Final Commissioning Report
YWCA Meadowlark
1800 S. 3rd St. W
Missoula, MT 59804

Prepared and provided by
Energy Efficiency Program (EEP)

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EXECUTIVE SUMMARY

This report summarizes results of the commissioning process for the YWCA Meadowlark Building in Missoula, Montana. Energy Efficiency Program (EEP) engineers conducted design- and construction-phase commissioning to optimize the energy efficiency of the building and to meet the IECC 2012 code requirements for heating, ventilation, and air-conditioning (HVAC) and lighting systems. Code commissioning requires testing of HVAC and lighting systems with the exception of sleeping rooms. Commissioning began in November 2018 during the project's design-development phase and continued through occupancy in the spring of 2021.

The Energy Efficiency Program (EEP) assists Montana healthcare facilities in identifying energy-saving opportunities and provides an opportunity to significantly reduce operating costs while upgrading capital systems. The Montana Facility Finance Authority provides funding for the audits, which are administered and conducted by the National Center for Appropriate Technology (NCAT). This project is an excellent example of preventing the need for future energy efficiency upgrades by conducting energy analyses during design and using that information to inform system selections.

EEP exceeded the scope of services we committed to under this project. We intended to conduct one design review, and we completed two. The plan was to conduct testing using sampling, where a percentage of each type of equipment is tested as opposed to testing every single device. EEP successfully tested nearly every device in the project, excluding sleeping rooms. EEP participated in two design reviews, one during design development (DD) and a second at 95% construction documents (CD). We additionally provided custom energy efficiency analyses of three different mechanical systems that were under consideration for the project. While attending a trade show in Atlanta, EEP engineers met with Friedrich representatives to better understand the features and operation of the higher-efficiency, sleeping-room HVAC units that we had recommended. This information was useful not only in the energy analyses, but also in the engineers contract documents when specifying the equipment.

EEP's participation in the commissioning process resulted in design changes that positively affected the project outcomes, as follows:

- Increased comfort and reduced equipment noise and sound transmission between spaces
- Reduced energy consumption, through:
    - high-efficiency vertical terminal air conditioners (VTAC)
    - electronically commutated (EC) motors
    - high-efficiency air conditioning
- Improved operation, through testing and deficiency resolution
- Reduced initial costs, by eliminating economizers from furnaces and maximizing utility rebates
- Improved ease of maintenance
- Reduced general construction document omissions and errors

The functional performance testing phase of the commissioning process proved to be extremely effective. As a direct result of testing, more than 40 mechanical and lighting deficiencies were discovered, documented, and resolved. Some of the major system deficiencies discovered and resolved during testing included:

- Zone thermostat calibrations
- Failed zone control board, Furnace 7, which precluded "opposite mode" operation
- Failed zone control damper, FN7 Z5
- VTAC thermostat programming
- Dishwasher ventilation system not starting when dishwasher door opens
- Numerous lighting deficiencies

PROJECT SUMMARY AND SCOPE

The Meadowlark is a new women's shelter located at 1800 S. 3rd St. W. It includes 36,725 ft^2 of conditioned space and 48,350 ft^2 of total space, including the basement parking garage. The basement is primarily a parking garage and storage space. The first floor is comprised of offices, client kitchens, healthcare spaces, living spaces for clients, and programmatic spaces. The second and third floors contain sleeping rooms for clients, as well as space for other uses such laundry, lounges, program support, and family bathrooms.

The scope of commissioning included equipment required by IECC 2012 for mechanical and lighting commissioning systems; sleeping rooms are exempted from this requirement and none of those were commissioned.

Design professionals included MMW Architects (Missoula), Morrison-Maierle Engineers (mechanical and plumbing, Missoula), and DC Engineering (Missoula). Kim Reinking was the Owner's Construction Representative.

COMMISSIONING PROCESS

Overview

Commissioning is the process of achieving, verifying, and documenting the performance of building systems in accordance with the design intent and the client's functional and operational needs. Commissioning consists of documenting the Owner's performance criteria and then systematically documenting that specified components and systems have been installed and started up properly. The process continues by functionally testing the systems to verify and document proper operation through all modes and conditions and tracking issues through resolution. The commissioning tasks included in this project are outlined in Appendix A and the preliminary commissioning report is included in Appendix B.

Commissioning included development of the Owner's Project Requirements (OPR) document, design reviews, developing a design-phase commissioning plan, and commissioning construction documents (specifications). Commissioning also included a construction-phase commissioning plan, submittal review, test and balance (TAB) report review, development and implementation

of functional performance testing, a code-required preliminary commissioning report and this final commissioning report. Commissioning did not include some typical construction tasks, such as Basis of Design review, construction inspection, prefunctional checklists, startup, training, and startup observation.

Commissioning the mechanical systems in this facility verified that all systems reflect their needs and goals: systems are complete and functioning properly upon occupancy; new systems integrate appropriately with each other; and the systems and operation meet the OPR and contract documents.

Design Phase

Commissioning during design review included working closely with the design team regarding system selection and operational sequences to be implemented to optimize energy efficiency and the OPR goals. EEP engineers reviewed design construction documents, and modifications were made to the plans and specs to ensure that the contract documents outlined a project that meets the owner's and engineers' goals.

Owners Project Requirements

The OPR document was written by the Owner's representative with the assistance of EEP engineers, outlining their requirements for a successful project. The OPR document is included in Appendix C.

Commissioning Plan - Design

EEP engineers developed a design-phase commissioning plan (Appendix D) that was implemented to guide the commissioning process and to inform the architect and engineers of specific requirements of the commissioning process and tasks to be conducted.

Design Review and Energy Consumption/Cost Analysis

As part of commissioning during design, EEP worked closely with the design engineer for system selection, as well as operational sequences and measures to be implemented to optimize the OPR goals. EEP reviewed design construction documents and recommended modifications to the plans and specs to ensure that the contract documents outlined a project that meets the owner's and engineers' goals. Two design reviews were conducted, one during the DD phase and a second at 95% CD. Design review comments are included in Appendix E, and energy analysis documents are included in Appendix F. Dozens of design comments helped the design team fine-tune the project and resulted in a more robust design, greater energy efficiency, and improved contract documents. This prevented change orders (missing or incorrect equipment), increased utility rebates, and optimized energy savings.

Notable design changes and recommendations initiated by EEP engineers included:

- Adding a separate demand-controlled ventilation system to the basement parking garage. This would minimize fan energy consumption while ensuring acceptable air quality in the garage. As a result, one small, continuously operated fan provides constant minimum ventilation, and a CO/NOx Tox-Alert system activates a larger fan for additional ventilation during times of poor air quality.

- Putting both family kitchen and living areas on the same furnace and thermostat so that the proposed two-furnace system would not "fight" each other, which can result in comfort complaints and excessive energy consumption.
- Modifying heat-recovery ventilation (HRV) exhaust design to pull from auxiliary spaces adjacent to the hallways, rather than installing separate exhaust fans for those spaces. This reduces capital costs and utility energy costs.
- Relocating a few vertical terminal air-conditioning (VTAC) units for ease of access and maintenance.
- Ensuring adequate ventilation in all occupant spaces.
- Adding ductwork to transfer grilles between offices (return air to furnaces) to reduce noise transmission between spaces.
- Replacing a supply soffit with spiral ductwork in the Family Living kitchen and living room. Spiral ductwork is easier to maintain and balance for proper airflow delivery.
- Adjusting Family Living kitchen and living room airflow configurations and cooling to improve comfort in both spaces.
- Adding a mini-split cooling unit in the dish room to address off-season cooling needs in the space.
- Selecting high-efficiency Friedrich vertical VTAC units for sleeping rooms and other spaces on second and third floors.

Energy analyses included:

- Estimating the savings and construction cost changes resulting from eliminating ventilation from the furnace systems and instead providing ventilation via heat recovery ventilators (HRV). HRVs were not selected due to higher capital costs and low payback. EEP review of future energy code found that future code versions do not require economizers on furnaces of the size in this project, and additional capital cost was saved by securing a variance from the code official/authority having jurisdiction (AHJ) to eliminate economizers. Energy analysis confirmed that this would not adversely affect long-term energy costs and thus was incorporated into the project.
- VTACs were selected by the project architect and engineers for sleeping rooms and offices/lounges on the second and third floors. EEP evaluated two different Friedrich models for operating costs, performance, rebates, and occupant satisfaction—the VRP and VHA models. The VHA is the base model and has the following pros and cons:
    - Less expensive to install
    - Does not qualify for utility rebates
    - Louder when operating (compressor and fans)
    - Higher operating costs from lower-efficiency fans and heat pumps
    - Simpler controls, which limit the unit's ability to conserve energy

  Because of the immediate and long-term benefit to the project, the VRP model was selected for this project.
- Evaluating cost/benefit of upgrading the building envelope, including added insulation and higher-efficiency doors and windows. Ultimately, these upgrades were not implemented due to limited benefits and high initial costs.
- Optimizing utility rebate funding by incorporating the following recommendations:
    - Specifying EC motors in the furnaces, HRV, VTACs, condensing units, heat pumps, and exhaust fans.

- Specifying high-efficiency air-conditioning (DX and heat pumps) equipment.
- Specifying rebate-qualifying lighting fixtures. During construction, a change to the garage lighting fixtures was required due to height conflicts with the planned fixtures. The proposed change would not qualify for utility rebates, and EEP proposed fixtures that met both the project height and utility rebate requirements.

Commissioning Specifications
EEP engineers created commissioning specifications and included them in the contract documents. These specifications serve as instructions to the contractor for participating in the commissioning process, and also spell out their contractual project requirements to participate in and complete the commissioning process for this project.

Construction Phase

Commissioning Plan - Construction
EEP updated the design-phase commissioning plan during construction (Appendix G) to incorporate the contractor requirements of the commissioning specifications and to detail construction activities required to successfully commission the project.

Construction Changes
During construction, EEP engineers participated in two commissioning meetings and provided feedback and recommendations on equipment changes, specifically identifying suitable parking-garage light substitutions that would qualify for utility rebates. Appendix H includes general documents regarding commissioning involvement during construction.

TAB review
EEP engineers reviewed the preliminary TAB report and found no deficiencies. TAB included all airside devices, and there were no service water-heating systems on the project. The portion of the TAB report relevant to this commissioning process is included in Appendix I.

Functional Performance Testing Methods
Functional Performance Testing (FPT) is the heart of the commissioning process, putting the systems and equipment through operational tests to ensure they operate properly, not only in regard to the construction documents but also in regard to the overall project goals and OPR. Field testing summaries are included in Appendix J, and the FPT reports are included in Appendices K and L.

FPTing included both summary and enhanced testing on the furnace systems, and nearly all other non-sleeping room devices were tested. EEP had planned to implement this commissioning project with some sampling in order to meet the project budget; however, we were able to do testing on nearly all devices. Enhanced testing included thoroughly testing all sequences with field verification, while summary testing included more basic tests to verify proper sequencing. Testing methods are outlined in the preliminary commissioning report attached in Appendix B.

SYSTEM DESCRIPTIONS

Furnace Systems

Nine furnace systems provide heating, cooling, and ventilation to most of the first floor. These systems include a two-stage, high-efficiency, natural gas-fired heating York furnace with an integral DX cooling coil and a single-stage condensing unit on the roof. Two of these systems also include fan coils (FC) and heat pumps (HP) for second-stage cooling, while seven of the systems are multizone units. The zone controllers allow each individual room to have a separate thermostat, improving occupant comfort compared to grouping multiple rooms on one furnace thermostat. Each zone has a damper that is open when the zone is in the same mode as the furnace or when all zones are satisfied, and it is closed when the zone is calling for an opposite mode. The actual damper does not fully close; instead, the minimum position provides for ventilation airflow as set by the engineer and TAB contractor. All furnaces are natural gas-fired units with two stages of heating. The furnaces have up to five fan speeds, three of which are utilized. Approved occupancy settings with schedules and setpoints for each are included in Appendix H. A summary of the specifications for each furnace system follows in Tables 1 and 2.

Table 1. Furnace Equipment Specifications

Unit	Make	Model	Heating capacity	Cooling Capacity
FN-1	York	YCE60B21S	59 MBH	5 tons
FN-2	York	YCG42B21S	67 MBH	3 tons
FN-3	York	YCE60B21S	59 MBH	5 tons
FN-4	York	YCG42B21S	67 MBH	3 tons
FN-5	York	YCG42B21S	67 MBH	3 tons
FN-6	York	YCD60B21S	84 MBH	5 tons
FN-7	York	YCD60B21S	84 MBH	5 tons
FN-8	York	YCD60B21S	84 MBH	5 tons
FN-9	York	YCD60B21S	84 MBH	5 tons

Table 2. Second-Stage Cooling Equipment Specifications

Unit	Furnace System	Make	Model	Cooling Capacity
FC-1, 1a, 2	FN-1	Daikin	FXAQ24PVJU	2 tons
Heat Pump 1	FC-1,1A	Daikin	RXTQ60TAVJU	5 tons
Heat Pump 2	FC-2	Daikin	RXTQ36TAVJ9	3 tons
FC-3, 4	FN-9	Daikin	FXAQ18PVJU	1.5 tons
Heat Pump 3	FC-3,4	Daikin	RXTQ48TAVJU	4 tons

Furnace 1. This system includes a single-zone furnace that provides heating, cooling, and ventilation to the Family Living kitchen and living room areas. The first stage of cooling is provided by a DX coil in the furnace and a condensing unit on the roof. The second stage of cooling is provided by five wall-mounted fan coils and two heat pumps, also on the roof. The second stage of cooling activates after the first stage has been running for a set period of time and does not satisfy the call for cooling.

Furnace 2. This system includes a seven-zone furnace that provides heating, cooling, and ventilation to the FP offices and meeting rooms. Cooling is provided by a DX coil in the furnace and a condensing unit on the roof.

Furnace 3. This system includes a four-zone furnace that provides heating, cooling, and ventilation to the dish room and activity rooms. Cooling is provided by a DX coil in the furnace and condensing unit on the roof.

Furnace 4. This system includes a six-zone furnace that provides heating, cooling, and ventilation to the front entry and associated rooms. Cooling is provided by a DX coil in the furnace and condensing unit on the roof. This unit stays occupied continuously and thus has no temperature setbacks.

Furnace 5. This system includes a single-zone furnace that provides heating, cooling, and ventilation to the large conference room. Cooling is provided by a DX coil in the furnace and a condensing unit on the roof.

Furnace 6. This system includes a two-zone furnace that provides heating, cooling, and ventilation to the children's, serving, and break rooms. Cooling is provided by a DX coil in the furnace and a condensing unit on the roof.

Furnace 7. This system includes a nine-zone furnace that provides heating, cooling, and ventilation to the Director's and manager's offices. Cooling is provided by a DX coil in the furnace and a condensing unit on the roof.

Furnace 8. This system includes a five-zone furnace that provides heating, cooling, and ventilation to the Domestic Violence (DV) living room, DV meeting room, a small conference room, and Pathway/First Step offices. Cooling is provided by a DX coil in the furnace and a condensing unit on the roof.

Furnace 9. This system includes a four-zone furnace that provides heating, cooling, and ventilation to the DV kitchen, dining, and office spaces. The first stage of cooling is provided by a DX coil in the furnace and a condensing unit on the roof. The second stage of cooling is provided by two wall-mounted fan coils and one heat pump, also on the roof. The second stage of cooling activates after the first stage has been running for a set period of time and doesn't satisfy the call for cooling.

Dishwasher Ventilation (DHEF-1) and MAU-1 provide exhaust and ventilation for the dishwasher room to control excess heat and moisture. MAU-1 is an inline supply fan with a duct heater. The exhaust fan is roof-mounted.

Exhaust Fans. Two exhaust fans (EF-1, EF-2) serve the basement parking garage and are mounted on the foundation wall. EF-1 operates based on CO and NOx air quality with a Tox Alert system, while EF-2 runs continuously. The bathrooms also each have a ceiling-mounted exhaust fan, which operates with the occupancy-sensor light switch.

Heat-Recovery Ventilator (HRV). One HRV provides ventilation to the corridors and common spaces on the second and third floors. Exhaust air is removed from office and work rooms, lounges, second-floor laundry room, and portions of the corridors. This unit has a duct heater to ensure temperature conditions of the supplied ventilation air and runs continuously.

Mini-Split Cooling Systems. Two split cooling systems provide cooling to the IT room and supplemental cooling to the dishwasher room.

Electric Heaters. Wall-mounted electric heaters are installed in stairways and laundry rooms, and a ceiling-mounted electric heater is in the front entrance foyer. Although electric heat was not the most energy-efficient option, the amount of heat energy that these units will require is small, and thus its cost, when compared to the much higher first costs of more efficient equipment.

VTACS. Friedrich model VRP VTACS were selected to provide heating, cooling, and ventilation air to individual rooms on the second and third floors. For commissioning purposes, these include offices, workspaces, and lounges. These units are also installed in most sleeping rooms, but those units were not part of the scope of commissioning. These units utilize high-efficiency heat pumps that have advanced technology that allows them to provide heat down to very cold temperatures (10°F) and run extremely quietly. The electronically-commutated (EC) motors on the fans also contribute to the lack of noise from the units. The heat pumps and supply fans cycle on a call for heating or cooling, while the ventilation fans run continuously.[1]

FUNCTIONAL PERFORMANCE TESTING RESULTS, DEFICIENCIES, AND RESOLUTION

The functional performance testing of the systems and equipment was a success, with numerous deficiencies identified and resolved. Many operational issues were identified that otherwise may not have been discovered until an occupant or the building was adversely affected, or after the warranty period had passed. Some issues may never have been identified, which would have caused excessive and unnecessary energy consumption. All issues and deficiencies have been addressed (with lighting exceptions noted herein) and the system has successfully exhibited operation in compliance with the contract documents and the OPR document. Testing findings, deficiencies, and questions identified during functional performance testing are outlined below.

HVAC

HVAC testing was conducted on March 18, April 5, April 7, April 9, and May 5, 2021. The testing summaries for each day or group of testing days are included in Appendix J and functional test reports for each equipment or system are included in Appendix K.

Furnace Systems

Furnace 1

Testing took place on April 7, 2021, and retesting occurred on May 5, 2021. This unit was fully tested using the enhanced testing procedures. Tests included room temperature control

[1] A switch on the front of each unit will turn the ventilation fans on or off, allowing them to be turned off during times of no occupancy in the room.

(thermostat response), heating (two stages), cooling (two stages), satisfied, occupied, unoccupied, and safeties (power failure recovery). Deficiencies identified on the first day of testing included:

- Room temperature sensor calibration
- Cooling systems (condensing unit) charge – low DAT when in cooling (56°F)
- Second-stage cooling – power failure recovery of heat pump

The sensor calibration was adjusted and resolved during testing. The first-stage cooling performance was resolved after GCPH charged the systems (with warmer weather) and a DAT of 42.5°F was measured on May 5, 2021.

Furnace 2
Testing took place on April 7, 2021, and retesting occurred on May 5, 2021. This unit was tested using summary testing procedures. Tests included heating (two stages), zone control (opposite mode with cooling), satisfied, occupied, unoccupied. Deficiencies identified on the first day of testing included:

- Room temperature sensor calibration, zones 3, 4, and 6
- Cooling systems (condensing unit) charge – low DAT when in cooling (56°F)

The sensor calibration was adjusted and resolved during testing. Cooling system charge was retested on May 5, 2021, and passed with a DAT of 44°F.

Furnace 3
Testing took place on April 7, 2021, and no deficiencies were identified. This unit was tested using summary testing procedures. Tests included heating (two stages), zone control (opposite modes with cooling), satisfied, occupied, and safeties (power failure recovery).

Furnace 4
Testing took place on April 4 and April 9, 2021, and retesting occurred on May 5, 2021. This unit was tested using summary testing procedures. Tests included heating (two stages), zone control (opposite mode with cooling), satisfied, occupied, unoccupied. Deficiencies identified on the first day of testing included:

- Room temperature sensor calibration, zone 5
- Cooling systems (condensing unit) charge – low DAT when in cooling (54°F)

The sensor calibration was adjusted and resolved during testing. Cooling system charge was retested on May 5, 2021, and passed with a DAT of 44°F.

Furnace 5
Testing took place on April 5 and April 9, 2021. This unit was fully tested using the enhanced testing procedures. Tests included room temperature control (thermostat response), heating (two stages), cooling (single-stage), satisfied, occupied, unoccupied, and safeties (power failure recovery). Deficiencies identified on the first day of testing included:

- Gap in the FN, casing allowing air leakage. This was resolved during testing.

Furnace 6
Testing took place on April 5, April 7, and April 9, 2021, and no deficiencies were identified. This unit was fully tested using the enhanced testing procedures. Tests included room temperature control (thermostat response), heating (two stages), cooling (single-stage), zone control (opposite mode), satisfied, occupied, unoccupied, and safeties (power failure recovery).

Furnace 7
Testing took place on April 7, 2021, and retesting occurred on May 5, 2021. This unit was fully tested using the enhanced testing procedures. Tests included room temperature control (thermostat response), heating (two stages), cooling (single-stage), zone control (opposite mode), satisfied, occupied, unoccupied, and safeties (power failure recovery). Deficiencies identified on the first day of testing included:

- Room temperature sensor calibration, zones 1 and 9
- Opposite modes operation (some zones heating, some in cooling)
- All zones cooling

The sensor calibration was adjusted and resolved during testing. During testing of "all zones cooling," the zone controller board failed. This happened when zone 5 was put into cooling, and testing stopped on this unit until it could be replaced. Upon retesting, when Zone 5 was put into "all cooling," it was found that the zone damper was not opening. GCHP investigated, found a problem in the thermostat, and repaired it. Testing resumed and both "all zones cooling" and "opposite modes" successfully passed.

Furnace 8
Testing took place on April 5, 2021. This unit was fully tested using the enhanced testing procedures. Tests included room temperature control (thermostat response), heating (two stages), cooling (single-stage), zone control (opposite mode), satisfied, occupied, unoccupied, and safeties (power failure recovery). Deficiencies identified included:

- Zone 4 room temperature sensor calibration, which was adjusted and resolved during testing

Furnace System 9
Testing took place on April 7, April 9, and May 5, 2021. This unit was fully tested using the enhanced testing procedures. Tests included room temperature control (thermostat response), heating (two stages), cooling (two stages) including 2 FCs and 1 HP, zone control (opposite mode), satisfied, occupied, unoccupied, and safeties (power failure recovery). Deficiencies identified on the first day of testing included:

- Power failure recovery of second-stage cooling – fan coil
- Zone 4 diffuser whistles when closed

Second-stage cooling recovery from power failure was accepted by the owner as the situation was anomalous during testing. The problem identified was that if the power fails while the second stage of cooling is on, and if that call for cooling drops out while the power is off to the FCs and HPs, they will not see the change in status. This is expected to be an extremely rare occurrence and there is no way to change the operation (equipment limitation), so it was accepted. Zone 4 diffuser noise will be monitored, and the contractor will work to address the issue.

Dishwasher Ventilation
Testing took place on April 7, 2021. The intended sequencing included having both MAU-1 and DHEF-1 turn on when the dishwasher door was opened, to capture escaping steam to control moisture and heat. During testing, it was discovered that the devices only turned on when the dishwasher door was closed, and they continued to run until a pre-set time after the dishwasher cycle ended. The project team investigated resolutions to this and ultimately determined that limitations within the dishwasher prevent the planned sequencing from being incorporated. The owner accepted the operation as-is, with a 10-minute run time, and will monitor it for acceptability as the space gets used.

Exhaust Fans
Testing took place on April 9 and May 5, 2021. All (parking garage and bathroom) fans turned on and off as specified, including the automatic Tox Alert system for EF-1. No deficiencies were identified.

HRV
The HRV (ERV-1) was tested on April 5, 2021. All sequences worked as specified, including start/stop, damper modulation, efficiency verification (99%), and the duct heater control of the supply air temperature.

Mini-Split Cooling Systems
Mini splits for the IT room and dishwasher room were tested on April 5 and May 5, 2021, and no deficiencies were identified.

Electric Heaters
Electric heaters were tested on April 7, 2021, and no deficiencies were identified.

Vertical Terminal Air Conditioners (VTAC)
Three VTAC units were tested on March 18 and April 9, 2021. Thermostat setup was not complete on the first day and as a result, testing was limited to heating, cooling, and ventilation response. On the second day of testing, thermostat programming was verified and control deadbands were tested, with no deficiencies noted.

Lighting
Lighting was tested on April 5, April 15, and May 2, 2021. Functional testing reports are included in Appendix L for each lighting zone, and the testing summaries for each day of testing are included in Appendix J.

Initial lighting testing was conducted on April 5, 2021, including nearly every zone in non-sleeping rooms. Numerous deficiencies were identified, including rooms whose lights did not turn off during testing, rooms where adjacent traffic (hallway) turned the lights on, incomplete installation (missing fixtures and switching), stairwell lights not illuminating/dimming properly, and basement garage lights that were not sensitive enough and therefore did not stay on long enough. Identified deficiencies included:

- Rooms 103, 106, 128, 129, 151, 154, 155, 156, 158, 255 – These lights never automatically turned off. Retesting required.
- Room 105 – These lights did not turn off within 20 minutes. They eventually did turn off, but it took over 30 minutes. Retesting required.
- Room 109 – This occupancy sensor (OS) may be blocked by a wall corner from use within the space. Recommended that YWCA monitor and report if operation is unacceptable. The duration to off is quite short (7 minutes) and extending that may help. EEP recommends that Kim inform the YWCA staff.
- Room 130 – Fixtures "G" over kitchen islands have no dimming. MMI will determine if this is per plans.
- Hallway OS outside room 156 – Poor sensitivity. These lights did not turn on until EEP engineers had walked well into the lighting zone (past first light).
- Rooms 171 and 100D – These lights did not turn off within 20 minutes. They eventually did turn off, but it took over 45 minutes. Retesting required.
- Room 178
    - These lights did not turn off within 20 minutes. They eventually did turn off, but it took 33 minutes. Retesting required.
    - Fixtures "U" are not installed.
    - Each set of switches for the kitchen has a dimmer switch with nothing apparently controlled. The plans show those switches to be used for Fixtures "U." Retesting required.
    - Fixtures S3 had no dimming and no automatic control. They only turned off by using switch "K" with the key. MMI will determine if this is per plans.
- Room 256 – The fixture closest to the door does not dim. The lights did not automatically turn off within 20 minutes, staying on for 38 minutes. Retesting required.
- S1A stair (SW) – All lights in this stairway were fully illuminated (not dimmed) during all observations. Retesting required.
- S1B stair (East) and S1C stair (NE-DV) – These lights are a mix of always bright, always dim, and responsive/unresponsive to motion. EEP requested that MMI clarify the intended operation of these. There were bright fixtures in spaces with lots of natural light, and dim fixtures in spaces without much natural light. Their response did not seem consistent with expected photo-occupancy control. Retesting required.
- Basement lights did not activate soon enough (not until EEP engineers were nearly underneath many fixtures) and did not stay on long enough (less than 1 minute). Sirius noted that the electrician adjusted the settings and increased the ON time to 10 minutes. Retesting required.

Exterior lighting testing was conducted on April 15, 202,1 and all exterior lights performed as designed by automatically turning on at 8:35 p.m., minutes after sunset.

Retesting of previous lighting deficiencies was conducted on May 3, 2021. All outstanding deficiencies except the following four were resolved:

- Room 103's lights did not turn off
- Room 106's lights were triggered on by hallway traffic
- Room 155's lights were triggered on by hallway traffic
- Room 156's lights did not turn off

OUTSTANDING ISSUES AND RESOLUTION PLAN

There are no outstanding HVAC deficiencies.

Four lighting retests remain for deficiencies in room 103, 106, 155, and 156.

There is one non-deficiency issue that remains to be resolved. VTAC reprogramming will need to be modified to eliminate the minimum run temperature for the compressors. This is currently limited by the vendor, Vemco, due to ongoing (unrelated to this project) litigation with Friedrich. Once that lawsuit is resolved, Vemco will be able to reprogram the units. This is key to minimizing energy consumption at cold temperatures, so is important to resolve before the upcoming winter to avoid excessive energy costs.

PROJECT OUTCOMES

Commissioning Process Benefits

The commissioning process has been completed successfully and resulted in correct and efficient operation of the installed systems and ensured that the systems operate as intended and designed. The number of items identified and addressed through commissioning made it worthwhile to all project team members. The optimization of energy efficiency resulting from commissioning this project exemplifies why commissioning has a financial value for the Owner. If this project had not been commissioned, a number of issues may not have been resolved that would have contributed to poor operation and high energy consumption. Notable outcomes of this process include:

- EEP engineers were able to exceed the original testing goals of the project, specifically testing nearly all the devices instead of testing only a sample of each equipment type.
- Justified upgrading from the base VTAC VHA model to the VRP model, providing improved energy efficiency and, most significantly, low operational noise that should result in substantially fewer complaints.
- Numerous testing deficiencies were found and corrected before the building was occupied. Without commissioning, many of these would not be found until they were

already causing problems for the occupants, and it ensured the problems were found while the system was still under warranty.

- Energy efficiency was greatly improved with the guidance of EEP in design and operational selections, and by assisting the project in planning and applying for utility rebates. The current rebate estimate is $23,000, pending final processing by NorthWestern Energy.

Recommended Owner Monitoring

Since the dishwasher ventilation system turns on when the dishwasher starts and not when the door opens, EEP recommends the Owner monitor this for excessive heat and humidity when opening the dishwasher.

Since the ventilation fan runs on each VTAC 24/7 when the ventilation switch is "on," occupants may notice that the temperature of the air coming out of the supply grille feels cool or warm when the unit is not running (supply fan, heat/cool). There is no separate heating or cooling for the ventilation (fresh air) fan, so this air will only be tempered when the unit is running in heating or cooling.

Zone thermostats served by each furnace will need to stay at similar setpoints or excessive cycling and energy consumption may result. Occupant comfort could also be adversely impacted, as the system is not designed for those conditions. These thermostats are intended to provide setpoint control of each space on the same furnace but are not intended to allow some spaces to be at a high setpoint, and others at a low setpoint. In that case, the furnace may cycle between heating and cooling to serve the zone(s) that are at an extreme setpoint. While changing from heating to cooling is normal at times during the spring and fall due to different solar exposures during the day, this should not happen in the winter or summer. To prevent this from becoming a problem, GCPH left the thermostats locked so they can only be adjusted by maintenance staff.

Noisy diffusers (when closed) at the main building entrance and the DV entrance should be monitored for acceptability.

Appendix A

EEP Task Scoping

Energy efficiency optimization and commissioning services for the new YWCA building through the MFFA EEP program

Laura Howe

11/28/18

Commissioning services include:

Commissioning will focus on optimizing energy efficiency through system design, equipment selection, and system operation verification, along with pursuing NorthWestern Energy rebates and Business Partners program funding

Commissioned systems include HVAC and lighting

Development of the Owners Project Requirements (OPR) for energy efficiency

One design review, including NWE rebate review and Business Partners calculations and analysis

Commissioning specifications and plan for inclusion in contract documents

Limited construction meeting attendance, one to two meetings

Test and Balance (TAB) report review

Functional performance testing (excluding equipment excluded from IECC requirements), 20% sampling of identical systems

Preliminary commissioning report

Final commissioning report

Limited alternate season testing

Commissioning tasks required by IECC but not included in NCAT's services:

TAB

Documentation requirements: drawings, manuals (submittals, O&M, service contact, controls drawings, operational narrative), balancing report

Documentation submission to code official

These commissioning services do not include:

BOD review

Separate commissioning meetings

Prefunctional checklists

Construction inspection

Commissioning issues log

Submittal review

System startup

Training coordination

Appendix B

Preliminary Commissioning Report

Preliminary Commissioning Report
YWCA Meadowlark
1800 S. 3rd St. W
Missoula, MT 59804

Prepared and provided by
Energy Efficiency Program (EEP)

April 21, 2021

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Energy Efficiency Program

EXECUTIVE SUMMARY

The Meadowlark Building is a new women's shelter located at 1800 S. 3rd St. W. in Missoula, Montana. NCAT's Energy Efficiency Program (EEP) engineers conducted testing of the HVAC and lighting systems per IECC 2012 commissioning requirements and submits this preliminary commissioning report to the YWCA.

INTRODUCTION

EEP engineers conducted functional performance testing of HVAC systems at the Meadowlark building on March 18, April 4-5, April 7, and April 9, 2021. Commissioned systems did not include those serving the sleeping units per IECC2012, C408.2, Exception 2. The air-side systems were all tested and balanced, and there is no heating service water system in the building.

HVAC SYSTEMS COMMISSIONED

The project includes commissioning of the following HVAC equipment:

1. Furnaces – Nine furnaces (FN) serve the first floor and provide heating, cooling, and ventilation to those areas. Two of the furnaces are single-zone units (FN-1 and FN-5), and the remainder are multizone units with two to nine zones each.
2. Second stage cooling – Two of the furnaces (FN-1 and FN-9) have secondary stage cooling consisting of wall-mounted cassette fan coils served by heat pumps.
3. Mini-splits – There are two mini-split air-conditioning (AC) units. One serves the kitchen dish room and the other serves the IT room.
4. Exhaust Fans – Two exhaust fans serve the basement parking garage. One fan is operated continuously and the second is controlled by a "Tox Alert" system to maintain safe indoor air quality. One exhaust fan serves the kitchen dishwasher, and each non-sleeping-room restroom on first through third floors also has an exhaust fan.
5. Makeup Air Unit (MAU) – One MAU provides ventilation makeup air for the kitchen dishwasher hood exhaust fan.
6. Heat Recovery Ventilator (HRV) – One HRV provides ventilation air to the common spaces on second and third floors.
7. Vertical Terminal Air Conditioners (VTAC) – Office and lounge spaces on the second and third floors are heated, cooled, and ventilated with these VTAC units. Three non-sleeping room VTACs were tested, including VT-225, 259, and 303.
8. Electric Wall/Ceiling Heaters – Numerous electric wall heaters and one electric ceiling heater all have local packaged control.
9. Lighting – Occupancy sensors control lights within rooms, hallway zones, and zones in larger rooms. Exterior lights are controlled by an astronomical timer.

Energy Efficiency Program

TESTING SUMMARY

Testing sequences for each device are summarized below:

1) Furnaces and DX cooling
   a) Room-temperature sensor calibration; verify response to varying temperatures
   b) Fan and outside air damper (OAD) operation during occupied and unoccupied (occupied – fan on and OAD open; unoccupied – fan auto and OAD closed)
   c) Two-stage heating operation, including discharge air temperature verification
   d) Cooling operation, discharge air temperature verification
   e) Zone control and operation (excluding FN-1 and FN-5, which are single-zone units)
   f) Power outage simulation and recovery
2) Second-stage cooling fan coils and heat pumps serving FN-1 and FN-9
   a) Control from applicable furnace
   b) Cooling operation, including discharge air temperature and airflow verification
   c) Power outage simulation and recovery
3) Mini-splits
   a) Fan and cooling operation, including discharge air temperature verification
   b) Power outage simulation and recovery
4) Exhaust Fans
   a) Automatic control of EF-1 with Tox Alert System
   b) Automatic control of dishwasher hood exhaust fan when the dishwasher door opens; verify positive airflow
   c) Automatic control of bathroom fans with lighting control; verify positive airflow
   d) Power outage simulation and recovery
5) Makeup Air Unit
   a) Verify automatic control of dishwasher; verify positive airflow
   b) Discharge air temperature control
   c) Power outage simulation and recovery
6) Heat Recovery Ventilator
   a) Power outage simulation and recovery
   b) Normal operation (damper and fan control and operation)
   c) Discharge air temperature control
7) VTAC
   a) Room temperature sensor calibration; verify response to varying temperatures
   b) Ventilation fan operation and airflow
   c) Space heating control, including discharge air temperature verification
   d) Space cooling control, including discharge air temperature verification
8) Electric Wall/Ceiling Heaters
   a) Automatic fan and heating operation

Energy Efficiency Program

9) Lighting
   a) Automatic on and off, interior and exterior zones
   b) Duration to automatic off
   c) False trips by adjacent traffic

TESTING RESULTS AND DEFICIENCIES

1. Furnaces and DX cooling
   a) Furnace zone thermostats (other than Zone 1) seem to allow overlap of heating and cooling setpoints, and cooling takes priority.

FN-1

   b) Furnace DX needs refrigeration charge as DAT was slightly high at 52°F. Outstanding deficiency.
   c) Re-test second-stage cooling heat pump (HP-1) operation and power failure. More cooling load is needed to conduct this test.
   d) Thermostat read 1.4°F high. Calibration was adjusted and resolved during testing.

FN-2

   e) Furnace DX needs refrigeration charge, as DAT was slightly high at 50°F. Outstanding deficiency.
   f) Calibration for thermostats in zones 3, 4, and 6 was deficient, reading 2.1°F, 2.9°F, and 2.3°F low, respectively. Calibration was adjusted and resolved during testing.

FN-3

   g) No deficiencies.

FN-4

   h) Furnace DX needs refrigeration charge as DAT was slightly high at 54°F. Outstanding deficiency.
   i) Calibration for zone 5 thermostat read 2.8°F low. Calibration was adjusted and resolved during testing.

FN-5

   j) There was a gap in the furnace casing, which was allowing air leakage. This gap was closed and sealed, which resolved the issue during testing.

FN-6

   k) No deficiencies.

FN-7

   l) The control board for this furnace has failed. The failure was discovered while testing "opposite mode" operation (where some zones are in cooling and some are in heating). FN-7 was left with the thermostats locked out and in heating only until the board can be replaced and the system retested.
   m) Calibration for thermostats in zones 1 and 9 was deficient, reading 2.1°F high and 2.3°F low, respectively. Calibration was adjusted and resolved during testing.

FN-8

n) Calibration for the thermostat in zone 4 was deficient (4.3°F high). Calibration was adjusted, the offset limit was reached, and the thermostat still read 2 °F high. EEP recommends replacing this thermostat.

FN-9

o) The zone controller is powered from a circuit separate from the furnace, and that controller powers the OAD. Shutting off the disconnect to the furnace did not close the OAD in the power-failure test. EEP recommends that Morrison-Maierle (MMI) review and respond if this acceptable.

p) Power failure testing of second-stage cooling (fan coils and heat pump) – After power was returned, fan coils resumed being ON (blowing air, but no heat pump operation) even if there was no longer a call for second stage. They stayed ON until another call for second-stage cooling happened, and then shut off correctly when that call ended. GCPH reports that this is a limitation of the Daikin FC/HPs, as they must see the call for second-stage cooling change, when it begins and when it ends. If the call ends during a power failure, the fan coils continue to operate. EEP recommends that MMI review and respond if this acceptable.

q) The zone diffuser for the Domestic Violence (DV) entrance foyer has a significant whistle most frequently observed when this damper was at its minimum position (ventilation air only). Because this foyer is open to most other DV spaces, including the kitchen, dining, and living rooms, EEP recommends setting this damper minimum to zero and letting the ventilation air be delivered through the kitchen and dining room zones when the foyer is not calling for heating or cooling. EEP recommend that MMI review and respond with recommendation.

2. <u>Second-stage cooling fan coils and heat pumps serving FN-1 and FN-9</u>

   See listing above for FN-1 and FN-9.

3. <u>Mini-splits</u>
   a) No deficiencies.
   b) Power failure recovery on dish room unit not tested due to inadequate cooling load.
4. <u>Exhaust Fans</u>
   a) EF-1 (emergency exhaust/Tox Alert system) operation verified. Vendor demonstrated testing with calibrated test gases.
   b) DHEF-1 – Neither this exhaust fan nor the MAU turned on when dishwasher door opened, as the plans specify. Both fans turned on when the dishwasher cycle was started (by closing the door) and ran for 10 minutes after the cycle was finished.
   c) Bathroom exhaust fans – No deficiencies.
5. <u>Makeup Air Unit</u>
   a) The fan did not turn on when dishwasher door opened. See DHEF-1 above for more information.
6. <u>Heat recovery Ventilator</u>
   a) No deficiencies.

7. VTAC
    a) VT-259 thermostat read 5.6°F high. Calibration was adjusted and resolved during testing.
    b) Initial deficiencies found on 3/18/21 were resolved and passed retesting on 4/9/21.
8. Electric Wall and Ceiling Heaters
    a) One wall heater had a broken adjustment knob. This unit is on the landing between the basement and first floors in the center stairwell "SOB."
    b) All remaining devices passed testing.
9. Lighting

    All non-sleeping room lighting zones were tested, along with the exterior lights. All passed with the following exceptions, with retesting requirements as listed:

    a) 100A Lobby
        - Switching is not per plans. There is a third switch on the west wall, which allows the recessed and pendant lights to be switched and dimmed separately. The dimmer for the recessed lights is on that west wall, while the dimmer for the pendants is on the other end of the reception desk. Recommend reconfiguring so all dimming is done on the west wall.
        - Fixtures T/T2 are not installed, as they were replaced with U. MMI to determine if this is per plans.
    b) 103, 106, 128, 129, 151, 154, 155, 156, 158, 255 – These lights never automatically turned off. Retesting required.
    c) 105 – These lights did not turn off within 20 minutes. They eventually did turn off, but it took over 30 minutes. Retesting required.
    d) 109 – This occupancy sensor (OS) may be blocked by a wall corner from use within the space. Recommended that YWCA monitor and report if operation is unacceptable. The duration to off is quite short (7 minutes) and extending that may help. EEP recommends that Kim inform the YWCA staff.
    e) 130 – Fixtures "G" over kitchen islands have no dimming. MMI to determine if this is per plans.
    f) Hallway OS outside 156 – Poor sensitivity. These lights did not turn on until EEP staff had walked well into the lighting zone (past first light).
    g) 171 and 100D – These lights did not turn off within 20 minutes. They eventually did turn off, but it took over 45 minutes. Retesting required.
    h) 178
        - These lights did not turn off within 20 minutes. They eventually did turn off, but it took 33 minutes. Retesting required.
        - Fixtures "U" are not installed.
        - Each set of switches for the kitchen has a dimmer switch with nothing apparently controlled. The plans show those switches to be used for Fixtures "U." Retesting required.

- Fixtures S3 had no dimming and no automatic control. They only turned off by using switch "K" with the key. MMI to determine if this is per plans.

i) 256 – The fixture closest to the door does not dim. The lights did not automatically turn off within 20 minutes, staying on for 38 minutes. Retesting required.
j) S1A stair (SW) – All lights in this stairway were fully illuminated (not dimmed) during all observations. Retesting required.
k) S1B stair (East) and S1C stair (NE-DV) – These lights are a mix of always bright, always dim, and responsive/unresponsive to motion. EEP requested that MMI clarify the intended operation of these. There were bright fixtures in spaces with lots of natural light, and dim fixtures in spaces without much natural light. Their response did not seem consistent with expected photo-occupancy control. Retesting required.
l) Basement lights did not activate soon enough (not until nearly underneath many fixtures) and did not stay on long enough (less than 1 minute). Sirius noted that the electrician adjusted the settings and increased the ON time to 10 minutes. Retesting required.

DEFERRED AND OUTSTANDING TESTS

1. Furnaces and DX cooling
    a) Zone thermostats – Retest setpoint overlap adjustment.
    b) Refrigerant charge in FN-1, FN-2, and FN-4. Warm weather is required to charge these units.
    c) FN-7 – Retest opposite mode operation after zone control board is replaced. Complete cooling testing in all zones. No special climatic conditions are required.
    d) FN-8 - Zone 4 thermostat – Retest calibration after it is replaced.
2. Second stage cooling fan coils and heat pumps serving FN-1 and FN-9
    a) HP-1 power-failure recovery (FN-1).
3. Mini-splits
    a) Dish room unit (HP-128) power failure recovery.
4. Exhaust Fans
    a) EF-2 (garage continuous exhaust fan) – Not yet tested. Waiting on replacement motor.
    b) DHEF-1 – Operation with dishwasher door. No special climatic conditions are required.
5. Makeup Air Unit
    a) Operation with dishwasher door. No special climatic conditions are required.
6. Heat Recovery Ventilator
    a) Testing complete.
7. VTAC
    b) Testing complete.
8. Electric Wall/Ceiling Heaters
    a) Testing complete.

Energy Efficiency Program

9. Lighting
    a) See “Testing Results and Deficiencies” section for retesting requirements. No special climatic conditions are required.

FINAL COMMISSIONING REPORT

The final commissioning report will be submitted to the owner once all deferred and outstanding tests are successfully completed and resolved. That report is expected to include the following appendices:

1. Preliminary commissioning report
2. Commissioning plan – design phase
3. Energy efficiency analysis information
4. Design review comments and design phase communications
5. Commissioning Plan – construction phase
6. Submittal review comments
7. Equipment startup reports
8. Test and balance report
9. TAB report review and comments
10. Testing summaries and construction phase communications
11. Functional testing reports

Appendix C

Owners Project Requirements (OPR)

YWCA Missoula
Owner's Project Requirements

The Owner's Representative should work with the Commissioning Provider to develop the Owner's Project Requirements document. This document should be completed as early as possible during the project and will focus on HVAC and lighting. The Commissioning Provider will review the Owner's Project Requirements document and refer to it throughout the design and construction process. The document can be changed as the project progresses to record changes in goals, objectives, and design decisions. The Owner's Project Requirements should document:

- Owner and User Requirements
- Energy Efficiency Goals
- Acoustical Design Goals and Requirements
- Indoor Environmental Quality Requirements
- Equipment and Systems Expectations
- Building Occupant and O&M Personnel Expectations

Owner's Project Requirements (OPR)

1. Owner and User Requirements
   - The facility will be the primary location for the YWCA's offices (Service Center, or SC), the Domestic Violence Shelter (DV), and the homeless Family Center (FC). The space will consist of offices and living space on the first floor, along with temporary sleeping rooms and group areas on the second and third floors.
   - The project budget is approximately $7.9 million.
   - The project will be commissioned by a third party, NCAT, to maximize energy efficiency and comply with commissioning requirements of the energy code.
   - HVAC design space temperatures shall be typical with no special requirements. There are no anticipated significant computer cooling room needs in the project, nor are any expected in the near future.
   - Sleeping rooms on the second and third floors shall be constructed to allow for easy decontamination and be generally negatively pressurized to the adjacent spaces. This includes not sharing any HVAC equipment and keeping the ensuite bathroom exhaust fans on continually.
   - The DV shelter spaces on all three floors will be secure from other portions of the building. Interior connecting doors between spaces will be locked and the DV shelter will

have separate exterior entrances.

- Operable windows are acceptable.
- No facility-wide building controls system is necessary.

2. Energy Efficiency Goals
   - Energy efficiency is a priority for the YWCA, as its owners intend to own this building for the foreseeable future. Thus, reasonable expenses to reduce life cycle energy costs will be considered in the design and construction of the building.
   - Energy conservation measures (ECMs) with a simple payback period of five years or less shall be incorporated into the project, and ECMs that pay back in five to 10 years should be considered on a case-by-case basis.
   - LED lighting shall be used throughout the building. Equipment should be on the approved list for NorthWestern Energy's rebate program to ensure that the equipment will achieve the savings and longevity expected of LED equipment.

3. Acoustical Design Goals
   - The mechanical and architectural design shall strive to minimize noise transmission from one space to another. The project includes multiple sensitive spaces that will have short sections of ductwork on the return grilles to minimize sound transmission between those and adjacent spaces.

4. Indoor Environmental Quality Requirements
   - Lighting design shall conform with IES recommendations and include occupancy controls and daylighting where appropriate.
   - No special conditions for space thermal and comfort are needed.
   - HVAC systems shall have setpoint setback functionality for unoccupied hours. Occupancy may be programmed with a calendar, rather than automatic occupancy sensing.
   - Occupants shall have some control over space temperature setpoints, but only within a few degrees of energy-efficient setpoints. Master setpoints will be adjusted in each thermostat by staff. Any occupant overrides shall be temporary and automatically revert to the preprogrammed setpoint after a few hours.
   - Additional requirements by space type
     - First Floor – Family Housing Center
       - Occupancy is anticipated to be seven days a week for approximately 16 hours a day.
       - Each room is not required to have its own thermostat; however, rooms that share a thermostat must be designed to have similar heating and

cooling loads to ensure comfort in all rooms.

- First Floor – Service Center
  - Occupancy is anticipated to be five to six days a week for approximately nine hours a day.
  - Each room is not required to have its own thermostat; however, rooms that share a thermostat must be designed to have similar heating and cooling loads to ensure comfort in all rooms.

- First Floor – Domestic Violence Shelter
  - Occupancy is anticipated to be seven days a week for approximately 16 hours a day.
  - Each room is not required to have its own thermostat; however, rooms that share a thermostat must be designed to have similar heating and cooling loads to ensure comfort in all rooms.

- Second and Third Floors – Sleeping Rooms
  - Occupancy is anticipated to be continuous.
  - There shall be no sharing of HVAC equipment or systems between the sleeping rooms and included bathrooms, nor between those rooms and any other spaces within the building.
  - Each sleeping room shall have its own thermostat.
  - Each ensuite bathroom will have an exhaust fan that runs continuously.

- Second Floor – Common Spaces
  - Occupancy is anticipated to be seven days a week for approximately 16 hours a day.
  - Each room is not required to have its own thermostat; however, rooms that share a thermostat must be designed to have similar heating and cooling loads to ensure comfort in all rooms.
  - An energy recovery ventilator (ERV) is planned for the corridors for code-required ventilation. Exhaust from bathrooms that are not within sleeping rooms may be connected and used by the ERV for exhaust.

5. Equipment and Systems Expectations
   - First Floor and common spaces on second and third floors
     - Light commercial heating, ventilation, and air-conditioning (HVAC) systems shall be used. Residential-grade equipment is not acceptable.

- Second and third floors – sleeping rooms
    - VTAC units are desired in sleeping rooms to provide for individual thermostats in each room. Bathroom fans should be rated for continuous duty.

6. Building Occupant and O&M Personnel Expectations
    - Day-to-day HVAC operation will be conducted by both staff and occupants. Occupants will have limited thermostatic control, limited to within a few degrees of energy-efficiency setpoints. Staff will have responsibility for changing occupied/unoccupied heating and cooling setpoints by programming individual thermostats.
    - Periodic HVAC maintenance will be performed by staff (filter changes, for example), while technical repairs are anticipated to be contracted.
    - Level of training required
        - Staff will require enough training to operate and program the thermostats. Maintenance staff will require enough training and documentation to know the location of equipment, filter replacement requirements, contractor contacts, and equipment documentation.

Document version history
2-13-19 Version #1

Appendix D

Commissioning Plan – Design Phase

COMMISSIONING PLAN
Design Phase
V1 - 12/21/2019

A. INTRODUCTION

The Montana Facility Finance Authority contracted with the National Center for Appropriate Technology (NCAT) to provide commissioning services for the YWCA Missoula project. Because it is most cost-effective to implement energy-conservation measures before equipment is installed, NCAT will emphasize energy efficiency in the commissioning process by evaluating and recommending design alternatives that will reduce the building's energy consumption.

This document provides guidance for execution of the commissioning process during design, including the commissioning scope, responsibilities, lines of communication, schedule, and documentation requirements. This plan will continue to evolve and change as the project progresses. The commissioning process does not replace the traditional construction administration functions of the architect/engineer such as design, existing conditions inspection, construction inspection and verification, design or construction scheduling.

The purpose of the commissioning process is to assure the Owner that the building systems have been installed according to the contract documents and will perform as specified. This commissioning process is intended to provide compliance with the IECC 2012 HVAC and lighting commissioning requirements.

B. COMMISSIONING ACTIVITIES

The commissioning activities for this project are as follows:

<u>Design</u>

1. Conduct one design review.
2. Conduct design reviews for energy efficiency measure analysis and utility rebates and funding.
3. Develop Owner's project requirements (OPR) document.
4. Draft design-phase commissioning plan.
5. Create commissioning specifications and incorporate into construction documents.
6. Include additional code commissioning requirements into the construction documents not provided by CxP.
7. Draft preliminary construction-phase commissioning plan, including preliminary functional test procedures.

<u>Construction</u>

8. Finalize construction-phase commissioning plan.
9. Review submittal – The commissioning provider (CxP) will review and provide comments on controls and other contractor submittals as they pertain to the OPR and commissioning process needs.
10. Hold commissioning meetings with contractor and appropriate subs, as needed, to facilitate the commissioning process. A control coordination meeting shall occur in which the controls subcontractor provides draft sequences of operation and control drawings, and final sequences are decided collaboratively. This is intended as a fine-tuning session only, not as a redesign outside the scope of controls contractor's bid. Significant modifications requiring a change to the contract or contract amount shall be made at the discretion of the

Owner.

11. Finalize functional testing procedures after resolution of all issues from the control coordination meeting.
12. Perform start-up testing - Normal start-up services performed by the contractor or manufacturer's representative to bring each system into full operational state. This includes factory start-up services for major equipment as specified.
13. Conduct initial systems testing - Tests performed by the contractor on equipment and systems in order to complete system installation and to verify proper operation. This is not commissioning functional testing.
14. Perform testing, adjusting, and balancing (TAB) of equipment and systems by the contractor. TAB report will be reviewed by CxP.
15. Conduct Functional Performance Tests - Tests performed by the contractor and documented by the commissioning provider to verify that all components, systems, and subsystems function in accordance with the contract documents and design intent. These tests include mechanical inspections, controls calibration verification, control sequence testing, balance and flow verification, performance verification, and controls system verification. The commissioning provider will provide independent verification of a representative sample of multiple units with a minimum of 25% or two units, whichever is greater.
16. Prepare preliminary commissioning report.

Warranty

17. Provide final commissioning report.
18. Conduct limited alternate-season testing.

C. COMMISSIONING TEAM AND RESPONSIBILITIES

The commissioning team consists of the Owner, the Owner's Representative the commissioning provider (CxP), and the design team. Once construction has started, the commissioning team will also include the contractor with applicable subcontractors. The contractor has ultimate responsibility for completing the commissioning process. For this project, the commissioning team is as follows:

YWCA Owner's Representative	Kim Reineking
CxP	Laura Howe, NCAT
MMW Architects	Colin Lane
MMI Engineering	Eric Webber/Ross Balfour - M/P
	DC Engineering- Lighting

Throughout the project, all commissioning team members are responsible for facilitating the transfer of information between commissioning team members as requested by those members. The design team is responsible for providing all project documents necessary for the CxP to complete her tasks. Those documents include plans and specifications, addenda, change orders, RFIs, CCDs, submittals, project schedule, substitutions, issues log, and any other documents or information required by the CxP to complete her tasks. Additional responsibilities of the commissioning team members during project phases include:

Design:

Commissioning Provider

- Conduct one design review.
- Review designs as necessary for the evaluation and recommendation of energy-efficiency measures and utility funding and rebate opportunities.

- Assist Owner's Representative in creating the OPR. Update as necessary throughout project.
- Develop a commissioning plan based on the scope of commissioning.
- Coordinate commissioning activities.
- Create commissioning specifications for inclusion in contract documents.
- Develop draft construction phase commissioning plan, which includes general guidance on anticipated system functional testing.

Owner, Owner's Representative

- Respond to requests and recommendations of CxP resulting from Cx activities.
- Lead team member in providing direction to design team based on CxP recommendations.
- Provide copies of all pertinent project changes, clarifications, etc. to the commissioning provider.
- Create the OPR with the assistance of the CxP.
- Review and provide feedback on the CxP's commissioning plan.
- Approve final plan.

Design Team

- Follow the OPR in the project design.
- Review and provide feedback on the CxP's commissioning plan. Approve final plan.
- Include IECC 2012 commissioning requirements for TAB and documentation into the project documents.
- Include commissioning specifications provided by CxP in the project construction documents.
- Include CP's recommendations into plans and specifications, as agreed upon and under direction of Owner's Representative.

Construction:

Commissioning Provider

- Coordinate commissioning activities, including scheduling of commissioning activities, meetings, and testing. Lead controls coordination meeting.
- Finalize construction phase commissioning plan.
- Submittal review (controls, TAB, other as requested by CxP).
- Review construction or design issues regarding the scope of commissioned systems and the OPR.
- Upon completion of the controls coordination meeting and resolution of all identified issues, develop functional performance test (FPT) procedures to commission the identified systems.
- Coordinate the functional performance test procedures.
- Provide a preliminary commissioning report to the Owner.

Owner

- Attend commissioning meetings as needed, including the controls coordination meeting.
- Respond to requests and recommendations of CxP and design team resulting from Cx activities and testing.
- Function as final arbiter for CxP recommendations. Provide formal direction to design team and/or contractor for resolution of issues identified during the commissioning process.
- Review and approve the CxP's commissioning final plan, as well as ongoing changes.

Design Team

- Include commissioning activities in project schedule.
- Review the CxP's commissioning final plan, as well as ongoing changes.
- Review and provide feedback of CxP generated functional test procedures.
- Provide copies of all pertinent change orders, clarifications, supplemental instructions, substitutions, etc. to the CxP.
- Provide submittals to CxP for concurrent review. Respond to CxP submittal review comments and incorporate as appropriate.
- Attend commissioning meetings as needed including the controls coordination meeting.
- Communicate with CxP construction or design issues on commissioned systems so the CxP may review and comment on proposed adjustments.
- Review and respond to deficiencies and issues identified through commissioning; investigate as necessary. Follow through with direction to contractor and recommendation to owner.
- Compile necessary documents (excluding the commissioning report) for code official as required by IECC 2012.
- Submit all code required commissioning documents to the code official.

Contractor and Subcontractors

- Include commissioning activities in project schedule.
- Assist the commissioning provider with scheduling and coordination of commissioning activities. Provide reviews of the commissioning plan and functional performance tests.
- Attend commissioning meetings as needed including a controls coordination meeting.
- Provide draft controls sequence of operation submittals at the control's coordination meeting. Finalize controls submittals after this meeting.
- Review and provide feedback of CxP generated functional test procedures.
- Perform start-up of equipment and initial testing.
- Complete all system testing and ensure that systems operate properly prior to notification of readiness to conduct functional performance testing. This is not commissioning functional testing.
- Perform testing, adjusting, and balancing (TAB)
- Execute functional performance testing under the direction of the CxP.
- Respond to issues identified through commissioning process as approved by design team and Owner.

Warranty

Commissioning Provider

- Provide a final commissioning report detailing the commissioning process, results, and documentation.
- Plan and coordinate limited alternate season testing with the contractor.

Owner

- Facilitate the transfer of information between commissioning team members.
- Respond to requests and recommendations of CxP and design team resulting from Cx activities and testing.

Design Team

- Assist in resolving deficiencies that require design decisions.
- Review and approve commissioning project documentation required by code. Submit documentation to code official as required.
- Review and respond to deficiencies and issues identified by the CP; investigate as

necessary. Follow through with direction to contractor and recommendation to Owner.

Contractor and Subcontractors

- Conduct limited alternate-season testing with CxP.
- Prepare documentation as required for compliance with commissioning code requirements.
- Respond to issues identified through commissioning process as approved by design team and Owner.

D. OTHER COMMISSIONING

Lines of Communication

NCAT has been contracted by the Montana Facility Finance Authority to perform the commissioning services with a focus on optimizing energy efficiency. The detailed communication protocol among members of the commissioning team is shown in Appendix 1: Commissioning Team Communication.

Meetings

The commissioning provider will attend one design review meeting to fulfill the project's commissioning requirements. The CxP will coordinate and facilitate the construction commissioning kick-off meeting and other meetings as necessary to complete the commissioning process. A controls coordination meeting shall take place to collaborate on implementation of HVAC and lighting control schemes prior to the contractor starting programming.

Systems

Commissioning will be performed on the following systems:

HVAC systems and controls
Lighting systems and controls

Appendix E

Design Review Documents and Communications

YWCA Missoula
DD Commissioning Plan Review - Laura Howe, NCAT
12/5/2018

For general design discussion

Add HRV's to 1st floor. Allow furnaces to cycle

Working on calcs, need operation of furnaces (on all the time occupied, cycle unocc? Hours occupied). Prelim calcs <$3,000 savings

Garage Exhaust fan - DCV on CO

First Floor open kitchen and living should be on same Furnace. Otherwise they may "fight"and simultaneously heat and cool

Electric wall heaters - inefficient. Alternatives?

ERV1 what is this going to pick up for exhaust?

alternative to 44 bathroom EF's - ERV? If not, include timer for bathroom EF's.

VPTACs

VRP would qualify for rebates, Vertipak won't
Recommend EMS for Vertipak, estimate?
These provide ventilation, will the fans run 24x7?

M0.2 Furnace refer to controls by BMS. Confirm furnaces will run CV when occupied

Rebates

Note: These are preliminary estimates, subject to change with design changes and rebate program changes. The rebate program will change July 2019

ERV -ECMotor	$373
EF1,2 - no information, wall fans usually not	
EF3,4,5 - ECM	$140
EF#- ECM	$440
CU 2, 4, 5, the rest are not rated high enough.	$490
CU's - might have ECM's, not clarified on cut sheet	
Fur 1-9 - all have Ecmotor, $2,700	$2,700
Heat pumps 1-4, high eff and also ECM	$2,622
FC's, ECM	$1,667
Lighting	$7,900
Total	$16,332

Vert-I-Pak - no rebates
VRP, $75/unit (1 ton unit) for high efficiency. Possibly ECM rebate but not verified $3,300

Business Partners

As long as code would allow electric resistance heat, then NWE will allow it as the base. Need incremental cost of VTAC, installed, from elec resistance heat (including less electrical service). Approx max cost $1,000 per unit (3,200 kwh/1 ton unit). Look at both models
savings of EMS system? Are these units programmable without? Do they have to be? What would be control be of resistance?

Other upgrades

Insulation - is there any additional beyond code? If so, where, total area, and incremental cost?

upgraded windows or doors?

Laura Howe

From: Laura Howe
Sent: Thursday, December 6, 2018 10:37 AM
To: Colin Lane; Eric J. Webber; Ross Balfour; Ryan Bundy; Kelli Littleton
Cc: stacieb@ncat.org
Subject: YWCA DD commissioning meeting recap

HI All-

Here is a quick recap of the outcome of yesterday's meeting on the YWCA project. Colin, would you forward on to Ken, the Owners rep please? I don't have his email address yet. Would you also give me his phone number?

Project Design

Laura is going to run some energy efficiency numbers for using HRV's instead of direct outside air to the furnaces, with a goal of gaining an exception to code required economizers. I may request from MMI some outputs of your energy model showing cooling loads.

The furnace layout has been changed so that a single unit serves the kitchen and living space on the 1st floor.

Laura will put on the functional testing list to make sure the electric heaters in the vestibules are set to a low setpoint, reducing energy consumption.

VTAC issues:

- MMI will confirm that the VTAC's must run during all occupied hours for ventilation, or if an exception is allowed to have them cycle on a call for heating or cooling. This will affect Laura's analysis for NWE Business Partners funding.
- VTAC's will begin heating with resistance heat at 30˚. MMI, please confirm if this immediately shuts off the heat pump, and the resistance hat comes on at 100%, or if the two stage as the heat pump loses capacity with colder temps. This also affects the Business Partners energy analysis.
- MMI is going to get more information on the controllability of the two VTAC options. See page 5 of the Vert-I-Pak brochure and 13 in the VRP for more information on the occupancy control available with the system (do both thermostats do this?) and also the "5 distinct energy saving modes" in the Energy Management tstat.
- MMI is going to get more information on the EMS system, what can it do that the thermostats can't.
- MMI will determine what the minimum code-required system for heating and cooling is, to use as a base for the Business Partners analysis. MMI will also provide incremental costs between a base system and as-designed, if needed, for this analysis.
- MMI is going to provide Laura with heating and cooling loads for the sleeping rooms.

MMW will provide energy model information and incremental costs to compare a base-code compliant envelope with the envelope as designed, for Laura to include in a Business Partners analysis and proposal.

Two things that I'd like to add that I came up with after the meeting are comments about the furnace and bathroom exhaust fan products. If those end up being devices that run all the time during occupied hours, or even 24x7, I recommend upgrading the selection to units that are light commercial. I am skeptical that the Guardian and Panasonic products will stand up to that kind of duty cycle and not fail prematurely. I think this is most significant with the exhaust fans, since there are 50 or so of them. If they are installed inside a hard lid, that makes replacement especially difficult and expensive. A panasonic fan will last a long time with intermittent use, but will it if it runs 24 hours a day?

Rebate program

I estimated that the HVAC rebates as the design and program stands now would be approximately $9,000. If the VRP unit is chosen, it may also qualify for a $75/ unit heat pump rebate. The Vert-I-pak does not qualify for this rebate. A number of the furnace condensing units do not qualify for AC rebates because their efficiency is too low. That is a $35/ton rebate.

I do need to determine if either of the VTAC units have EC Motors. Shall I contact the vendor/mfg directly, or does MMI want to gather this information?
I will update the lighting rebate estimate as the $7,900 number I had at the meeting is likely incorrectly high. This is due to the likelihood that many of the Brownlee fixtures won't qualify for a full fixture rebate. This may be irrelevant as the lighting design is changing.

Please let me know if you recall anything different, have anything to add, or comments in general.

Thanks everyone, good meeting!

Laura

Laura Howe, PE, BCxP, LEED AP

NCAT

Ph: 406-241-2863
E: Laurah@ncat.org
Web: www.ncat.org

YWCA
99% plan review
NCAT
2/21/2019

			followup requested
M0.2	Furnace	consider removing cooling efficiency, so it doesn't conflict with CU	
M0.3	erv-1	Fan wattages look high. Lists 856 W for supply/Ex fan. Submittal lists 0.5 hp for each.	
	Multisplit fan coils	Recommend listing outside air quantities	
M0.4	PH-1	I can't locate cutsheet online, please provide	X
M0.5	detail 5	I recommend the upward elbow have a leg on it, like the downward side so reduce noise transmission. I recommend a minimum length of the transfer duct, and the minimum height of the elbow legs, be listed.	
	detail 6	delete, no floor register on product	
	detail 10	I recommend a minimum length of the transfer duct, and the minimum height of the elbow legs, be listed.	
M0.7	Detail 1 - ducted fan coil	Waiting to turn on duct heaters to 0 deg F may be too cold. Recommend that this be 32 deg F and easily adjustable by staff. Is it possible to have an integral resistance heater in the unit, so the control is seamless?	X
	Detail 3 - VTAC	eliminate OAT specs for heat pump/elec operation. Allow it to run per mfgrs programming	
M0.8	furnace SOO	Need to add graphic and description of the operation of the bypass damper and zone control dampers. I would like to review this prior to bid set.	X
		Unoccupied/unoccupied titles need to be swapped.	
M2.1	pressurized supply soffit	should this be only shown in kitchen/living? It looks to continue left (south) of there without any outlets. Please provide more detail on this construction	X
	other soffit looking items	are pressurized soffits shown for the kitchen hoods, and end of living room? I'm not clear on what those dashed boxes are, if not soffits. If they are soffits, I'm not clear how they are used.	X
	air distribution - kit/liv	why is so much air distribution going over the kitchen, as opposed to the living area? This seems as though the living area may get colder.	X
	returns	I don't see return grilles shown for the kitchen/living.	
	dish room	This room could get warm in the warm months when the dish MAU and EF are running. Were those loads included in the system selection (DX size) and zone airflow calcs? That furnace and CU sizing has not changed from prior review sets without the MAU and EF.	X
	furnace schematics	recommend a detailed drawing of these units, and a detail of the mechanical rooms. I am not clear on the configuration and air paths from the drawing.	X
	zoning	putting room 165 on FN7 instead of FN4 is not ideal. Is there any way to move that so rooms that open to a common space are on the same unit? It could lead to comfort issues, and possibly maint if it is not clear which room is on which unit.	X

	returns	I don't see returns for the childrens room, except possibly one that goes back to the conf room and a different AHU.	X
	Missing VD's	171, 173,172,	
M2.2	HRV supply duct	I recommend routing this through hallway, not sleeping rooms.	
	VTAC 201/2	two furnace flues are quite close to these units. Recommend moving those furnace flues further away from air intakes	
	Connected EF's- not sleeping	consider replacing multiple EF's that are manifolded into one roof top EF serving all those spaces. Less equipment to maintain. EF226 grouping and EF242	
	Quiet room	needs H&V	X
	laundry	needs ventilation?	X
M2.3	OA inlets for split AC units	Consider routing these closer together in attic, to avoid contamination from nearby exhaust and flues	
M7.1	detail 4	does this apply to sleeping and overflow rooms?	
A8.1	VTAC details	I don't follow how these show the VTACS to be installed and weatherized.	X
General	VTAC detail	Need to add a VTAC installation detail, with weatherization and condensate	X
	VTAC's 255 & 305	I don't think these will be able to be installed and sealed weather-tight. I recommend moving these into the room they serve.	X
	No plenum relief fan in DV area	is the plenum completely open between DV and service center?	X
	did not review for completeness of returns and paths back to F's and relief fans		

Appendix F

Design Energy Analysis and Communications

YWCA VTAC analysis

Laura Howe, NCAT 1/22/2019

Energy analysis of Friedrich VRP vs VHA units at the YWCA

Assumptions include 100% fan operation, heating below 60, cooling above 75. VRP runs heat pump down to 25, VHA down to 35. Heating and cooling loads roughly 6,000 Btuh. Detailed EER, COP, and capacity ratings at various bins from Friedrich engineer. Electricity assumed at a blended rate of $0.10/kwh.

Analysis does not include additional electric heat required for defrost.

	VRP			VHA		
	motor size, W	EER, cooling	COP, heating	motor size, W	EER, cooling	COP, heating
	307	14-19.9	3.66-5.72	466.25	9.9-12.9	3.37-4.38
annual fan kwh/yr	1,075			1,633		
fan savings, kwh/yr	558					
fan savings, $	$55.77					
heating kwh/yr	1,575			2,872		
heating savings, kwh/yr	1,297					
heating savings, $	$129.74					
cooling, kwh/yr	569			831		
cooling savings, kwh/yr	262					
cooling savings, $	$26.16					
Total Annual Savings	**$211.68**					
Project Cost	$1,000.00					
rebate	$225.00					
net cost	**$775.00**					
payback, yrs	**3.7**					

Energy Analysis
VRP12K25SSAS-A

Country	USA
State	MONTANA
City	Missoula International A
Altitude	3189

Summer Load	
Latent Btu/hr	1500
Sensible Btu/hr	4500
Target DB °F	75
Target RH%	60

Winter Load	
Sensible Btu/hr	6000
Target DB °F	70

VPAKHP	12K
Other Unit Capacity (Btu/hr)	12000
Other Unit EER	12
Electric Energy Cost $/kWh	0.1
Diversity Factor % (1-100)	50

Annual Result	Cooling kWh	Cooling Cost $	Heating kWh	HeatingCost $	Total Cost $	VRP Saving $	
VRP 12	226	$22.61	1,498	$149.76	$172.37	$336.19	
VPAKHP 12K	567	$56.71	4,519	$451.85	$508.56		

			VRP Unit							VPAKHP Unit				
Bin DB °F	Bin WB °F	Bin Hours	VRP Stage	SCFM	Comp Speed	EER/COP	Cooling Watts	Heating Watts		Stage	Cycle on Time	EER/COP	Cooling Watts	Heating Watts
97	61.41	1	Cooling	270	30	14.02	491	0		Cooling	0.65	9.89	1,155	0
95	61.501999	4	Cooling	250	30	14.46	482	0		Cooling	0.67	10.17	1,134	0
93	62.537998	15	Cooling	270	30	14.93	471	0		Cooling	0.69	10.50	1,110	0
91	62.089001	18	Cooling	220	30	15.28	464	0		Cooling	0.64	10.68	1,095	0
89	62.341	25	Cooling	270	30	15.79	454	0		Cooling	0.69	10.99	1,074	0
87	60.188999	59	Cooling	220	30	16.41	442	0		Cooling	0.64	11.34	1,051	0
85	59.948002	67	Cooling	270	30	17.03	430	0		Cooling	0.7	11.68	1,030	0
83	59.556	94	Cooling	220	30	17.58	421	0		Cooling	0.64	11.97	1,013	0
81	58.935001	102	Cooling	270	30	18.17	411	0		Cooling	0.7	12.25	998	0
79	58.167999	110	Cooling	220	30	18.83	400	0		Cooling	0.65	12.51	984	0
77	58.320999	84	Cooling	200	30	19.35	392	0		Cooling	0.63	12.70	974	0
75	57.327999	114	Cooling	200	30	19.88	384	0		Cooling	0.63	12.90	965	0
73	56.730999	131	Cooling	200	30	20.67	373	0		Cooling	0.63	13.08	956	0
71	55.796001	113	Cooling	200	30	21.43	363	0		Cooling	0.63	13.26	949	0
69	54.870998	217	Cooling	200	30	22.46	350	0		Cooling	0.63	13.45	943	0
67	54.014999	174	OFF	0	0	0.00	0	0		OFF	0	0.00	0	0
65	53.050999	233	OFF	0	0	0.00	0	0		OFF	0	0.00	0	0
63	51.694	231	OFF	0	0	0.00	0	0		OFF	0	0.00	0	0
61	51.410999	256	Heat Pump	200	30	5.79	0	388		Heat Pump	0.41	4.31	0	996
59	50.502998	147	Heat Pump	200	30	5.65	0	389		Heat Pump	0.42	4.25	0	992
57	49.044998	229	Heat Pump	200	30	5.52	0	391		Heat Pump	0.42	4.19	0	988
55	47.832001	265	Heat Pump	200	30	5.38	0	391		Heat Pump	0.43	4.12	0	984
53	46.723999	311	Heat Pump	200	30	5.23	0	392		Heat Pump	0.44	4.05	0	980
51	44.665001	420	Heat Pump	200	30	5.05	0	393		Heat Pump	0.45	3.96	0	975
49	42.924	300	Heat Pump	200	30	4.88	0	394		Heat Pump	0.47	3.87	0	972
47	41.360001	308	Heat Pump	200	30	4.75	0	395		Heat Pump	0.48	3.80	0	969
45	39.918999	366	Heat Pump	200	30	4.62	0	395		Heat Pump	0.49	3.72	0	967
43	37.946999	353	Heat Pump	200	30	4.50	0	395		Heat Pump	0.5	3.65	0	965
41	36.845001	192	Heat Pump	200	30	4.41	0	396		Heat Pump	0.51	3.58	0	963
39	35.692001	356	Heat Pump	200	31	4.33	0	406		Heat Pump	0.52	3.52	0	962
37	33.950001	373	Heat Pump	200	32	4.22	0	416		Heat Pump	0.53	3.45	0	961
35	32.567001	381	Heat Pump	200	33	4.12	0	427		Heat Pump	0.54	3.37	0	960
33	31.014	610	Heat Pump	200	34	4.01	0	436		E-Heat	1	1.00	0	1807
31	28.573999	374	Heat Pump	200	36	3.90	0	456		E-Heat	1	1.00	0	1807
29	26.971001	346	Heat Pump	200	37	3.82	0	465		E-Heat	1	1.00	0	1807
27	25.058001	246	Heat Pump	200	38	3.74	0	474		E-Heat	1	1.00	0	1807
25	23.169001	190	Heat Pump	200	39	3.66	0	483		E-Heat	1	1.00	0	1807
23	21.704	110	Heat Pump	200	40	3.60	0	492		E-Heat	1	1.00	0	1807
21	20.347	179	Heat Pump	200	41	3.54	0	501		E-Heat	1	1.00	0	1807
19	18.697001	193	Heat Pump	200	42	3.46	0	508		E-Heat	1	1.00	0	1807
17	16.743999	153	Heat Pump	200	43	3.40	0	516		E-Heat	1	1.00	0	1807
15	14.712	130	Heat Pump	200	45	3.33	0	533		E-Heat	1	1.00	0	1807
13	12.073	67	Heat Pump	200	47	3.25	0	549		E-Heat	1	1.00	0	1807
11	10.043	41	Heat Pump	200	48	3.19	0	555		E-Heat	1	1.00	0	1807
9	8.1350002	37	Heat Pump	200	49	3.14	0	561		E-Heat	1	1.00	0	1807
7	6.1680002	26	Heat Pump	200	51	3.09	0	576		E-Heat	1	1.00	0	1807
5	4.6440001	9	Heat Pump	200	52	3.05	0	583		E-Heat	1	1.00	0	1807

Laura Howe

From: Eric J. Webber <ewebber@m-m.net>
Sent: Tuesday, January 15, 2019 6:38 PM
To: Laura Howe
Cc: Colin Lane; Ryan Bundy; Ross Balfour
Subject: Re: YWCA modeling

Laura,
Great idea visiting with the manufacturers. Looking forward to any insight you have gained in talking with them. We are looking for a direction as soon as you can as we are rapidly approaching the design deadline. Thanks for all of your help.

-Eric

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From: Laura Howe <laurah@ncat.org>
Sent: Tuesday, January 15, 2019 13:46
To: Eric J. Webber
Cc: Colin Lane; Ryan Bundy; Ross Balfour
Subject: Re: YWCA modeling

Hi Eric- I am on Atlanta at the ASHRAE conference & AHR expo. I had a great conversation with the Friedrich reps to help me fine tune my analysis. I also spoke with guardian and they are going to send me more info, specifically in reaponse to my skepticism that their fan motors might be undersized.

What time frame are you needing this by? Will early next week work?

Laura

From: Eric J. Webber <ewebber@m-m.net>
Sent: Tuesday, January 15, 2019 4:42:10 PM
To: Laura Howe
Cc: Colin Lane; Ryan Bundy; Ross Balfour
Subject: YWCA modeling

Laura,
Talking with Colin today we have agreed to base our decision about utilizing economizer cooling and/or ERV's for ventilation on your econimic and energy modeling results. We are looking for direction on which option(s) will work best for the YWCA. Please let us know as soon as possible when you have your results. Also, we are always available for questions and or information needed with equipment selections, control strategies, or thermal loads. Thanks for all of your help.

-Eric

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Appendix G

Commissioning Plan – Construction Phase

YWCA Missoula - COMMISSIONING PLAN
Construction Phase
12/04/2019

A. INTRODUCTION

The Montana Facility Finance Authority contracted with the National Center for Appropriate Technology (NCAT) to provide commissioning services for the YWCA Missoula project. Because it is most cost-effective to implement energy-conservation measures before equipment is installed, NCAT will emphasize energy efficiency in the commissioning process by evaluating and recommending design alternatives that will reduce the building's energy consumption.

This document provides guidance for execution of the commissioning process during construction, including the commissioning scope, responsibilities, lines of communication, schedule, and documentation requirements. This plan will continue to evolve and change as the project progresses. The commissioning process does not replace the traditional construction administration functions of the architect/engineer such as design, existing conditions inspection, construction inspection and verification, design or construction scheduling.

The purpose of the commissioning process is to assure the Owner that the building systems have been installed according to the contract documents and will perform as specified. This commissioning process is intended to provide compliance with the IECC 2012 HVAC and lighting commissioning requirements.

B. COMMISSIONING ACTIVITIES

The commissioning activities for this project are as follows:

<u>Construction</u>

1. Finalize construction-phase commissioning plan.
2. Review submittals – The commissioning provider (CxP) will review and provide comments on HVAC (including controls and TAB) and lighting equipment and controls, along with any other contractor submittals as they pertain to the Owner's Project Requirements (OPR) and commissioning process needs.
3. Hold commissioning meetings with contractor and appropriate subs, as needed, to facilitate the commissioning process. A control coordination meeting shall occur in which the controls subcontractor provides draft sequences of operation and control drawings, and final sequences are decided collaboratively. This is intended as a fine-tuning session only, not as a redesign outside the scope of controls contractor's bid. Significant modifications requiring a change to the contract or contract amount shall be made at the discretion of the Owner.
4. Finalize functional testing procedures after resolution of all issues from the control coordination meeting.
5. Perform start-up testing - Normal start-up services performed by the contractor or manufacturer's representative to bring each system into full operational state. This includes factory start-up services for major equipment as specified.
6. Conduct initial systems testing - Tests performed by the contractor on equipment and systems in order to complete system installation and to verify proper operation. This is not commissioning functional testing.
7. Perform testing, adjusting, and balancing (TAB) of equipment and systems by the contractor. TAB report will be reviewed by CxP.

8. Conduct Functional Performance Tests - Tests performed by the contractor and documented by the commissioning provider to verify that all components, systems, and subsystems function in accordance with the contract documents and design intent. These tests include mechanical inspections, controls calibration verification, control sequence testing, balance and flow verification, performance verification, and controls system verification. The commissioning provider will provide independent verification of a representative sample of multiple units with a minimum of 25% or two units, whichever is greater.
9. Prepare preliminary commissioning report.

Warranty

10. Provide final commissioning report.
11. Conduct limited alternate-season testing.

C. COMMISSIONING TEAM AND RESPONSIBILITIES

The commissioning team consists of the Owner, the Owner's Representative (OR) the commissioning provider (CxP), and the design team (architect and engineers), the general contractor and applicable subcontractors. The general contractor has ultimate responsibility for completing the commissioning process. For this project, the commissioning team is as follows:

YWCA Owner's Representative	Kim Reineking
CxP	Laura Howe, NCAT
MMW Architects	Colin Lane, Ryan Bundy
MMI Engineering	Eric Webber/Ross Balfour - M/P
	DC Engineering- Lighting
General Contractor- Sirius Construction	Brian Mether/Mark Umile
Mechanical subcontractor	Garden City Plumbing
Plumbing subcontractor	Garden City Plumbing
Lighting subcontractor	Talco Electric

Throughout the project, all commissioning team members are responsible for facilitating the transfer of information between commissioning team members as requested by those members. The design team is responsible for providing all project documents necessary for the CxP to complete her tasks. Those documents include plans and specifications, addenda, change orders, RFIs, CCDs, submittals, project schedule, substitutions, issues log, and any other documents or information required by the CxP to complete her tasks. Additional responsibilities of the commissioning team members during project phases include:

Construction:

Commissioning Provider

- Coordinate commissioning activities, including scheduling of commissioning activities, meetings, and testing. Lead controls coordination meeting.
- Finalize construction phase commissioning plan.
- Submittal review (HVAC, controls, TAB, lighting, and other as requested by CxP).
- Review construction or design issues regarding the scope of commissioned systems and the OPR.
- Upon completion of the controls coordination meeting and resolution of all identified issues, develop functional performance test (FPT) procedures to commission the identified systems.
- Coordinate the implementation of functional performance testing.

- Provide a preliminary commissioning report to the Owner.

Owner
- Attend commissioning meetings as needed, including the controls coordination meeting.
- Respond to requests and recommendations of CxP and design team resulting from Cx activities and testing.
- Function as final arbiter for CxP recommendations. Provide formal direction to design team and/or contractor for resolution of issues identified during the commissioning process.
- Review and approve the CxP's commissioning final plan, as well as ongoing changes.

Design Team
- Include commissioning activities in project schedule.
- Review the CxP's commissioning final plan, as well as ongoing changes.
- Review and provide feedback of CxP generated functional test procedures.
- Provide copies of all pertinent RFI's, CCD's, change orders, clarifications, supplemental instructions, substitutions, etc. to the CxP.
- Provide submittals to CxP for concurrent review. Respond to CxP submittal review comments and incorporate as appropriate.
- Attend commissioning meetings as needed including the controls coordination meeting.
- Communicate with CxP construction or design issues on commissioned systems so the CxP may review and comment on proposed adjustments.
- Review and respond to deficiencies and issues identified through commissioning; investigate as necessary. Follow through with direction to contractor and recommendation to owner.
- Compile necessary documents (excluding the commissioning report) for code official as required by IECC 2012.
- Submit all code required commissioning documents to the code official.

Contractor and Subcontractors
- Include commissioning activities in project schedule.
- Assist the commissioning provider with scheduling and coordination of commissioning activities. Provide reviews and feedback of the commissioning plan and functional performance tests.
- Attend commissioning meetings as needed including a controls coordination meeting.
- Provide draft controls sequence of operation submittals at the control's coordination meeting. Finalize controls submittals after this meeting.
- Review and provide feedback of CxP generated functional test procedures.
- Perform start-up of equipment and initial testing.
- Complete all system testing and ensure that systems operate properly prior to notification of readiness to conduct functional performance testing. This is not commissioning functional testing.
- Perform testing, adjusting, and balancing (TAB).
- Execute functional performance testing under the direction of the CxP.
- Respond to issues identified through commissioning process as approved by design team and Owner.

Warranty

Commissioning Provider
- Provide a final commissioning report detailing the commissioning process, results, and

documentation.
- Plan and coordinate limited alternate season testing with the contractor.

Owner
- Facilitate the transfer of information between commissioning team members.
- Respond to requests and recommendations of CxP and design team resulting from Cx activities and testing.

Design Team
- Assist in resolving deficiencies that require design decisions.
- Review and approve commissioning project documentation required by code. Submit documentation to code official as required.
- Review and respond to deficiencies and issues identified by the CxP; investigate as necessary. Follow through with direction to contractor and recommendation to Owner.

Contractor and Subcontractors
- Conduct limited alternate-season testing with CxP.
- Prepare documentation as required for compliance with commissioning code requirements.
- Respond to issues identified through commissioning process as approved by design team and Owner.

D. OTHER COMMISSIONING

Lines of Communication

NCAT has been contracted by the Montana Facility Finance Authority to perform the commissioning services with a focus on optimizing energy efficiency. The detailed communication protocol among members of the commissioning team is shown in Appendix 1: Commissioning Team Communication.

Meetings

The commissioning provider will attend one design review meeting to fulfill the project's commissioning requirements. The CxP will coordinate and facilitate the construction commissioning kick-off meeting and other meetings as necessary to complete the commissioning process. A controls coordination meeting shall take place to collaborate on implementation of HVAC and lighting control schemes prior to the contractor starting programming.

Systems

Commissioning will be performed on the following systems:

HVAC systems and controls
Lighting systems and controls

Appendix H

Construction-Phase Meetings and Documents

YWCA Missoula

Commissioning of HVAC and lighting systems summary

Preconstruction meeting 8/19/19

This project is utilizing a 3rd party Commissioning Provider to meet IECC requirements for commissioning HVAC and lighting systems. This commissioning process is outlined in the specifications, including 019100, 230800, 250800, and other sections as referred. The Commissioning Plan document is a narrative summary of the process and the most recent version is attached to this document.

The heart of commissioning is functional performance testing, which takes place after the contractor has completed their installation, start-up testing, and checkout of the systems, and are ready to turn those systems over to the owner. The contractor must complete all of their own systems testing and ensure that systems operate properly prior to notification of readiness to conduct functional performance testing. Contractor start-up and initial testing (sometimes called commissioning) is not commissioning functional testing for the purposes of the construction documents.

The first step is a commissioning kickoff meeting, to coincide with a regularly scheduled construction meeting. Date is to be announced, likely no sooner than the beginning of October. The next step is to hold a controls preinstallation meeting, this must take place before the control's submittals are generated.

Commissioning tasks are required to be included in the contractor's schedule, including, but not limited to:

- Commissioning kickoff meeting
- Commissioning controls preinstallation meeting
- Submittals of commissioned systems (HVAC, lighting)
- Draft functional performance tests submitted to contractor
- Test and Balancing
- Commissioned systems are ready for functional performance testing
- Functional performance testing

Questions, please call Laura Howe/NCAT at 241-2863 or laurah@ncat.org

Laura Howe

From: Laura Howe
Sent: Friday, November 8, 2019 10:07 AM
To: Colin Lane; Ryan Bundy
Cc: Kim Reineking
Subject: RE: YWCA PR4 - NWE rebates

That's great! Have a good weekend,

Laura

From: Colin Lane <colin@mmwarchitects.com>
Sent: Friday, November 8, 2019 8:35 AM
To: Laura Howe <laurah@ncat.org>; Ryan Bundy <ryanb@mmwarchitects.com>
Cc: Kim Reineking <kim.reineking@gmail.com>
Subject: RE: YWCA PR4 - NWE rebates

Laura,

Darin thinks this spec will work. I'll let you know if we have any further questions.

Colin Lane, AIA, LEED AP BD+C
Principal Architect
MMW Architects
125 W. Alder St.
Missoula, MT 59802
406.543.5800

From: Laura Howe <laurah@ncat.org>
Sent: Thursday, November 7, 2019 11:39 AM
To: Colin Lane <colin@mmwarchitects.com>; Ryan Bundy <ryanb@mmwarchitects.com>
Cc: Kim Reineking <kim.reineking@gmail.com>
Subject: RE: YWCA PR4 - NWE rebates

Maxlite has some low profile options, this line is 3.44" tall and has integral occupancy and photo sensors.

https://websvc.maxlite.com/api/products/documents/item/CPL40AUP50B?type=datasheet

That's my easy one, let me know if it doesn't fit the project and I'll dig more.

L

From: Colin Lane <colin@mmwarchitects.com>
Sent: Thursday, November 7, 2019 11:12 AM
To: Laura Howe <laurah@ncat.org>; Ryan Bundy <ryanb@mmwarchitects.com>
Cc: Kim Reineking <kim.reineking@gmail.com>
Subject: RE: YWCA PR4 - NWE rebates

Laura,

We absolutely have to be under 4". Our original fixtures were close to 2", which we prefer. We want some wiggle room, since as you know construction can be an imprecise field. Our new fixtures are around 3.5", which is a little close to our limit, but we felt comfortable enough to proceed.

How's that for a convoluted answer?

Colin Lane, AIA, LEED AP BD+C
Principal Architect
MMW Architects
125 W. Alder St.
Missoula, MT 59802
406.543.5800

From: Laura Howe <laurah@ncat.org>
Sent: Thursday, November 7, 2019 10:54 AM
To: Colin Lane <colin@mmwarchitects.com>; Ryan Bundy <ryanb@mmwarchitects.com>
Cc: Kim Reineking <kim.reineking@gmail.com>
Subject: Re: YWCA PR4 - NWE rebates

Let me do some digging on my end and see what I can come up with. What is the limit we are working with on fixture height?

Laura

From: Colin Lane <colin@mmwarchitects.com>
Sent: Thursday, November 7, 2019 10:40:27 AM
To: Laura Howe <laurah@ncat.org>; Ryan Bundy <ryanb@mmwarchitects.com>
Cc: Kim Reineking <kim.reineking@gmail.com>
Subject: RE: YWCA PR4 - NWE rebates

All,

I spoke with Darin at DC again about the parking garage light fixtures. We are shooting for a pretty specific fixture: low profile to keep ADA head clearance plus an integrated occupancy sensor. This limits our choices quite a bit. With our revised selection, we are saving $500 from the original specification. Losing $1000 in rebates isn't any fun, but the net is only a loss of $500. The only other option would be to install occ sensors separately, which would likely increase our costs significantly.

I'd like to proceed with our new specification and understand that we'll lose out on the rebate. Let me know if you have any other ideas.

thanks

Colin Lane, AIA, LEED AP BD+C
Principal Architect
MMW Architects
125 W. Alder St.
Missoula, MT 59802
406.543.5800

From: Laura Howe <laurah@ncat.org>
Sent: Wednesday, November 6, 2019 10:10 AM
To: Ryan Bundy <ryanb@mmwarchitects.com>; Colin Lane <colin@mmwarchitects.com>
Cc: Kim Reineking <kim.reineking@gmail.com>
Subject: YWCA PR4 - NWE rebates

Hi Ryan and Colin-

PR4 changes the light fixtures in the parking garage (PG & PG2) to models that are not on any of the NWE rebate program lists, as best I can tell, and therefore won't qualify for NWE rebates. That is the loss of over $1,000 in rebates from my prior lighting rebate estimate of $7,000. I recommend the project consider a fixture that is either ENERGY STAR approved or on the DLC list.

Regarding the other fixture changes PR4 mentions, A6 as designed is an approved fixture, but only worth a rebate of $8. R and U2 are not approved fixtures. Whatever substitutions are made for A6, R, and U2 will not have a significant impact on rebates.

Please note that I need to update the rebate estimate for the project based on the new rebate program that is in effect from July 1, 2019 to June 30, 2020. The lighting likely won't be completed in time for this current program, and it may change again this coming July 1 making even an updated estimate still a preliminary one only.

Please let me know if you have any questions.

Laura

Laura Howe, PE, BCxP, LEED AP

NCAT

Ph: 406-241-2863
Fax: 406-258-7510
E: Laurah@ncat.org
Web: www.ncat.org

OAC Meeting Minutes #007
YWCA

Project #: 17.041
Meeting Date: 12/04/19
Notes Prepared: 12/11/19

Attendees

- Ryan Bundy, MMW
- Kim Reineking, YWCA
- Cindy Weese, YWCA
- Marc Umile, Sirius
- Brian Mether, Sirius
- Erin Norstrant, Hulteng CCM
- Ronnie Shumard, YWCA
- Elise Chard, YWCA

Agenda

1. Progress to Date
    a. Concrete is going well – Sirius is maintaining good temps in the heated tents. It is staying covered for 4 days. They are currently only doing a 7 day break test, which is working well.
    b. By next meeting we will be at 90 percent of the parking structure walls completed.
    c. Elevator pit excavation is done.
    d. Survey grid lines for underground garage is done.

2. Schedule for next 2 weeks
    a. Kim asked for an estimate of how much delay time we have to date. Marc said that we are looking at roughly 6 weeks at this point. Sirius will be able to make a more precise estimate on this after concrete is complete.
    b. Another pour is scheduled for this Friday.
    c. Underground plumbing in garage to begin next week.
    d. See Sirius attachment for additional detail.

3. Outstanding COR's
    a. COR #03 – electrical credit per ASI 002 and PR 004.1 – to be included in the next change order
    b. COR #4 – conduit to the Quonset hut for data connection per PR006 – to be included on the next change order.

c. Per Sirius, Bargreen's kitchen equipment increase by $4848. To be discussed further. This is based on adjusted schedule delivery price.
d. Marc said that he received notification from Dupree that there will be some price increases coming based on updated delayed schedule. Dupree and Bargreens are not subs, so they are not contracted to hold their price. Kim noted that it is not feasible to buy equipment earlier and store it, because warranty typically starts when you purchase items, and you need room to store items which is typically not feasible or recommended. This will be discussed further once the updated pricing is solidified.
e. Marc noted that there may be some lumber cost increases coming as well, based on the same reasons stated above. The team will react once all these are finalized.

4. RFI's:
    a. 014 answered - none outstanding

5. Owner Discussion
    a. Framing Pre con meeting is set for 12/11 at MMW.
    b. MMW to send Elise updated drawings for Shane with AMS for an updated camera quote.

6. ASI's
    a. No new ASI's

7. Submittals
    a. 016 - plumbing fixtures in design team's court
    b. 018 - Gas Water Heater – Garden City sent an updated submittal.
    c. Window Shops are in design team's court.

8. Proposal Requests:
    a. PR 002 - extra project sign. Sirius to issue COR.
    b. PR 003 - still waiting on response from Gregg W.
    c. PR4.1 per COR 003

9. Miscellaneous Discussion:
    a. Kim would like to substitute CDX plywood for the osb subfloors - MMW to write up a PR for this.
    b. Kim: We should look into issuing a PR to add spray foam under 1st floor assembly, which arose from talking to other contractors. Spray foam under 1st floor is helpful, and/or needed to keep garage fumes out of the rest of the building. The design team will research this further.
    c. Kim and Brian had an idea to use the two deleted bollards to protect the plumbing venting in the basement in the South West most parking space. Sirius to issue an RFI.
    d. Prior to the meeting there was a pre – commissioning meeting, run by Laura Howe, who will be doing limited commissioning work on the project. She outlined some of the scope of commissioning that she will be doing.

10. On Going Pending Action Items
    a. Delays – Total Days, as outlined by Sirius:
        i. August 26-30 (Waste Less No Sam Number)
        ii. September 12-13 (Waste Less Behind Schedule)
        iii. September 23-27 (Century Link Fiber Optic)
        iv. Total Impacted 12 days – this will be discussed further so that it can be rectified within the contract.

Sign In Sheet

Pre-comision

	Printed Name	Company	Date	Signature
1)	Lee McMillan	Talon Elec	12/4/19	
2)	FRED TALARICO	" "	"	
3)	Laura Howe	NCAT	12/4/19	
4)	Eric Webber	MMI	12/4/19	
5)	ROSS BALFOUR	MMI	12/4/19	
6)	COLIN LANE	MMW	12/4/19	
7)	Tim Kesta	GCT&H	12/4/19	
8)	MARK MILLER	SIRIUS	12/4/19	
9)	KIM REMEKING	TWCHFL	12.4.19	
10)	Ryan Bundy	MMW	12/4/19	
11)				
12)				
13)				
14)				

Laura Howe

From: Laura Howe
Sent: Monday, April 6, 2020 8:56 AM
To: Ross Balfour
Cc: Colin Lane; Chris Haskell; Eric J. Webber
Subject: Re: YWCA

Hi Ross, thanks for the feedback. The NWE rebate SEER criteria is currently 18.0, so the Daikin unit should qualify unless the rebate program criteria changes (annually on July 1).

Have a good day,
Laura

From: Ross Balfour <rbalfour@m-m.net>
Sent: Friday, April 3, 2020 2:45:56 PM
To: Laura Howe <laurah@ncat.org>
Cc: Colin Lane <colin@mmwarchitects.com>; Chris Haskell <chris@mmwarchitects.com>; Eric J. Webber <ewebber@m-m.net>
Subject: RE: YWCA

Laura,

RFI030 – The location of the dampers are in an effort to keep them accessible while minimizing access panels especially in highly visible areas. We also try to keep remote dampers to a minimum as they cost more and add one more cabling to the already busy ceiling space. If the worry is relocating these dampers in the future, once the building is complete the owner will be provided updated drawings (as-builts) showing the location of all dampers installed in the building.

RFI031 – I agree

On another note - In submittal review I have run into a Multi-Split Heat Pump (HP-1) that has a slightly lower SEER than the unit we scheduled in design. We specified a LG unit with a SEER of 18.9 and a Daikin unit with a SEER of 18.0. I know that some rebates are tied to the SEER rating on these units. Will this slight drop in SEER change the rebate eligibility? If so, I can reject the Heat Pump per our note on M0.1, but if we can still receive the full rebate I would consider this heat pump further.

Please advise.

Thanks,

Ross Balfour, PE
Mechanical Engineer, Buildings, Morrison-Maierle
406.542.4836

From: Laura Howe <laurah@ncat.org>
Sent: Tuesday, March 31, 2020 12:18 PM
To: Ross Balfour <rbalfour@m-m.net>; Eric J. Webber <ewebber@m-m.net>
Cc: Colin Lane <colin@mmwarchitects.com>; Chris Haskell <chris@mmwarchitects.com>
Subject: RE: YWCA

Hi Ross-

I have a couple of thoughts and questions for you on these RFI's.

RFI030 – access above hard ceilings; I recommend not relocating balancing dampers to adjacent rooms because it can make it difficult for the owner/maintenance to locate those again, although not impossible. It complicates maintenance as they will then have to impact the occupants of those other spaces (youth room, healthcare) to inspect or adjust these . Can you tell me what your reasoning was behind those, vs using remote dampers or adding an access door? Specifically for the activity room and WC107?

RFI031 – I recommend you add language to maximize the RA damper position and minimize the OA damper position to minimize pressure drop.

RFI032 & 33 – I have nothing to add.

Thanks!
Laura

Laura Howe, PE, BCxP, LEED AP

NCAT ENERGY SERVICES

Ph: 406-241-2863
Fax: 406-258-7510
E: Laurah@ncat.org
Web: https://www.ncat.org/commercial-energy-services/

From: Chris Haskell <chris@mmwarchitects.com>
Sent: Tuesday, March 31, 2020 8:55 AM
To: Laura Howe <laurah@ncat.org>
Cc: Colin Lane <colin@mmwarchitects.com>
Subject: FW: YWCA

Laura,

Please see attached RFI's regarding mechanical questions.

Let us know if you have any questions or concerns.

Thanks,

Chris Haskell, AIA
Project Architect
MMW Architects
125 W. Alder St.
Missoula, MT 59802
406.543.5800

From: Chris Haskell
Sent: Monday, March 30, 2020 8:00 PM
To: Marc Umile <mumile@siriusconst.com>
Cc: Colin Lane <colin@mmwarchitects.com>
Subject: RE: YWCA

Marc,

Please see attached responses to RFI's 30, 31, 32, & 33. We are still reviewing roof mounted equipment with PV array and roof penetrations. Should get back to you this week.

Thanks,

Chris Haskell, AIA
Project Architect
MMW Architects
125 W. Alder St.
Missoula, MT 59802
406.543.5800

From: Marc Umile <mumile@siriusconst.com>
Sent: Monday, March 30, 2020 9:37 AM
To: Chris Haskell <chris@mmwarchitects.com>
Cc: Colin Lane <colin@mmwarchitects.com>
Subject: FW: YWCA

Chris,

I'm getting nudged by GCP&H regarding responses to the RFI's below. Would you please check in with the MEOR and update us on the status of the following:

HVAC 029	Proposed CU Relocation	MMW	3/18/20
HVAC 030	Mechanical Items above hard lids	MMW	3/19.20
HVAC 031	O.A. & R.A. Dampers for Furnaces FN-1 thru FN-9	MMW	3/19/20
HVAC 032	**HVAC Test, Balance and Adjustment issues**	MMW	3/19/20
HVAC 033	Plenum Relief Fans	MMW	3/19/20

Thanks,
Marc

Marc Umile
President
Project Manager / LEED GA
http://www.siriusconst.com
O: 406.542.0004
M: 406.544.6193

From: Terri Ruthruff <TerriRuthruff@gardencityplumbing.com>
Sent: Monday, March 30, 2020 7:55 AM
To: Marc Umile <mumile@siriusconst.com>
Cc: Kyle Schaff <KyleSchaff@gardencityplumbing.com>; Tim Kester <TimKester@gardencityplumbing.com>
Subject: YWCA

Good morning Marc;

Could you please prompt the design team on a response to our RFI's?

Thanks!

Terri

YWCA Furnace & Zone Control Settings Settings					
			M-F	Sa/Su	
FN-1	FC Kitchen Room 130 & FC Living Room 131	Occupied Time	7:00	7:00	
		Unoccupied Time	22:00	22:00	
			M-F	Sa/Su	
FN-2	FP Offices/Meeting Rooms	Occupied Time	7:00	Unocc.	
		Unoccupied Time	18:00	Unocc.	
		Occ. HT	Occ. Cool	Unocc. HT	Unocc. Cool
ZN 2-1	Meeting Room 121	68	74	65	78
Zn 2-2	FP Director Room 124C	68	74		
Zn 2-3	Family Shelter Mgr. Room 124B	68	74		
ZN 2-4	Rapid Rehousing Coord. Room 124A	68	74		
ZN 2-5	Meeting Room 122	68	74		
ZN 2-6	FP Vol./Div. Spec./Housing Nav. Room 124	68	74		
ZN 2-7	Meeting Room 132	68	74		
			M-F	Sa/Su	
FN-3	Dish Room/Activity	Occupied Time	6:00	6:00	
		Unoccupied Time	20:00	20:00	
		Occ. HT	Occ. Cool	Unocc. HT	Unocc. Cool
ZN 3-1	Circ. Room 100B	68	74	65	78
Zn 3-2	Dish Room 128	68	74		
Zn 3-3	Activity Room 129	68	74		
ZN 3-4	Locker Area 100B	68	74		
			M-F	Sa/Su	
FN-4	Lobby/Walk-in/Health Care	Occupied Time	0:00	0:00	
		Unoccupied Time	N/A	N/A	
		Occ. HT	Occ. Cool	Unocc. HT	Unocc. Cool
ZN 4-1	Lobby Room 100A	68	74	65	78
Zn 4-2	Walk-in Room 108	68	74		
Zn 4-3	Walk-in Room 109	68	74		
ZN 4-4	Operations Manager Room 104	68	74		
ZN 4-5	Youth Room 103	68	74		
ZN 4-6	Health Care Room 166	68	74		
			M-F	Sa/Su	
FN-5	Large Conference Room 106	Occupied Time	7:00	Unocc.	
		Unoccupied Time	18:00	Unocc.	
			M-F	Sa/Su	
FN-6	Chidren's/Serving/Break Rooms	Occupied Time	6:00	6:00	
		Unoccupied Time	20:00	20:00	
		Occ. HT	Occ. Cool	Unocc. HT	Unocc. Cool
ZN 6-1	Children's Room 105	68	74	65	78
Zn 6-2	Serving/Break Room 141	68	74		

YWCA Furnace & Zone Control Settings Settings					
			M-F	Sa/Su	
FN-7	Directors/Managers Offices	Occupied Time	7:00	Unocc.	
		Unoccupied Time	18:00	Unocc.	
		Occ. HT	Occ. Cool	Unocc. HT	Unocc. Cool
ZN 7-1	Executive Director Room 162	68	74	65	78
Zn 7-2	ADA's Place Manager Room 163	68	74		
Zn 7-3	GUTS! Office Room 165	68	74		
ZN 7-4	Director of Programs Room 160	68	74		
ZN 7-5	Comm./Dev. Assoc./Racial Justice Room 157	68	74		
ZN 7-6	Devel. Director/Philan. Officer Room 156	68	74		
ZN 7-7	Bullpen Room 155	68	74		
ZN 7-8	Finance Mgr./Grant. Room 154	68	74		
ZN 7-9	Wellness Room 152	68	74		
			M-F	Sa/Su	
FN-8	Living Rm./Meeting Rm./Offices	Occupied Time	7:00	7:00	
		Unoccupied Time	22:00	22:00	
		Occ. HT	Occ. Cool	Unocc. HT	Unocc. Cool
ZN 8-1	Living Room 172	68	74	65	78
Zn 8-2	Pathway Mgr. Room 144	68	74		
Zn 8-3	First Step Interns Room 145	68	74		
ZN 8-4	Small Conference Room 142	68	74		
ZN 8-5	Meeting Room 173	68	74		
			M-F	Sa/Su	
FN-9	Kitchen/Dining/Office	Occupied Time	6:00	6:00	
		Unoccupied Time	20:00	20:00	
		Occ. HT	Occ. Cool	Unocc. HT	Unocc. Cool
ZN 9-1	Kitchen Room 178	68	74	65	78
Zn 9-2	Didning Room 171	68	74		
Zn 9-3	Office Room 176	68	74		
ZN 9-4	Circ. Room 100D	68	74		

Appendix I

Test and Balance Report Excerpts

AIRCOMMANDER
TEST & BALANCE LLC

FINAL
TEST, ADJUST, AND BALANCE REPORT

April 19, 2021

YWCA New Facility

1800 South 3rd Street
Missoula, MT 59801

MECHANICAL ENGINEER:
Eric J. Webber
Morrison Maierle
1055 Mount Avenue
Missoula, MT 59801

MECHANICAL CONTRACTOR:
Garden City Plumbing and Heating
3955 Flynn Lane
Missoula, MT 59808

TAB CONTRACTOR:
Air Commander Test & Balance, LLC
1521 N Argonne Rd, Suite C254
Spokane Valley, WA 99212
Mike@AirCommanderUSA.com
License # AIRCOCT866BW

NEBB

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

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AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

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TEST & BALANCE LLC

YWCA New Facility

CERTIFICATION

The data presented in this report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the NEBB *Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems*. The measurements shown, and the information given, in this report are certified to be accurate and complete, at the time and date information was gathered. Any variances from design quantities, which exceed NEBB tolerances, are noted in the TAB report project summary.

SUBMITTED & CERTIFIED BY:

NEBB CERTIFIED TAB FIRM NAME Air Commander Test & Balance, LLC

CERTIFICATION NO. NEBB Certification # 3616 CERTIFICATION EXPIRATION DATE March 31, 2023

REPORT DATE April 19, 2021

Air Commander Test & Balance, LLC
NEBB
MICHEAL S. MACLAY
CERTIFICATION
3616
Exp. 3/31/23
Air and Hydronic Testing

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AIRCOMMANDER
TEST & BALANCE LLC

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Record of Instrument(s) Used on Project

YWCA New Facility - Missoula, MT

Instrument	Model #	Manufacturer	Serial #	Date(s) of Use	Calibration Date
Balometer	EBT731	TSI Alnor	EBT731741012	3/4/2021 - 4/15/2021	01/27/2021
Electrical Meter	324	Fluke	24970446	3/4/2021 - 4/15/2021	06/17/2020
Hydronic Manometer	A-490W-3	Dywer	01L6BT, 01L6BV	3/4/2021 - 4/12/2021	03/15/2021

YWCA New Facility

SUMMARY

Air Commander Test and Balance, LLC is nearing completion of the new YWCA Facility in Missoula, MT. This project consisted of one energy recovery ventilator, nine furnaces, one make-up air unit, eight fan coil units, numerous vertical terminal air conditioners, numerous exhaust fans, and a domestic hot water recirculation system. Below is a brief description of the equipment as well as the methods used for balancing.

ERV-1 is a RenewAire energy recovery ventilator which is equipped with a direct drive supply and exhaust fan. This unit serves seven supply and nine exhaust grilles throughout the second and third floors. After commanding the unit on, preliminary airflows were taken at each diffuser and grille using a flowhood. The system was then proportionally balanced to the available airflow using the remote regulated dampers. The speed of both fans was then adjusted using the factory installed potentiometers.

FN-1 through FN-9 are all York furnaces which are equipped with five speed direct drive fan motors. FN-1 and FN-5 serve single zones while all other units serve multiple zone dampers. After verifying that all volume dampers were fully open and setting deflection of all side wall diffusers, each unit was setup to operate in cooling mode so that the fans would operate on high speed. If equipped, the zone dampers were all fully opened and the associated bypass dampers fully closed. A flowhood or velocity-grid was then used to take preliminary airflows at each diffuser. The systems were then proportionally balanced to the available airflow. If above design, the speed tap was changed until the units design airflow was achieved. Each furnace was then commanded to high heat mode, or the next lowest speed. The diffusers were then remeasured and recorded in the preliminary column of the furnaces heating supply flowhood test report. Finally the furnaces were commanded to low heat mode, or the next lowest speed. The diffusers were then measured and recorded in the final column of the heating supply flowhood test report. While operating on this lowest speed, the minimum outside air (OSA) of each unit was measured by pitot-tube traverse and adjusted using the stops on the OSA damper. Once completed each furnace was commanded back to cooling mode where the OSA and other operating data were measured and recorded. If so equipped, the bypass dampers were then auto calibrated to the actual operating pressures. These controllers do not provide an actual differential pressure setpoint, so we measured the pressure differentials across each bypass damper and have recorded them on the terminal box test reports for reference. With the bypass dampers calibrated, the units serving zone dampers were then returned to low heat mode so that the minimum airflow of each zone could be set by adjusting the stops on each zone damper actuator. It should be noted that a few zones are high on their minimum airflows, as their zone dampers were fully closed or the design airflow was below the capabilities of our instrumentation.

MAU-1 is a direct driven Fantech make up air unit that serves two supply diffusers in the kitchen anytime DHEF-1 is operating. After taking preliminary airflows using a flowhood, the diffusers were proportionally balanced and the fan speed set using the potentiometer located in the units control panel.

YWCA New Facility

SUMMARY

FC-212 through FC-217 are Enviro-Tec fan coil units which are equipped with direct drive fans that serve a single side wall supply diffuser. After taking preliminary airflows using a flowhood, the fan speeds were adjusted using the factory installed potentiometer. Once completed, the minimum outside air (OSA) of each unit was determined by performing a pitot-tube traverse of the OSA duct and adjusted using the installed manual volume dampers. FC-241 is also an Enviro-Tec unit, but serves eight supply diffusers in the room where its located. After taking preliminary airflows, the diffusers were proportionally balanced before setting the fan speed as mentioned above. We were unable to determine the minimum OSA of this unit, as its OSA duct is located above a hard lid ceiling. To provide ventilation air, we elected to leave the manual volume damper fully open.

The Friedrich vertical terminal air conditioners that serve all of the sleeping rooms are equipped with a direct drive supply fan and two small direct drive ventilation fans. The supply fan is capable of operating on either high or low speed, which is changed by the user through the thermostat. Airflow was determined using a flowhood at the single side wall supply diffuser of each unit. The airflows achieved at both fan speeds have been measured and recorded on the Flowhood test reports. All other recorded data was taken with each unit operating on low speed, while achieving within ten percent of the design airflow. Due to the compact design of these units, we were unable to determine the actual OSA, however did verify that all of the ventilation fans were operational.

EF-1 and EF-2 are Loren Cook direct drive prop fans that serve the parking garage. EF-1 is setup to operate anytime the CO levels in the garage increase beyond the normal levels, while EF-2 runs continuously to provide minimal ventilation. Total airflow for both fans was determined by traversing the fans inlets using a velocity-grid. The fan speed of EF-1 was then set by limiting the maximum frequency through the variable frequency drive (VFD). EF-2 was found achieving its design airflow and required no adjustments.

EF-3 and EF-4 are Loren Cook direct drive centrifugal roof mounted exhaust fans. After taking preliminary airflows using a flowhood, the speed of each fan was adjusted using the ECM potentiometer until the design airflows were achieved.

DHEF-1 is a CaptiveAire direct drive centrifugal roof mounted exhaust fan that serves the dishwasher hood. After taking preliminary airflows using a flowhood, the fan speed was adjusted using the ECM digital speed controller. The recorded rpm and fan speed were taken directly from the speed controller digital display.

All other exhaust fans are Panasonic direct drive ceiling mounted fans that serve a single grille in the room where they are located. The fans serving the tenant restrooms are all setup to operate continuously at 70 cfm and 110 cfm anytime the timer switch is enabled by the tenant. These two airflows have been measured and recorded on the flowhood test reports for each fan. The fans serving the common space restrooms have been setup to operate at 80 cfm only and are commanded on by the rooms occupancy sensors. EF-100B is not operational as it has not been wired.

YWCA New Facility

SUMMARY

RCP-1 serves the seven domestic hot water recirculation loops throughout the building. After taking preliminary measurements, the balance valves were proportionally balanced to the available flow. It should be noted that this pump was enlarged, from the projects original equipment schedule, in order to provide enough flow to balance the system with the installed oversized balance valves. Currently all valves are achieving an average of 0.7 GPM.

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AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: ERV-01

UNIT INFORMATION	
Unit Location	Mechanical 258
Area Served	2nd / 3rd Floors
Manufacturer	RenewAire
Model Number	HE1XIN
Serial Number	E20 7176C
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Top horizontal
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Glasfloss
Quantity / Merv Rating	1 / 10
Filter Size	20x20x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	1/2 / 300-1800
Volts / Phase / Hertz	240 / 1 / 60
Full Load Amps / S.F.	4.8 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	350	---
Outlet Total Airflow (cfm)	350	375
Fan Speed (rpm)	---	DD
Motor Voltage	240	208
Corrected Full Load Amps	5.5	1.7
Brake Horsepower		(2)
External Static (inWC)	1.0	0.55
Total Static (inWC)	---	0.91
Outdoor Airflow (cfm)	350	375
Return Airflow (cfm)	---	---

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.06
Heating Coil DP (in WC)	0.29 (1)
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	-0.71
Fan Discharge Static Pressure (in WC)	0.20
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	100
Return Air Damper Position(%)	---

Notes: (1) dSP as measured across the heat recovery core.
(2) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.

TEST DATE: 03/18/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - RETURN FAN

UNIT DESIGNATION: ERV-01

UNIT INFORMATION	
Unit Location	Mechanical 258
Area Served	2nd / 3rd Floors
Manufacturer	RenewAire
Model Number	HE1XIN
Serial Number	E20 7176C
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Top horizontal
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Glasfloss
Quantity / Merv Rating	1 / 10
Filter Size	20x20x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	1/2 / 300-1800
Volts / Phase / Hertz	240 / 1 / 60
Full Load Amps / S.F.	4.8 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	540	---
Outlet Total Airflow (cfm)	540	550
Fan Speed (rpm)	---	DD
Motor Voltage	240	208
Corrected Full Load Amps	5.5	2.5
Brake Horsepower		(1)
External Static (inWC)	1.0	1.04
Total Static (inWC)	---	1.68

TEST DATA	ACTUAL
Fan Suction Static Pressure (in WC)	-1.06
Fan Discharge Static Pressure (in WC)	0.62
Heat Recovery dSP (inWC)	0.44
Filter dSP (inWC)	0.08
VFD Frequency (Hz)	---

Notes: (1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.

TEST DATE: 03/18/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	ERV-01											
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
SUPPLY											
01	Circ 200B N	CD	6x6	50	135	270%	50	100%	**50**	100%	
02	Circ 200B	CD	6x6	50	75	150%	50	100%	**50**	100%	
03	Circ 200B S	CD	6x6	50	35	70%	55	110%	**55**	110%	
04	Quiet 219	CD	6x6	50	30	60%	55	110%	**55**	110%	
05	Circ 200A E	CD	6x6	50	40	80%	55	110%	**55**	110%	
06	Circ 200A W	CD	6x6	50	25	50%	55	110%	**55**	110%	
07	Circ 300A	SD	10x6	50	60	120%	55	110%	**55**	110%	
			TOTAL	**350**	**400**	**114%**	**375**	**107%**	**375**	**107%**	
EXHAUST											
01	Meet 252	EG	6x6	60	75	125%	60	100%	**60**	100%	
02	Office 256	EG	8x8	60	80	133%	60	100%	**60**	100%	
03	Lounge 255	EG	6x6	60	100	167%	65	108%	**65**	108%	
04	Mgr 259	EG	6x6	60	0	0%	65	108%	**65**	108%	
05	Jan 257B	EG	8x8	50	80	160%	50	100%	**50**	100%	
06	Circ 200B	EG	8x8	50	40	80%	50	100%	**50**	100%	
07	Elec 225	EG	8x8	50	55	110%	50	100%	**50**	100%	
08	Circ 200A	EG	8x8	100	50	50%	100	100%	**100**	100%	
09	Circ 300A	EG	10x6	50	105	210%	50	100%	**50**	100%	
			TOTAL	**540**	**585**	**108%**	**550**	**102%**	**550**	**102%**	

TEST DATE: 03/18/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-01

UNIT INFORMATION	
Unit Location	Mechanical 127
Area Served	Living 131
Manufacturer	York
Model Number	TM9Y100C20MP11A
Serial Number	W2C0640150
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	3/4 / 1050
Volts / Phase / Hertz	115 / 1 / 60
Full Load Amps / S.F.	8.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1935	---
Outlet Total Airflow (cfm)	1930	1880
Fan Speed (rpm)	---	High
Motor Voltage	120	122
Corrected Full Load Amps	8.2	7.1
Brake Horsepower		(1)
External Static (inWC)	0.60	0.31
Total Static (inWC)	---	0.69
Outdoor Airflow (cfm)	500	590 (2)
Return Airflow (cfm)	1430	1290

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.23
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.15
Fan Suction Static Pressure (in WC)	-0.36
Fan Discharge Static Pressure (in WC)	0.33
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - high, High heat - medium/high, Low heat - medium.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-01								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	12 X 12	1.000	500	500	470	470	-0.07	Pitot-tube	
MINIMUM OSA (COOLING)	12 X 12	1.000	-	---	590	590	-0.11	Pitot-tube	

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	FN-01										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
COOLING SUPPLY											
01	Kitch 130 N	SW	14x8	290	255	88%	275	95%	**275**	95%	(1)
02	Kitch 130	SW	14x8	290	290	100%	280	97%	**280**	97%	(1)
03	Kitch 130	SW	14x8	290	360	124%	280	97%	**280**	97%	(1)
04	Kitch 130 S	SW	14x8	290	300	103%	285	98%	**285**	98%	(1)
05	Liv 131 NW	SW	14x8	195	235	121%	190	97%	**190**	97%	(1)
06	Liv 131 NE	SW	14x8	195	200	103%	195	100%	**195**	100%	(1)
07	Liv 131 SE	SW	14x8	190	140	74%	190	100%	**190**	100%	(1)
08	Liv 131 SW	SW	14x8	190	160	84%	185	97%	**185**	97%	(1)
			TOTAL	**1930**	**1940**	**101%**	**1880**	**97%**	**1880**	**97%**	

Notes: (1) Measured using a flowhood with a cardboard adapter.

HEATING SUPPLY											
01	Kitch 130 N	SW	14x8	---	245	-	-	-	**215**	-	(1)
02	Kitch 130	SW	14x8	---	250	-	-	-	**220**	-	(1)
03	Kitch 130	SW	14x8	---	250	-	-	-	**220**	-	(1)
04	Kitch 130 S	SW	14x8	---	255	-	-	-	**225**	-	(1)
05	Liv 131 NW	SW	14x8	---	170	-	-	-	**150**	-	(1)
06	Liv 131 NE	SW	14x8	---	175	-	-	-	**155**	-	(1)
07	Liv 131 SE	SW	14x8	---	170	-	-	-	**150**	-	(1)
08	Liv 131 SW	SW	14x8	---	165	-	-	-	**145**	-	(1)
			TOTAL		**1680**				**1480**		

Notes: System proportionally balanced while operating in cooling mode (high speed). This report was included to demonstrate the actual airflow at all supply diffusers with the furnace operating in high heating (preliminary column) and low heating (final column). See summary.
(1) Measured using a flowhood with a cardboard adapter.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-02

UNIT INFORMATION	
Unit Location	Mechanical 125
Area Served	Rooms 121 - 124
Manufacturer	York
Model Number	TM9Y080C16MP11A
Serial Number	W2E0819101
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	1/2 / 1050
Volts / Phase / Hertz	120 / 1 / 60
Full Load Amps / S.F.	6.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1500	---
Outlet Total Airflow (cfm)	1500	1440
Fan Speed (rpm)	---	High
Motor Voltage	120	121
Corrected Full Load Amps	6.3	5.6
Brake Horsepower		(1)
External Static (inWC)	0.50	0.34
Total Static (inWC)	---	0.65
Outdoor Airflow (cfm)	250	295 (2)
Return Airflow (cfm)	1250	1145

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.19
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.12
Fan Suction Static Pressure (in WC)	-0.33
Fan Discharge Static Pressure (in WC)	0.32
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - high, High heat - medium/high, Low heat - medium.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-02								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	8 X 8	0.444	562	250	584	260	-0.07	Pitot-tube	
MINIMUM OSA (COOLING)	8 X 8	0.444	-	---	663	295	-0.10	Pitot-tube	

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TERMINAL BOX TEST REPORT

SYSTEM:	FN-02		MAXIMUM AIRFLOW (cfm)			MINIMUM AIRFLOW (cfm)				
NO.	DDC ADDRESS / UNIT	SIZE (")	DESIGN	SETPOINT	ACTUAL	DESIGN	SETPOINT	ACTUAL	C/F	NOTES
ZONE DAMPER SUPPLY										
01	ZD-2-1	10x10	320	---	310	55	---	75	---	(1)
02	ZD-2-2	8	200	---	195	39	---	38	---	
03	ZD-2-3	8	200	---	195	38	---	40	---	
04	ZD-2-4	8	200	---	190	38	---	37	---	
05	ZD-2-5	10	300	---	275	50	---	50	---	
06	ZD-2-6	8x8	180	---	180	15	---	40	---	(1)
07	ZD-2-7	6	100	---	95	15	---	20	---	(2)
		TOTAL	1500		1440					

Notes: Measured bypass differential pressure: -0.13 / 0.25 = 0.38" w.c.
(1) Unable to decrease airflow further as the zone damper is fully closed.
(2) Unable to measure airflow below 20 cfm.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	FN-02										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
COOLING SUPPLY											
01	Navi 124 W	CD	6x6	90	105	117%	90	100%	**90**	100%	
02	Navi 124 E	CD	6x6	90	100	111%	90	100%	**90**	100%	
03	Navi 124C	CD	8x8	200	250	125%	195	98%	**195**	98%	
04	Navi 124	CD	8x8	200	210	105%	195	98%	**195**	98%	
05	Rapi 124A	CD	8x8	200	185	92%	190	95%	**190**	95%	
06	Meet 122	CD	10x10	300	230	77%	275	92%	**275**	92%	
07	Meet 132	CD	6x6	100	80	80%	95	95%	**95**	95%	
08	Meet 121 W	CD	6x6	160	170	106%	155	97%	**155**	97%	
09	Meet 121 E	CD	6x6	160	145	91%	155	97%	**155**	97%	
			TOTAL	**1500**	**1475**	**98%**	**1440**	**96%**	**1440**	**96%**	

HEATING SUPPLY											
01	Navi 124 W	CD	6x6	---	85	-	-	-	**75**	-	
02	Navi 124 E	CD	6x6	---	80	-	-	-	**70**	-	
03	Navi 124C	CD	8x8	---	175	-	-	-	**160**	-	
04	Navi 124	CD	8x8	---	175	-	-	-	**160**	-	
05	Rapi 124A	CD	8x8	---	170	-	-	-	**155**	-	
06	Meet 122	CD	10x10	---	240	-	-	-	**220**	-	
07	Meet 132	CD	6x6	---	80	-	-	-	**75**	-	
08	Meet 121 W	CD	6x6	---	135	-	-	-	**125**	-	
09	Meet 121 E	CD	6x6	---	130	-	-	-	**120**	-	
			TOTAL		**1270**				**1160**		

Notes: System proportionally balanced while operating in cooling mode (high speed). This report was included to demonstrate the actual airflow at all supply diffusers with the furnace operating in high heating (preliminary column) and low heating (final column). See summary.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-03

UNIT INFORMATION	
Unit Location	Mechanical 127
Area Served	Kitchen Area
Manufacturer	York
Model Number	TM9Y100C20MP11A
Serial Number	W2C0640149
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	3/4 / 1050
Volts / Phase / Hertz	115 / 1 / 60
Full Load Amps / S.F.	8.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1600	---
Outlet Total Airflow (cfm)	1600	1615
Fan Speed (rpm)	---	High
Motor Voltage	120	122
Corrected Full Load Amps	8.2	6.9
Brake Horsepower		(1)
External Static (inWC)	0.50	0.32
Total Static (inWC)	---	0.70
Outdoor Airflow (cfm)	510	595 (2)
Return Airflow (cfm)	1090	1020

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.24
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.14
Fan Suction Static Pressure (in WC)	-0.34
Fan Discharge Static Pressure (in WC)	0.36
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - high, High heat - medium/high, Low heat - medium.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-03								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	12 X 12	1.000	510	510	495	495	-0.06	Pitot-tube	
MINIMUM OSA (COOLING)	12 X 12	1.000	-	---	595	595	-0.08	Pitot-tube	

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TERMINAL BOX TEST REPORT

SYSTEM:	FN-03		MAXIMUM AIRFLOW (cfm)			MINIMUM AIRFLOW (cfm)				
NO.	DDC ADDRESS / UNIT	SIZE (")	DESIGN	SETPOINT	ACTUAL	DESIGN	SETPOINT	ACTUAL	C/F	NOTES
ZONE DAMPER SUPPLY										
01	ZD-3-1	12x12	750	---	765	205	---	195	---	
02	ZD-3-2	12x12	380	---	380	155	---	150	---	
03	ZD-3-3	8	120	---	120	35	---	36	---	
04	ZD-3-4	12x10	350	----	350	115	---	125	---	
		TOTAL	1600		1615					

Notes: Measured bypass differential pressure: -0.02 / 0.31 = 0.33" w.c.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	FN-03										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
COOLING SUPPLY											
01	Corr W	SW	12x10	250	295	118%	250	100%	**250**	100%	
02	Corr S	SW	10x6	100	155	155%	105	105%	**105**	105%	
03	Navi 124 S	SW	12x10	200	255	127%	210	105%	**210**	105%	
04	Navi 124 N	SW	12x10	200	260	130%	200	100%	**200**	100%	
05	Dish 128 W	CD	6x6	190	200	105%	190	100%	**190**	100%	
06	Dish 128 E	CD	6x6	190	210	111%	190	100%	**190**	100%	
07	Activ 129	CD	6x6	120	135	112%	120	100%	**120**	100%	
08	Circ 100B	SW	12x10	350	130	37%	350	100%	**350**	100%	
			TOTAL	**1600**	**1640**	**102%**	**1615**	**101%**	**1615**	**101%**	
HEATING SUPPLY											
01	Corr W	SW	12x10	220	225	102%	-	-	**200**	91%	
02	Corr E	SW	10x6	90	95	106%	-	-	**85**	94%	
03	Navi 124 S	SW	12x10	180	190	106%	-	-	**170**	94%	
04	Navi 124 N	SW	12x10	180	180	100%	-	-	**160**	89%	
05	Dish 128 W	CD	6x6	170	170	100%	-	-	**150**	88%	
06	Dish 128 E	CD	6x6	170	170	100%	-	-	**150**	88%	
07	Activ 129	CD	6x6	105	110	105%	-	-	**95**	90%	
08	Circ 100B	SW	12x10	310	315	102%	-	-	**280**	90%	
			TOTAL	**1425**	**1455**	**102%**			**1290**	**91%**	

Notes: System proportionally balanced while operating in cooling mode (high speed). This report was included to demonstrate the actual airflow at all supply diffusers with the furnace operating in high heating (preliminary column) and low heating (final column). See summary.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-04

UNIT INFORMATION	
Unit Location	Mechanical 164
Area Served	Lobby Area
Manufacturer	York
Model Number	TM9Y080C16MP11A
Serial Number	W2F0855516
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	1/2 / 1050
Volts / Phase / Hertz	120 / 1 / 60
Full Load Amps / S.F.	6.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1500	---
Outlet Total Airflow (cfm)	1510	1505
Fan Speed (rpm)	---	High
Motor Voltage	120	122
Corrected Full Load Amps	6.3	5.5
Brake Horsepower		(1)
External Static (inWC)	0.50	0.23
Total Static (inWC)	---	0.62
Outdoor Airflow (cfm)	350	405 (2)
Return Airflow (cfm)	1160	1100

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.19
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.20
Fan Suction Static Pressure (in WC)	-0.30
Fan Discharge Static Pressure (in WC)	0.32
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - high, High heat - medium/high, Low heat - medium.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TERMINAL BOX TEST REPORT

SYSTEM:	FN-04		MAXIMUM AIRFLOW (cfm)			MINIMUM AIRFLOW (cfm)				
NO.	DDC ADDRESS / UNIT	SIZE (")	DESIGN	SETPOINT	ACTUAL	DESIGN	SETPOINT	ACTUAL	C/F	NOTES
ZONE DAMPER SUPPLY										
01	ZD-4-1	8x8, 10x6	460	---	470	100	---	105	---	(1)
02	ZD-4-2	6	70	---	70	15	---	20	---	(2)
03	ZD-4-3	10	260	---	250	60	---	65	---	
04	ZD-4-4	8	180	---	175	45	---	45	---	
05	ZD-4-5	10x10	280	---	285	70	---	100	---	(3)
06	ZD-4-6	10	260	---	255	60	---	60	---	
		TOTAL	1510		1505					

Notes: Measured bypass differential pressure: -0.08 / 0.24 = 0.32" w.c.
(1) Area is served by twin zone dampers.
(2) Unable to measure airflow below 20 cfm.
(3) Unable to decrease airflow further as the zone damper is fully closed.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-04								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	10 X 10	0.694	504	350	511	355	-0.04	Pitot-tube	
MINIMUM OSA (COOLING)	10 X 10	0.694	-	---	583	405	-0.06	Pitot-tube	

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	FN-04										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
COOLING SUPPLY											
01	Health 166	CD	10x10	260	290	112%	255	98%	**255**	98%	
02	Walk 108	CD	6x6	70	115	164%	70	100%	**70**	100%	
03	Walk 109	CD	8x8	260	360	138%	250	96%	**250**	96%	
04	Lob 100A NW	SW	10x6	115	145	126%	115	100%	**115**	100%	
05	Lob 100A SW	SW	10x6	115	155	135%	120	104%	**120**	104%	
06	Mgr 104	CD	6x6	180	145	81%	175	97%	**175**	97%	
07	Youth 103 E	CD	6x6	140	135	96%	140	100%	**140**	100%	
08	Youth 103 W	CD	6x6	140	150	107%	145	104%	**145**	104%	
09	Lob 100A NE	SW	10x6	115	25	22%	120	104%	**120**	104%	
10	Lob 100A SE	SW	10x6	115	20	17%	115	100%	**115**	100%	
			TOTAL	**1510**	**1540**	**102%**	**1505**	**100%**	**1505**	**100%**	

HEATING SUPPLY											
01	Health 166	CD	10x10	---	225	-	-	-	**210**	-	
02	Walk 108	CD	6x6	---	60	-	-	-	**55**	-	
03	Walk 109	CD	8x8	---	225	-	-	-	**205**	-	
04	Lob 100A NW	SW	10x6	---	105	-	-	-	**95**	-	
05	Lob 100A SW	SW	10x6	---	110	-	-	-	**100**	-	
06	Mgr 104	CD	6x6	---	160	-	-	-	**145**	-	
07	Youth 103 E	CD	6x6	---	130	-	-	-	**120**	-	
08	Youth 103 W	CD	6x6	---	130	-	-	-	**120**	-	
09	Lob 100A NE	SW	10x6	---	110	-	-	-	**100**	-	
10	Lob 100A SE	SW	10x6	---	105	-	-	-	**95**	-	
			TOTAL		**1360**				**1245**		

Notes: System proportionally balanced while operating in cooling mode (high speed). This report was included to demonstrate the actual airflow at all supply diffusers with the furnace operating in high heating (preliminary column) and low heating (final column). See summary.

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-05

UNIT INFORMATION	
Unit Location	Mechanical 158
Area Served	Conference 106
Manufacturer	York
Model Number	TM9Y080C16MP11A
Serial Number	W1N8433666
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	1/2 / 1050
Volts / Phase / Hertz	120 / 1 / 60
Full Load Amps / S.F.	6.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1200	---
Outlet Total Airflow (cfm)	1225	1265
Fan Speed (rpm)	---	Med/High
Motor Voltage	120	122
Corrected Full Load Amps	6.3	5.2
Brake Horsepower		(1)
External Static (inWC)	0.50	0.38
Total Static (inWC)	---	0.67
Outdoor Airflow (cfm)	425	510 (2)
Return Airflow (cfm)	800	755

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.15
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.14
Fan Suction Static Pressure (in WC)	-0.33
Fan Discharge Static Pressure (in WC)	0.34
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - medium/high, High heat - medium, Low heat - medium/low.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-05								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	10 X 10	0.694	612	425	605	420	-0.10	Pitot-tube	
MINIMUM OSA (COOLING)	10 X 10	0.694	-	---	734	510	-0.16	Pitot-tube	

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	FN-05										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
COOLING SUPPLY											
01	Conf 106 NW	CD	8x8	245	200	82%	225	92%	**250**	102%	
02	Conf 106 NE	CD	8x8	245	215	88%	230	94%	**255**	104%	
03	Conf 106 SE	CD	8x8	245	200	82%	230	94%	**255**	104%	
04	Conf 106 SW	CD	8x8	245	225	92%	225	92%	**250**	102%	
05	Corridor	CD	6x6	245	210	86%	115	47%	**255**	104%	
			TOTAL	**1225**	**1050**	**86%**	**1025**	**84%**	**1265**	**103%**	
HEATING SUPPLY											
01	Conf 106 NW	CD	8x8	---	230	-	-	-	**205**	-	
02	Conf 106 NE	CD	8x8	---	230	-	-	-	**205**	-	
03	Conf 106 SE	CD	8x8	---	235	-	-	-	**210**	-	
04	Conf 106 SW	CD	8x8	---	230	-	-	-	**200**	-	
05	Corridor	CD	6x6	---	235	-	-	-	**210**	-	
			TOTAL		**1160**				**1030**		

Notes: System proportionally balanced while operating in cooling mode (high speed). This report was included to demonstrate the actual airflow at all supply diffusers with the furnace operating in high heating (preliminary column) and low heating (final column). See summary.

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-06

UNIT INFORMATION	
Unit Location	Mechanical 143
Area Served	Children 105
Manufacturer	York
Model Number	TM9Y100C20MP11A
Serial Number	W2C0640133
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	3/4 / 1050
Volts / Phase / Hertz	115 / 1 / 60
Full Load Amps / S.F.	8.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1700	---
Outlet Total Airflow (cfm)	1700	1758
Fan Speed (rpm)	---	High
Motor Voltage	120	122
Corrected Full Load Amps	8.2	7.1
Brake Horsepower		(1)
External Static (inWC)	0.50	0.33
Total Static (inWC)	---	0.80
Outdoor Airflow (cfm)	630	720 (2)
Return Airflow (cfm)	1070	1038

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.28
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.19
Fan Suction Static Pressure (in WC)	-0.48
Fan Discharge Static Pressure (in WC)	0.32
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - high, High heat - medium/high, Low heat - medium.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-06								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	12 X 12	1.000	630	630	625	625	-0.14	Pitot-tube	
MINIMUM OSA (COOLING)	12 X 12	1.000	-	---	720	720	-0.18	Pitot-tube	
SUPPLY CHILD 105	18	1.767	656	1160	656	1159	0.09	Pitot-tube	

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TERMINAL BOX TEST REPORT

SYSTEM:	FN-06		MAXIMUM AIRFLOW (cfm)			MINIMUM AIRFLOW (cfm)				
NO.	DDC ADDRESS / UNIT	SIZE (")	DESIGN	SETPOINT	ACTUAL	DESIGN	SETPOINT	ACTUAL	C/F	NOTES
ZONE DAMPER SUPPLY										
01	ZD-6-1	20x12	1160	---	1203	425	---	460	---	(1)
02	ZD-6-2	12x12	540	---	555	205	---	215	---	
		TOTAL	1700		1758					

Notes: Measured bypass differential pressure: -0.19 / 0.21 = 0.40" w.c.
(1) Unable to decrease airflow further as the zone damper is fully closed.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

VELOCITY TEST REPORT

SYSTEM:	FN-06											
NO.	AREA SERVED	TYPE	SIZE (inches)	Free Area (sq. ft.)	DESIGN		PRELIMINARY		FINAL		% of DESIGN	NOTES
					VELOCITY (fpm)	AIRFLOW (cfm)	VELOCITY (fpm)	AIRFLOW (cfm)	VELOCITY (fpm)	AIRFLOW (cfm)		
COOLING SUPPLY												
01	Child 105 NW	SW	36x12	1.52	191	290	137	208	201	306	106%	(1)
02	Child 105 NE	SW	36x12	1.52	191	290	146	222	194	295	102%	(1)
03	Child 105 SE	SW	36x12	1.52	191	290	229	348	196	298	103%	(1)
04	Child 105 SW	SW	36x12	1.52	191	290	218	331	200	304	105%	(1)
05	Break 141 W	SW	12x10	1.00	270	270	200	200	280	280	104%	(2)
06	Break 141 E	SW	12x10	1.00	270	270	235	235	275	275	102%	(2)
				TOTAL		**1700**		**1544**		**1758**	**103%**	

Notes: (1) Measured using a velocity-grid. Free area determined by pitot-tube traverse.
(2) Measured using a flowhood.

HEATING SUPPLY												
01	Child 105 NW	SW	36x12	1.52	-	---	170	258	155	236	-	(1)
02	Child 105 NE	SW	36x12	1.52	-	---	162	246	147	223	-	(1)
03	Child 105 SE	SW	36x12	1.52	-	---	166	252	152	231	-	(1)
04	Child 105 SW	SW	36x12	1.52	-	---	170	258	155	236	-	(1)
05	Break 141 W	SW	12x10	1.00	-	---	255	255	225	225	-	(2)
06	Break 141 E	SW	12x10	1.00	-	---	220	220	200	200	-	(2)
				TOTAL				**1489**		**1351**		

Notes: System proportionally balanced while operating in cooling mode (high speed). This report was included to demonstrate the actual airflow at all supply diffusers with the furnace operating in high heating (preliminary column) and low heating (final column). See summary.
(1) Measured using a velocity-grid. Free area determined by pitot-tube traverse.
(2) Measured using a flowhood.

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-07

UNIT INFORMATION	
Unit Location	Mechanical 164
Area Served	SW Offices
Manufacturer	York
Model Number	TM9Y100C20MP11A
Serial Number	W2F0899015
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	3/4 / 1050
Volts / Phase / Hertz	115 / 1 / 60
Full Load Amps / S.F.	8.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1920	---
Outlet Total Airflow (cfm)	1930	1875
Fan Speed (rpm)	---	High
Motor Voltage	120	121
Corrected Full Load Amps	8.3	7.6
Brake Horsepower		(1)
External Static (inWC)	0.50	0.19
Total Static (inWC)	---	0.72
Outdoor Airflow (cfm)	300	330 (2)
Return Airflow (cfm)	1630	1545

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.27
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.26
Fan Suction Static Pressure (in WC)	-0.34
Fan Discharge Static Pressure (in WC)	0.38
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - high, High heat - medium/high, Low heat - medium.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-07								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	10 X 10	0.694	432	300	425	295	-0.05	Pitot-tube	
MINIMUM OSA (COOLING)	10 X 10	0.694	-	---	475	330	-0.07	Pitot-tube	

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TERMINAL BOX TEST REPORT

SYSTEM:	FN-07		MAXIMUM AIRFLOW (cfm)			MINIMUM AIRFLOW (cfm)				
NO.	DDC ADDRESS / UNIT	SIZE (")	DESIGN	SETPOINT	ACTUAL	DESIGN	SETPOINT	ACTUAL	C/F	NOTES
ZONE DAMPER SUPPLY										
01	ZD-7-1	10	250	---	250	40	---	43	---	
02	ZD-7-2	10	220	---	215	35	---	37	---	
03	ZD-7-3	10	220	---	215	35	---	35	---	
04	ZD-7-4	10	220	---	220	33	---	35	---	
05	ZD-7-5	10	220	---	215	35	---	35	---	
06	ZD-7-6	10	220	---	210	35	---	36	---	
07	ZD-7-7	10	250	---	240	40	---	42	---	
08	ZD-7-8	8	170	---	160	25	---	27	---	
09	ZD-7-9	8	160	---	150	22	---	21	---	
		TOTAL	1930		1875					

Notes: Measured bypass differential pressure: -0.06 / 0.10 = 0.16" w.c.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	FN-07										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
COOLING SUPPLY											
01	Guts 165	CD	8x8	220	320	145%	215	98%	**215**	98%	
02	Mgr 163	CD	8x8	220	270	123%	215	98%	**215**	98%	
03	Direct 162	CD	8x8	250	270	108%	250	100%	**250**	100%	
04	Direct 160	CD	8x8	220	205	93%	220	100%	**220**	100%	
05	Comm 157	CD	8x8	220	200	91%	215	98%	**215**	98%	
06	Direct 156	CD	8x8	220	215	98%	210	95%	**210**	95%	
07	Bull 155	CD	8x8	250	200	80%	240	96%	**240**	96%	
08	Grant 154	CD	6x6	170	135	79%	160	94%	**160**	94%	
09	Well 152	CD	6x6	160	120	75%	150	94%	**150**	94%	
			TOTAL	**1930**	**1935**	**100%**	**1875**	**97%**	**1875**	**97%**	

HEATING SUPPLY											
01	Guts 165	CD	8x8	---	190	-	-	-	**170**	-	
02	Mgr 163	CD	8x8	---	190	-	-	-	**170**	-	
03	Direct 162	CD	8x8	---	220	-	-	-	**200**	-	
04	Direct 160	CD	8x8	---	185	-	-	-	**165**	-	
05	Comm 157	CD	8x8	---	185	-	-	-	**160**	-	
06	Direct 156	CD	8x8	---	185	-	-	-	**165**	-	
07	Bull 155	CD	8x8	---	205	-	-	-	**185**	-	
08	Grant 154	CD	6x6	---	135	-	-	-	**120**	-	
09	Well 152	CD	6x6	---	130	-	-	-	**115**	-	
			TOTAL		**1625**				**1450**		

Notes: System proportionally balanced while operating in cooling mode (high speed). This report was included to demonstrate the actual airflow at all supply diffusers with the furnace operating in high heating (preliminary column) and low heating (final column). See summary.

TEST DATE: 04/01/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-08

UNIT INFORMATION	
Unit Location	Mechanical 143
Area Served	Living 172
Manufacturer	York
Model Number	TM9Y100C20MP11A
Serial Number	W2C0640130
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	3/4 / 1050
Volts / Phase / Hertz	115 / 1 / 60
Full Load Amps / S.F.	8.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1920	---
Outlet Total Airflow (cfm)	1930	1815
Fan Speed (rpm)	---	High
Motor Voltage	120	122
Corrected Full Load Amps	8.2	7.1
Brake Horsepower		(1)
External Static (inWC)	0.50	0.38
Total Static (inWC)	---	0.86
Outdoor Airflow (cfm)	410	435 (2)
Return Airflow (cfm)	1520	1380

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.24
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.20
Fan Suction Static Pressure (in WC)	-0.42
Fan Discharge Static Pressure (in WC)	0.44
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - high, High heat - medium/high, Low heat - medium.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-08								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	10 X 10	0.694	590	410	540	375	-0.14	Pitot-tube	
MINIMUM OSA (COOLING)	10 X 10	0.694	-	---	626	435	-0.18	Pitot-tube	

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TERMINAL BOX TEST REPORT

SYSTEM:	FN-08		MAXIMUM AIRFLOW (cfm)			MINIMUM AIRFLOW (cfm)				
NO.	DDC ADDRESS / UNIT	SIZE (")	DESIGN	SETPOINT	ACTUAL	DESIGN	SETPOINT	ACTUAL	C/F	NOTES
ZONE DAMPER SUPPLY										
01	ZD-8-1	14x12	960	---	880	210	---	220	---	
02	ZD-8-2	10	230	---	220	46	---	45	---	
03	ZD-8-3	10	230	---	225	46	---	50	---	
04	ZD-8-4	10	350	---	335	73	---	75	---	
05	ZD-8-5	8	160	---	155	35	---	38	---	
		TOTAL	1930		1815					

Notes: Measured bypass differential pressure: -0.17 / 0.38 = 0.55" w.c.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	FN-08										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
COOLING SUPPLY											
01	Conf 142	CD	10x10	350	275	79%	300	86%	**335**	96%	
02	Mgr 144	CD	8x8	230	335	146%	200	87%	**220**	96%	
03	Intern 145	CD	8x8	230	315	137%	205	89%	**225**	98%	
04	Liv 172 SW	SW	14x8	240	110	46%	200	83%	**225**	94%	
05	Liv 172 NW	SW	14x8	240	190	79%	200	83%	**220**	92%	
06	Liv 172 NE	SW	14x8	240	185	77%	195	81%	**215**	90%	
07	Liv 172 SE	SW	14x8	240	100	42%	200	83%	**220**	92%	
08	Meet 173	CD	6x6	160	185	116%	140	88%	**155**	97%	
			TOTAL	**1930**	**1695**	**88%**	**1640**	**85%**	**1815**	**94%**	

HEATING SUPPLY											
01	Conf 142	CD	10x10	---	300	-	-	-	**270**	-	
02	Mgr 144	CD	8x8	---	195	-	-	-	**175**	-	
03	Intern 145	CD	8x8	---	200	-	-	-	**180**	-	
04	Liv 172 SW	SW	14x8	---	200	-	-	-	**180**	-	
05	Liv 172 NW	SW	14x8	---	195	-	-	-	**175**	-	
06	Liv 172 NE	SW	14x8	---	190	-	-	-	**170**	-	
07	Liv 172 SE	SW	14x8	---	195	-	-	-	**175**	-	
08	Meet 173	CD	6x6	---	140	-	-	-	**125**	-	
			TOTAL		**1615**				**1450**		

Notes: System proportionally balanced while operating in cooling mode (high speed). This report was included to demonstrate the actual airflow at all supply diffusers with the furnace operating in high heating (preliminary column) and low heating (final column). See summary.

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: FN-09

UNIT INFORMATION	
Unit Location	Mechanical 147
Area Served	Kitchen 178
Manufacturer	York
Model Number	TM9Y100C20MP11A
Serial Number	W2F0899032
Fan Type / Size	Centrifugal / Not labeled
Rotation / Configuration	CCW / Upblast
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Columbia
Quantity / Merv Rating	1 / 8
Filter Size	20x25x2

MOTOR INFORMATION	
Manufacturer / Frame	Genteq / Not labeled
Horsepower / RPM	3/4 / 1050
Volts / Phase / Hertz	115 / 1 / 60
Full Load Amps / S.F.	8.4 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Electronically protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	1920	---
Outlet Total Airflow (cfm)	1920	1815
Fan Speed (rpm)	---	High
Motor Voltage	120	121
Corrected Full Load Amps	8.2	7.0
Brake Horsepower		(1)
External Static (inWC)	0.50	0.34
Total Static (inWC)	---	0.85
Outdoor Airflow (cfm)	260	335 (2)
Return Airflow (cfm)	1660	

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.29
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	0.22
Fan Suction Static Pressure (in WC)	-0.38
Fan Discharge Static Pressure (in WC)	0.47
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: Fan speeds: Cooling - high, High heat - medium/high, Low heat - medium.
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(2) Minimum OSA balanced with unit operating in low heat mode. See summary.

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	FN-09								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
MINIMUM OSA (LOW HEAT)	10 X 10	0.694	374	260	389	270	-0.03	Pitot-tube	
MINIMUM OSA (COOLING)	10 X 10	0.694	-	---	482	335	-0.04	Pitot-tube	

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

TERMINAL BOX TEST REPORT

SYSTEM:	FN-09		MAXIMUM AIRFLOW (cfm)			MINIMUM AIRFLOW (cfm)				
NO.	DDC ADDRESS / UNIT	SIZE (")	DESIGN	SETPOINT	ACTUAL	DESIGN	SETPOINT	ACTUAL	C/F	NOTES
ZONE DAMPER SUPPLY										
01	ZD-9-1	14	1120	---	1055	205	---	240	---	(1,2)
02	ZD-9-2	14	620	---	580	35	---	38	---	(3)
03	ZD-9-3	6	50	---	50	10	---	20	---	(4)
04	ZD-9-4	10x6	130	---	130	10	---	40	---	(5)
		TOTAL	1920		1815					

Notes: Measured bypass differential pressure: 0.38 / -0.08 = 0.46" w.c.
(1) Unable to decrease airflow further without creating noise issues.
(2) Area is served by twin zone dampers.
(3) Airflow calculated using fan law two.
(4) Unable to measure below 20 cfm.
(5) Unable to decrease airflow further as the zone damper is fully closed.

TEST DATE: 04/02/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	FN-09										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
COOLING SUPPLY											
01	Circ 100D NW	SW	14x8	155	240	155%	150	97%	**150**	97%	(1)
02	Circ 100D NE	SW	14x8	155	235	152%	140	90%	**140**	90%	(1)
03	Circ 100D SE	SW	14x8	155	165	106%	140	90%	**140**	90%	(1)
04	Circ 100D SW	SW	14x8	155	160	103%	150	97%	**150**	97%	(1)
05	Kitch 176 SW	SW	12x10	280	285	102%	255	91%	**255**	91%	
06	Kitch 176 SE	SW	12x10	280	100	36%	270	96%	**270**	96%	
07	Kitch 176 NE	SW	12x10	280	140	50%	260	93%	**260**	93%	
08	Kitch 176 NW	SW	12x10	280	235	84%	270	96%	**270**	96%	
09	Office 176	CD	6x6	50	115	230%	50	100%	**50**	100%	
10	Corridor	SW	10x6	130	235	181%	130	100%	**130**	100%	
			TOTAL	**1920**	**1910**	**99%**	**1815**	**95%**	**1815**	**95%**	

Notes: (1) Measured using a flowhood with a cardboard adapter.

HEATING SUPPLY											
01	Circ 100D NW	SW	14x8	---	130	-	-	-	**115**	-	(1)
02	Circ 100D NE	SW	14x8	---	125	-	-	-	**105**	-	(1)
03	Circ 100D SE	SW	14x8	---	125	-	-	-	**105**	-	(1)
04	Circ 100D SW	SW	14x8	---	130	-	-	-	**115**	-	(1)
05	Kitch 176 SW	SW	12x10	---	225	-	-	-	**190**	-	
06	Kitch 176 SE	SW	12x10	---	240	-	-	-	**200**	-	
07	Kitch 176 NE	SW	12x10	---	230	-	-	-	**195**	-	
08	Kitch 176 NW	SW	12x10	---	235	-	-	-	**200**	-	
09	Office 176	CD	6x6	---	45	-	-	-	**40**	-	
10	Corridor	SW	10x6	---	105	-	-	-	**90**	-	
			TOTAL		**1590**				**1355**		

Notes: System proportionally balanced while operating in cooling mode (high speed). This report included to demonstrate the actual airflow at all supply diffusers with the furnace operating in heating mode (low speed). See summary.
(1) Measured using a flowhood with a cardboard adapter.

TEST DATE: 03/31/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: MAU-01

UNIT INFORMATION	
Unit Location	Mechanical 125
Area Served	Kitchen
Manufacturer	Fantech
Model Number	FKD14XL EC
Serial Number	1004763724
Fan Type / Size	Axial / Not labeled
Rotation / Configuration	CCW / Drawthrough
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Glasfloss
Quantity / Merv Rating	1 / HV
Filter Size	20x30x2

MOTOR INFORMATION	
Manufacturer / Frame	Ziehl-Abegg / Not labeled
Horsepower / RPM	436 watt / 1470
Volts / Phase / Hertz	120 / 1 / 60
Full Load Amps / S.F.	2.43 / Not labeled
Power Factor / Efficiency	Not labeled / Not labeled
Overload Setting	Thermally protected
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	600	---
Outlet Total Airflow (cfm)	600	620
Fan Speed (rpm)	---	DD
Motor Voltage	120	121
Corrected Full Load Amps	2.4	0.8
Brake Horsepower		(1)
External Static (inWC)	0.50	0.27
Total Static (inWC)	---	0.35
Outdoor Airflow (cfm)	600	620
Return Airflow (cfm)	---	---

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.08
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	-0.23
Fan Discharge Static Pressure (in WC)	0.12
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	100
Return Air Damper Position(%)	---

Notes: (1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.

TEST DATE: 04/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	SUPPLY										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
MAU-01											
01	Dish 128 N	CD	8x8	300	500	167%	320	107%	**320**	107%	
02	Dish 128 S	CD	8x8	300	475	158%	300	100%	**300**	100%	
			TOTAL	**600**	**975**	**162%**	**620**	**103%**	**620**	**103%**	

TEST DATE: 04/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	MINIMUM OSA								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
FC-212	4	0.087	458	40	462	40	-0.03	Pitot-tube	
FC-213	4	0.087	458	40	504	44	-0.04	Pitot-tube	
FC-214	4	0.087	458	40	489	43	-0.03	Pitot-tube	
FC-215	4	0.087	458	40	502	44	-0.04	Pitot-tube	
FC-216	4	0.087	458	40	485	42	-0.03	Pitot-tube	
FC-217	4	0.087	458	40	467	41	-0.03	Pitot-tube	

TEST DATE: 03/23/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: VT-223A

UNIT INFORMATION	
Unit Location	Room 223
Area Served	same
Manufacturer	Friedrich
Model Number	VRP12K50DSAL-C
Serial Number	2008M09064
Fan Type / Size	Inaccessible / 1 ton
Rotation / Configuration	Inaccessible / Inaccessible
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Not labeled
Quantity / Merv Rating	1, 2 / 8
Filter Size	14x24x1, 6x6x1

MOTOR INFORMATION	
Manufacturer / Frame	(1) / (1)
Horsepower / RPM	(1) / (1)
Volts / Phase / Hertz	208 / 1 / 60
Full Load Amps / S.F.	0.38 / (1)
Power Factor / Efficiency	(1) / (1)
Overload Setting	(1)
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	400	---
Outlet Total Airflow (cfm)	400	380
Fan Speed (rpm)	---	Low
Motor Voltage	208	209
Corrected Full Load Amps	0.38	0.30
Brake Horsepower		(3)
External Static (inWC)	0.10	0.06
Total Static (inWC)	---	(2)
Outdoor Airflow (cfm)	60	(4)
Return Airflow (cfm)	340	(4)

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.01
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	(2)
Fan Discharge Static Pressure (in WC)	(2)
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: (1) Inaccessible. Embedded fan and motor.
(2) Packaged unit. Static pressures are inaccessible.
(3) Power factor and efficiency ratings are inaccessible, unable to calculate.
(4) No acceptable location available for a direct airflow measurement. See summary.

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: VT-223B

UNIT INFORMATION	
Unit Location	Room 223
Area Served	same
Manufacturer	Friedrich
Model Number	VRP12K50DSAL-C
Serial Number	2008M09058
Fan Type / Size	Inaccessible / 1 ton
Rotation / Configuration	Inaccessible / Inaccessible
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Not labeled
Quantity / Merv Rating	1, 2 / 8
Filter Size	14x24x1, 6x6x1

MOTOR INFORMATION	
Manufacturer / Frame	(1) / (1)
Horsepower / RPM	(1) / (1)
Volts / Phase / Hertz	208 / 1 / 60
Full Load Amps / S.F.	0.38 / (1)
Power Factor / Efficiency	(1) / (1)
Overload Setting	(1)
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	400	---
Outlet Total Airflow (cfm)	400	385
Fan Speed (rpm)	---	Low
Motor Voltage	208	209
Corrected Full Load Amps	0.38	0.30
Brake Horsepower		(3)
External Static (inWC)	0.10	0.06
Total Static (inWC)	---	(2)
Outdoor Airflow (cfm)	60	(4)
Return Airflow (cfm)	340	(4)

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.01
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	(2)
Fan Discharge Static Pressure (in WC)	(2)
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: (1) Inaccessible. Embedded fan and motor.
(2) Packaged unit. Static pressures are inaccessible.
(3) Power factor and efficiency ratings are inaccessible, unable to calculate.
(4) No acceptable location available for a direct airflow measurement. See summary.

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: VT-252

UNIT INFORMATION	
Unit Location	Room 252
Area Served	same
Manufacturer	Friedrich
Model Number	VRP12K50DSAL-C
Serial Number	2008M09073
Fan Type / Size	Inaccessible / 1 ton
Rotation / Configuration	Inaccessible / Inaccessible
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Not labeled
Quantity / Merv Rating	1, 2 / 8
Filter Size	14x24x1, 6x6x1

MOTOR INFORMATION	
Manufacturer / Frame	(1) / (1)
Horsepower / RPM	(1) / (1)
Volts / Phase / Hertz	208 / 1 / 60
Full Load Amps / S.F.	0.38 / (1)
Power Factor / Efficiency	(1) / (1)
Overload Setting	(1)
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	400	---
Outlet Total Airflow (cfm)	400	380
Fan Speed (rpm)	---	Low
Motor Voltage	208	209
Corrected Full Load Amps	0.38	0.31
Brake Horsepower		(3)
External Static (inWC)	0.10	0.06
Total Static (inWC)	---	(2)
Outdoor Airflow (cfm)	60	(4)
Return Airflow (cfm)	340	(4)

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.01
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	(2)
Fan Discharge Static Pressure (in WC)	(2)
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: (1) Inaccessible. Embedded fan and motor.
(2) Packaged unit. Static pressures are inaccessible.
(3) Power factor and efficiency ratings are inaccessible, unable to calculate.
(4) No acceptable location available for a direct airflow measurement. See summary.

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: VT-255

UNIT INFORMATION	
Unit Location	Lounge 255
Area Served	same
Manufacturer	Friedrich
Model Number	VRP12K50DSAL-C
Serial Number	2008M09041
Fan Type / Size	Inaccessible / 1 ton
Rotation / Configuration	Inaccessible / Inaccessible
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Not labeled
Quantity / Merv Rating	1, 2 / 8
Filter Size	14x24x1, 6x6x1

MOTOR INFORMATION	
Manufacturer / Frame	(1) / (1)
Horsepower / RPM	(1) / (1)
Volts / Phase / Hertz	208 / 1 / 60
Full Load Amps / S.F.	0.38 / (1)
Power Factor / Efficiency	(1) / (1)
Overload Setting	(1)
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	400	---
Outlet Total Airflow (cfm)	400	415
Fan Speed (rpm)	---	Low
Motor Voltage	208	209
Corrected Full Load Amps	0.38	0.33
Brake Horsepower		(3)
External Static (inWC)	0.10	0.08
Total Static (inWC)	---	(2)
Outdoor Airflow (cfm)	60	(4)
Return Airflow (cfm)	340	(4)

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.01
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	(2)
Fan Discharge Static Pressure (in WC)	(2)
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: (1) Inaccessible. Embedded fan and motor.
(2) Packaged unit. Static pressures are inaccessible.
(3) Power factor and efficiency ratings are inaccessible, unable to calculate.
(4) No acceptable location available for a direct airflow measurement. See summary.

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: VT-256

UNIT INFORMATION	
Unit Location	Room 256
Area Served	same
Manufacturer	Friedrich
Model Number	VRP12K50DSAL-C
Serial Number	2008M09043
Fan Type / Size	Inaccessible / 1 ton
Rotation / Configuration	Inaccessible / Inaccessible
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Not labeled
Quantity / Merv Rating	1, 2 / 8
Filter Size	14x24x1, 6x6x1

MOTOR INFORMATION	
Manufacturer / Frame	(1) / (1)
Horsepower / RPM	(1) / (1)
Volts / Phase / Hertz	208 / 1 / 60
Full Load Amps / S.F.	0.38 / (1)
Power Factor / Efficiency	(1) / (1)
Overload Setting	(1)
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	400	---
Outlet Total Airflow (cfm)	400	415
Fan Speed (rpm)	---	Low
Motor Voltage	208	209
Corrected Full Load Amps	0.38	0.33
Brake Horsepower		(3)
External Static (inWC)	0.10	0.08
Total Static (inWC)	---	(2)
Outdoor Airflow (cfm)	60	(4)
Return Airflow (cfm)	340	(4)

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.01
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	(2)
Fan Discharge Static Pressure (in WC)	(2)
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: (1) Inaccessible. Embedded fan and motor.
(2) Packaged unit. Static pressures are inaccessible.
(3) Power factor and efficiency ratings are inaccessible, unable to calculate.
(4) No acceptable location available for a direct airflow measurement. See summary.

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: VT-259

UNIT INFORMATION	
Unit Location	Room 259
Area Served	same
Manufacturer	Friedrich
Model Number	VRP12K50DSAL-C
Serial Number	2008M09061
Fan Type / Size	Inaccessible / 1 ton
Rotation / Configuration	Inaccessible / Inaccessible
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Not labeled
Quantity / Merv Rating	1, 2 / 8
Filter Size	14x24x1, 6x6x1

MOTOR INFORMATION	
Manufacturer / Frame	(1) / (1)
Horsepower / RPM	(1) / (1)
Volts / Phase / Hertz	208 / 1 / 60
Full Load Amps / S.F.	0.38 / (1)
Power Factor / Efficiency	(1) / (1)
Overload Setting	(1)
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	400	---
Outlet Total Airflow (cfm)	400	385
Fan Speed (rpm)	---	Low
Motor Voltage	208	209
Corrected Full Load Amps	0.38	0.31
Brake Horsepower		(3)
External Static (inWC)	0.10	0.06
Total Static (inWC)	---	(2)
Outdoor Airflow (cfm)	60	(4)
Return Airflow (cfm)	340	(4)

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.01
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	(2)
Fan Discharge Static Pressure (in WC)	(2)
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes: (1) Inaccessible. Embedded fan and motor.
(2) Packaged unit. Static pressures are inaccessible.
(3) Power factor and efficiency ratings are inaccessible, unable to calculate.
(4) No acceptable location available for a direct airflow measurement. See summary.

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

AIR HANDLER TEST REPORT - SUPPLY FAN

UNIT DESIGNATION: VT-305

UNIT INFORMATION	
Unit Location	Lounge 305
Area Served	same
Manufacturer	Friedrich
Model Number	VRP12K50DSAL-C
Serial Number	2008M09076
Fan Type / Size	Inaccessible / 1 ton
Rotation / Configuration	Inaccessible / Inaccessible
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Filter Manufacturer	Not labeled
Quantity / Merv Rating	1, 2 / 8
Filter Size	14x24x1, 6x6x1

MOTOR INFORMATION	
Manufacturer / Frame	(1) / (1)
Horsepower / RPM	(1) / (1)
Volts / Phase / Hertz	208 / 1 / 60
Full Load Amps / S.F.	0.38 / (1)
Power Factor / Efficiency	(1) / (1)
Overload Setting	(1)
Sheave Manufacturer	DD
Sheave Diameter / Bore (")	DD / DD
Sheave Position	DD
Centerline Distance (")	DD
Belt Manufacturer	DD
Number of Belts / Size	DD / DD

TEST DATA	DESIGN	ACTUAL
Fan Total Airflow (cfm)	400	---
Outlet Total Airflow (cfm)	400	390
Fan Speed (rpm)	---	Low
Motor Voltage	208	209
Corrected Full Load Amps	0.38	0.31
Brake Horsepower		(3)
External Static (inWC)	0.10	0.06
Total Static (inWC)	---	(2)
Outdoor Airflow (cfm)	60	(4)
Return Airflow (cfm)	340	(4)

TEST DATA	ACTUAL
Pre Filter DP (in WC)	0.01
Heating Coil DP (in WC)	---
Cooling Coil DP (in WC)	---
Fan Suction Static Pressure (in WC)	(2)
Fan Discharge Static Pressure (in WC)	(2)
Final Filter DP (in WC)	---
Duct static Pressure Set Point (in WC)	---
VFD Frequency (Hz)	---
Outdoor Air Damper Position(%)	Fixed
Return Air Damper Position(%)	---

Notes:
(1) Inaccessible. Embedded fan and motor.
(2) Packaged unit. Static pressures are inaccessible.
(3) Power factor and efficiency ratings are inaccessible, unable to calculate.
(4) No acceptable location available for a direct airflow measurement. See summary.

TEST DATE: 03/04/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	SUPPLY										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
VT-201											
01	Room 201	SW	12x10	400	610	152%		-	**405**	101%	
VT-202											
01	Room 202	SW	12x10	400	550	138%		-	**370**	92%	
VT-203											
01	Room 203	SW	12x10	400	580	145%		-	**385**	96%	
VT-204											
01	Room 204	SW	12x10	400	625	156%		-	**420**	105%	
VT-205											
01	Room 205	SW	12x10	400	610	152%		-	**410**	102%	
VT-206											
01	Room 206	SW	12x10	400	595	149%		-	**410**	102%	
VT-207											
01	Room 207	SW	12x10	400	575	144%		-	**385**	96%	
VT-208											
01	Room 208	SW	12x10	400	580	145%		-	**390**	98%	
VT-209											
01	Room 209	SW	12x10	400	570	142%		-	**390**	98%	
VT-210											
01	Room 210	SW	12x10	400	615	154%		-	**420**	105%	

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	SUPPLY										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
VT-211											
01	Room 211	SW	12x10	400	550	138%		-	**375**	94%	
VT-218											
01	Room 218	SW	12x10	400	565	141%		-	**385**	96%	
VT-220											
01	Room 220	SW	12x10	400	550	138%		-	**375**	94%	
VT-222											
01	Room 222	SW	12x10	400	600	150%		-	**415**	104%	
VT-223A											
01	Room 223A	SW	12x10	400	565	141%		-	**380**	95%	
VT-223B											
01	Room 223B	SW	12x10	400	570	142%		-	**385**	96%	
VT-224											
01	Room 224	SW	12x10	400	575	144%		-	**390**	98%	
VT-226											
01	Room 226	SW	12x10	400	610	152%		-	**415**	104%	
VT-228											
01	Room 228	SW	12x10	400	620	155%		-	**415**	104%	
VT-230											
01	Room 230	SW	12x10	400	580	145%		-	**390**	98%	

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	SUPPLY										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
VT-232											
01	Room 232	SW	12x10	400	590	148%		-	**410**	102%	
VT-250											
01	Room 250	SW	12x10	400	550	138%		-	**380**	95%	
VT-251											
01	Room 251	SW	12x10	400	600	150%		-	**410**	102%	
VT-252											
01	Room 252	SW	12x10	400	550	138%		-	**380**	95%	
VT-253											
01	Room 253	SW	12x10	400	595	149%		-	**410**	102%	
VT-255											
01	Lounge 255	SW	12x10	400	605	151%		-	**415**	104%	
VT-256											
01	Room 256	SW	12x10	400	605	151%		-	**415**	104%	
VT-259											
01	Room 259	SW	12x10	400	570	142%		-	**385**	96%	
VT-301											
01	Room 301	SW	12x10	400	585	146%		-	**400**	100%	
VT-302											
01	Room 302	SW	12x10	400	615	154%		-	**410**	102%	

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	SUPPLY										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
VT-303											
01	Room 303	SW	12x10	400	575	144%		-	**385**	96%	
VT-304											
01	Room 304	SW	12x10	400	610	152%		-	**410**	102%	
VT-305											
01	Lounge 305	SW	12x10	400	580	145%		-	**390**	98%	
VT-306											
01	Room 306	SW	12x10	400	590	148%		-	**405**	101%	
VT-308											
01	Room 308	SW	12x10	400	585	146%		-	**400**	100%	
VT-309											
01	Room 309	SW	12x10	400	610	152%		-	**415**	104%	
VT-310											
01	Room 310	SW	12x10	400	580	145%		-	**390**	98%	
VT-312											
01	Room 312	SW	12x10	400	580	145%		-	**400**	100%	
VT-314											
01	Room 314	SW	12x10	400	575	144%		-	**385**	96%	

TEST DATE: 03/08/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FAN TEST REPORT

UNIT INFORMATION	UNIT: EF-01		UNIT: EF-02		UNIT: EF-03	
Location / Service	Garage / same		Garage / same		Roof / Rooms 223, 241	
Manufacturer	Loren Cook		Loren Cook		Loren Cook	
Model Number	30A11DC		12A17D		90C17DEC	
Serial Number	372SI75274-01/0000701		372SI75274-01/0002401		372SI75274-00/0000701	
Type / Size	Prop / 30.0"		Prop / 12.0"		Centrifugal / Not labeled	
Motor Manufacturer	Weg		Marathon		McMillan	
Horsepower / RPM / Frame	2 / 1165 / 182/4T		1/4 / 1725 / 48Z		1/6 / 350-1725 / Not labeled	
Volts / Phase / Hertz	230 / 3 / 60		208 / 1 / 60		120 / 1 / 60	
Full Load Amps / S.F.	5.9 / 1.15		2.8 / 1.35		2.36 / Not labeled	
Power Factor / Efficiency	0.73 / 87.5		Not labeled / Not labeled		Not labeled / Not labeled	
Overload Setting	6.79 (VFD)		Not labeled		Not labeled	
Motor Sheave Manufacturer	DD		DD		DD	
Diameter / Bore (")	DD / DD		DD / DD		DD / DD	
Fan Sheave Manufacturer	DD		DD		DD	
Diameter / Bore (")	DD / DD		DD / DD		DD / DD	
Belt Manufacturer	DD		DD		DD	
Number of Belts / Size	DD / DD		DD / DD		DD / DD	
Centerline Distance (")	DD		DD		DD	
Sheave Position	DD		DD		DD	
TEST DATA	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
Fan Total Airflow (cfm)	**8100**	**8370**	**540**	**560**	**400**	**---**
Outlet Total Airflow (cfm)	**---**	**---**	**---**	**---**	**400**	**395**
Fan Speed (rpm)	DD	738 (1)	1725	DD	---	DD
Motor Voltage	**230**	172 / Thru / VFD	**208**	210	**120**	122
Corrected Full Load Amps	**5.9**	5.0 / Thru / VFD	**2.7**	2.3	**2.3**	1.7
Brake Horsepower		1.27		(1)		(1)
Pressure In/Out	---	Atm. / Atm.	---	Atm. / Atm.	---	-0.28 / Atm.
External Static (InWC)	0.25	---	0.25	---	0.25	0.28

Notes: **EF-01:** (1) Fan limited to 38.0 hertz.
EF-02: EF-03:
(1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.

TEST DATE: 04/15/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FAN TEST REPORT

UNIT INFORMATION	UNIT: EF-08		UNIT: DHEF-01		UNIT:	
Location / Service	Roof / Lounge 305		Roof / Kitchen Hood		/	
Manufacturer	Loren Cook		CaptiveAire			
Model Number	70C17DEC		DU33HFA			
Serial Number	372SI75274-00/0003201		Job #3706697			
Type / Size	Centrifugal / Not labeled		Centrifugal / Not labeled		/	
Motor Manufacturer	Inaccessible		Telco			
Horsepower / RPM / Frame	57 watt / 1800 / Not labeled		1/3 / 1800 / Not labeled		/ /	
Volts / Phase / Hertz	115 / 1 / 60		115 / 1 / 60		/ /	
Full Load Amps / S.F.	1.1 / Not labeled		4.3 / Not labeled		/	
Power Factor / Efficiency	Not labeled / Not labeled		Not labeled / Not labeled		/	
Overload Setting	Not labeled		Electronically protected			
Motor Sheave Manufacturer	DD		DD			
Diameter / Bore (")	DD / DD		DD / DD		/	
Fan Sheave Manufacturer	DD		DD			
Diameter / Bore (")	DD / DD		DD / DD		/	
Belt Manufacturer	DD		DD			
Number of Belts / Size	DD / DD		DD / DD		/	
Centerline Distance (")	DD		DD			
Sheave Position	DD		DD			
TEST DATA	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
Fan Total Airflow (cfm)	**60**	**---**	**600**	**---**		
Outlet Total Airflow (cfm)	**60**	**65**	**600**	**640**		
Fan Speed (rpm)	1359	DD	---	1059 (1)		
Motor Voltage	**115**	122	**115**	121		
Corrected Full Load Amps	**1.0**	0.2	**4.1**	1.0		
Brake Horsepower		(1)		(2)		
Pressure In/Out	---	-0.01 / Atm.	---	(3) / Atm.	---	/
External Static (InWC)	0.25	0.01	0.50	(3)		

Notes: **EF-08:** (1) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
DHEF-01: (1) Recorded rpm taken from digital ECM speed controller. Fan operating at 57%.
(2) Power factor and efficiency ratings are not listed on the motors nameplate, unable to calculate.
(3) Drilling into kitchen grease ducting to obtain TAB measurements is not permitted.

TEST DATE: 04/15/21
READINGS BY: Jesse Wendlandt

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TEST & BALANCE LLC

YWCA New Facility

TRAVERSE TEST REPORT

SYSTEM:	EXHAUST								
TRAVERSE DESCRIPTION	**DUCT SIZE (inches)**	**AREA (sq. ft.)**	**REQUIRED VELOCITY (fpm)**	**REQUIRED AIRFLOW (cfm)**	**ACTUAL VELOCITY (fpm)**	**ACTUAL AIRFLOW (cfm)**	**STATIC PRESSURE (inWC)**	**TEST INSTRUMENT**	**NOTES**
EF-01	36 X 36	9.000	900	8100	930	8370	---	Vel-grid	
EF-02	40 X 13	3.611	150	540	155	560	---	Vel-grid	

TEST DATE: 03/25/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	EXHAUST										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
EF-03											
01	Lounge 223	EG	6x6	150	130	87%	170	113%	**150**	100%	
02	Sleep 241	EG	8x8	250	320	128%	280	112%	**245**	98%	
			TOTAL	**400**	**450**	**112%**	**450**	**112%**	**395**	**99%**	
EF-08											
01	Lounge 305	EG	8x8	60	225	375%		-	**65**	108%	
DHEF-01											
01	Dishwash	OED	10	600	785	131%		-	**640**	107%	
EF-100B											
01	Jan 126	EG	---	80	(1)	-		-		-	(1)

Notes: Panasonic Model: FV-0511VKS2 (1) Fan is not wired.

EF-102											
01	RR 102	EG	---	80	55	69%		-	**80**	100%	

Notes: Panasonic Model: FV-0511VKS2

EF-105A											
01	RR 105A	EG	---	80	35	44%		-	**75**	94%	

Notes: Panasonic Model: FV-0511VKS2

EF-107											
01	RR 107	EG	---	80	40	50%		-	**80**	100%	

Notes: Panasonic Model: FV-0511VKS2

EF-123											
01	RR 123	EG	---	80	50	62%		-	**80**	100%	

Notes: Panasonic Model: FV-0511VKS2

TEST DATE: 03/18/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	EXHAUST										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
EF-141											
01	Break 141	EG	---	80	40	50%		-	**75**	94%	

Notes: Panasonic Model: FV-0511VKS2

EF-148											
01	RR 148	EG	---	80	55	69%		-	**85**	106%	

Notes: Panasonic Model: FV-0511VKS2

EF-149											
01	RR 149	EG	---	80	60	75%		-	**80**	100%	

Notes: Panasonic Model: FV-0511VKS2

EF-150											
01	RR 150	EG	---	80	55	69%		-	**85**	106%	

Notes: Panasonic Model: FV-0511VKS2

EF-179											
01	RR 179	EG	---	80	55	69%		-	**75**	94%	

Notes: Panasonic Model: FV-0511VKS2

EF-201											
01	RR 201	EG	---	110	75	68%		-	**100**	91%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-202											
01	RR 202	EG	---	110	75	68%		-	**110**	100%	(1)

Notes: Panasonic Model: FV-0511VKS2
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TEST DATE: 03/18/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	EXHAUST										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
EF-230											
01	RR 230	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-232											
01	RR 232	EG	---	110	75	68%		-	**115**	105%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-242											
01	RR 242	EG	---	80	30	38%		-	**80**	100%	

Notes: Panasonic Model: FV-0511VKS2

EF-244											
01	RR 244	EG	---	80	25	31%		-	**75**	94%	

Notes: Panasonic Model: FV-0511VKS2

EF-245											
01	RR 245	EG	---	80	40	50%		-	**80**	100%	

Notes: Panasonic Model: FV-0511VKS2

EF-246											
01	RR 246	EG	---	80	80	100%		-	**80**	100%	

Notes: Panasonic Model: FV-0511VKS2

EF-250											
01	RR 250	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

TEST DATE: 03/18/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	EXHAUST										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
EF-251											
01	RR 251	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-253											
01	RR 253	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-254											
01	RR 254	EG	---	80	105	131%		-	**80**	100%	

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-301											
01	RR 301	EG	---	110	70	64%		-	**100**	91%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-302											
01	RR 302	EG	---	110	70	64%		-	**110**	100%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary

EF-303											
01	RR 303	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-304											
01	RR 304	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

TEST DATE: 03/18/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER TEST & BALANCE LLC

YWCA New Facility

FLOWHOOD TEST REPORT

SYSTEM:	EXHAUST										
NO.	AREA SERVED	TYPE	SIZE	DESIGN AIRFLOW (cfm)	PRELIM AIRFLOW (cfm)	% OF DESIGN	PRELIM AIRFLOW (cfm)	% OF DESIGN	FINAL AIRFLOW (cfm)	% OF DESIGN	NOTES
EF-306											
01	RR 306	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-307B											
01	Jan 307B	EG	---	110	70	64%		-	**110**	100%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-308											
01	RR 308	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-309											
01	RR 309	EG	---	110	70	64%		-	**100**	91%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-310											
01	RR 310	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-312											
01	RR 312	EG	---	110	70	64%		-	**100**	91%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

EF-314											
01	RR 314	EG	---	110	70	64%		-	**105**	95%	(1)

Notes: Panasonic Model: FV-0511VKS2
(1) Preliminary and final columns represent the airflows measured at low and high speeds. See summary.

TEST DATE: 03/18/21
READINGS BY: Jesse Wendlandt

AIRCOMMANDER
TEST & BALANCE LLC

ABBREVIATIONS LIST

ACH / ACPH	air changes / air changes per hour
AFS / AFMS	airflow station / airflow monitoring station
AH / AHU	air handler / air handler unit
ATM / Atm.	atmosphere
CD	ceiling diffuser
C/F	correction factor
cfm	cubic feet per minute
DD	direct drive
DP	differntial pressure
DS	duct sox
ECM	electronically commutated motor
EF	exhaust fan
EG	exhaust grille
ERU / ERV	energy recovery unit / energy recovery ventilator
(E)	existing
ftH2O	feet of water column
F	furnace
FC / FCU	fan coil (unit)
FD	fire Damper
FPVAV	fan powered variable air volume
fpm	feet per minute
gpm	gallons per minute
HP	horsepower
Hz	hertz (frequency)
InWC	inches water column
LD	linear slot diffuser
MAU	make up air unit
OBD	opposed blade damper
OD	outside diameter
OED	open end duct
OSA	outside air
psi / psid	pounds per square inch (differential)
RG	return grille
rpm	revolutions per minute
RTU	roof top unit
RVA	rotating vane anemometer
Sq. Ft.	square feet
SD	supply diffuser
S.F.	service factor
SW	side wall diffuser
TU	terminal unit
VAV	variable air volume
VFD	variable frequency drive
---	not applicable, not specified, and or cell left blank intentionally
' / "	feet / inches

GENERAL MECHANICAL NOTES

A.) IT SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR TO FIELD COORDINATE THE LOCATION OF EQUIPMENT ROUTING OF ALL DUCTWORK AND PIPING WITH ALL OTHER TRADES.

B.) IT SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR TO REVIEW THE DRAWINGS FOR ALL DISCIPLINES AND PROVIDE ALL LABOR AND MATERIALS REQUIRED FOR A COMPLETE INSTALLATION.

C.) COORDINATE THE INSTALLATION OF GRILLES, REGISTERS AND DIFFUSERS WITH THE ARCHITECTURAL REFLECTED CEILING PLANS AND THE ELECTRICAL LIGHTING PLANS.

D.) VERIFY THE LOCATION OF THERMOSTATS AND SENSORS WITH THE ARCHITECT AND ENGINEER PRIOR TO INSTALLATION. INSTALL THERMOSTATS 48" ABOVE FINISHED FLOOR PER ADA REQUIREMENTS.

E.) PROVIDE AND INSTALL SEISMIC BRACING FOR ALL EQUIPMENT, DUCTWORK AND PIPING PER THE REQUIREMENTS OF THE INTERNATIONAL BUILDING CODE.

F.) FLEXIBLE DUCTWORK BETWEEN BRANCH DUCTS AND GRILLES, REGISTERS OR DIFFUSERS SHALL BE LIMITED TO 5FT.

G.) PROVIDE AND INSTALL FIRE, SMOKE AND/OR COMBINATION SMOKE/FIRE DAMPERS WHERE DUCTWORK PASSES THROUGH FIRE RATED ASSEMBLIES. ASSOCIATED DUCT DETECTORS SHALL BE ADDRESSABLE. SMOKE DAMPERS AND COMBINATION SMOKE/FIRE DAMPERS SHALL INCLUDE A KEYED REMOTE TEST SWITCH LOCATED IN AN ACCESSIBLE LOCATION. FIELD COORDINATE THE LOCATION OF TEST SWITCHES WITH THE ARCHITECT AND ENGINEER PRIOR INSTALLATION.

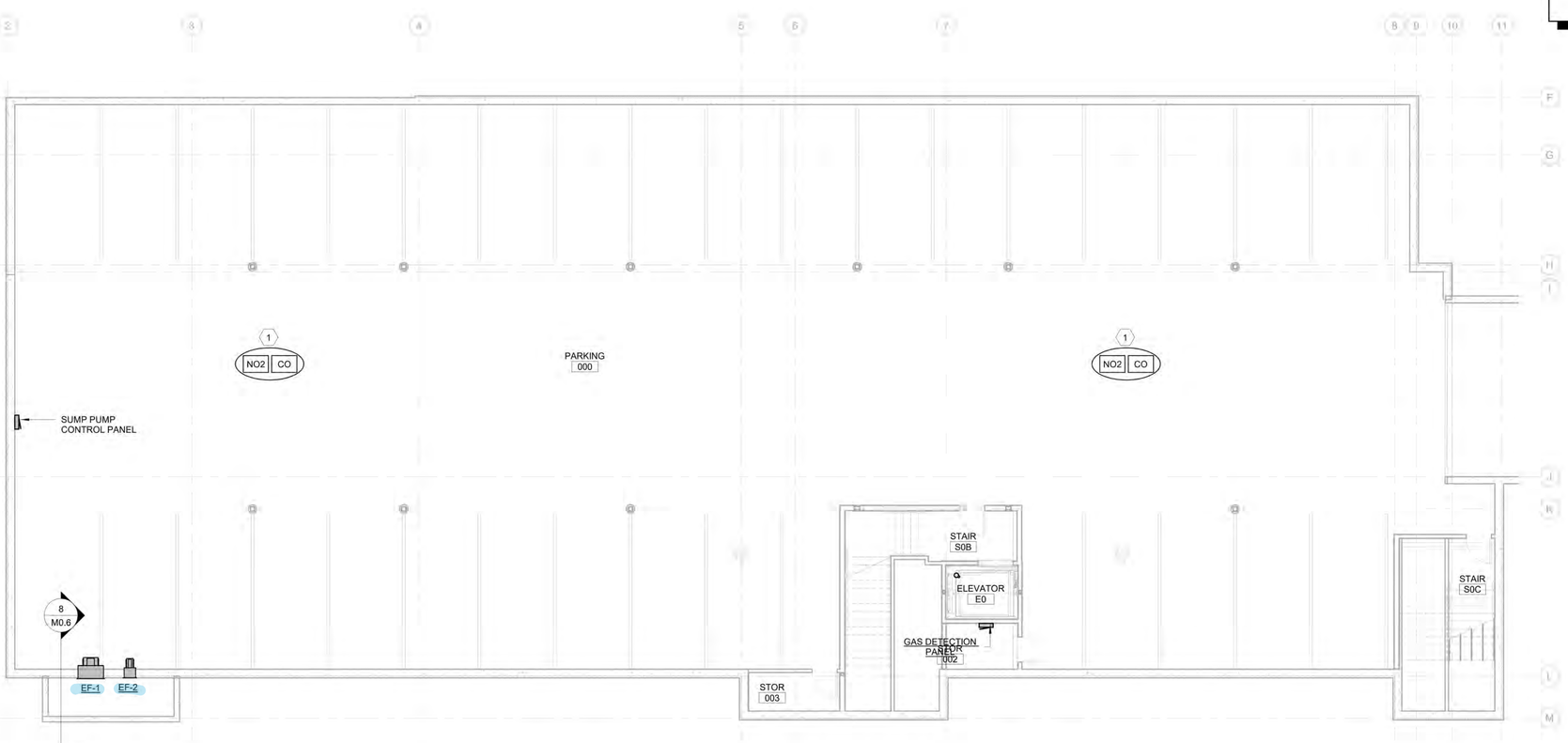
H.) SEAL ALL DUCT AND PIPE PENETRATIONS THROUGH FIRE RATED ASSEMBLIES WITH A UL-APPROVED FIRE STOP SYSTEM.

I.) PROVIDE ACCESS DOORS TO ALLOW SERVICE AND INSPECTION OF EQUIPMENT, VALVES, DAMPERS AND DEVICES INSTALLED ABOVE NON-REMOVABLE CEILINGS.

J.) PROVIDE REMOTE CONTROLLED DAMPER ACTUATORS FOR BALANCING DAMPERS INSTALLED IN INACCESSIBLE LOCATION. PROVIDE RUSKIN ZPD25 OR APPROVED EQUAL.

KEY NOTES:

1. PROVIDE TOXALERT (OR EQUAL) GAS DETECTION SYSTEM, COMPLETE WITH CONTROL PANEL AND SENSORS. THE QUANTITY, LOCATION, AND HEIGHTS OF ALL SENSORS SHALL BE SELECTED BY THE CONTRACTOR AND SHALL BE PLACED TO ADEQUATELY COVER THE ENTIRE SPACE. CONTRACTOR SHALL FOLLOW MANUFACTURERS WRITTEN INSTALLATION INSTRUCTIONS FOR SENSORS AND FOR THE ENTIRE SYSTEM FOR A FULLY FUNCTIONING SYSTEM.



1 LEVEL 0 MECHANICAL PLAN
1/8" = 1'-0"

NORTH

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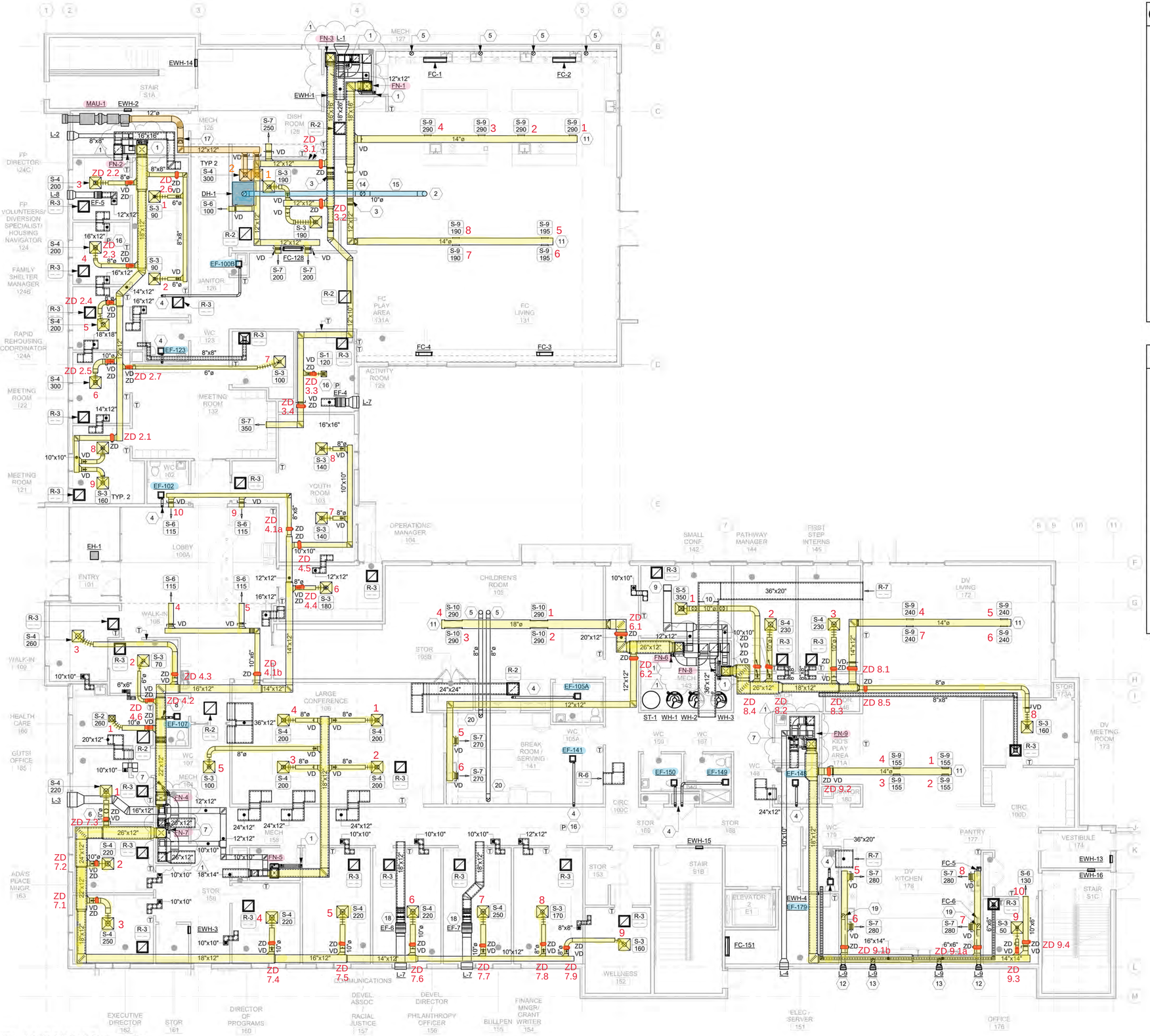
Revision Number	Revision Date

JOB # 4668.052
DATE: 03.06.2019

LEVEL 0 MECHANICAL PLAN

M2.0



1 LEVEL 1 MECHANICAL PLAN
1/8" = 1'-0"

NORTH

GENERAL MECHANICAL NOTES

A.) IT SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR TO FIELD COORDINATE THE LOCATION OF EQUIPMENT ROUTING OF ALL DUCTWORK AND PIPING WITH ALL OTHER TRADES.

B.) IT SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR TO REVIEW THE DRAWINGS FOR ALL DISCIPLINES AND PROVIDE ALL LABOR AND MATERIALS REQUIRED FOR A COMPLETE INSTALLATION.

C.) COORDINATE THE INSTALLATION OF GRILLES, REGISTERS AND DIFFUSERS WITH THE ARCHITECTURAL REFLECTED CEILING PLANS AND THE ELECTRICAL LIGHTING PLANS.

D.) VERIFY THE LOCATION OF THERMOSTATS AND SENSORS WITH THE ARCHITECT AND ENGINEER PRIOR TO INSTALLATION. INSTALL THERMOSTATS 48" ABOVE FINISHED FLOOR PER ADA REQUIREMENTS.

E.) PROVIDE AND INSTALL SEISMIC BRACING FOR ALL EQUIPMENT, DUCTWORK AND PIPING PER THE REQUIREMENTS OF THE INTERNATIONAL BUILDING CODE.

F.) FLEXIBLE DUCTWORK BETWEEN BRANCH DUCTS AND GRILLES, REGISTERS OR DIFFUSERS SHALL BE LIMITED TO 5FT.

G.) PROVIDE AND INSTALL FIRE, SMOKE AND/OR COMBINATION SMOKE/FIRE DAMPERS WHERE DUCTWORK PASSES THROUGH FIRE RATED ASSEMBLIES. ASSOCIATED DUCT DETECTORS SHALL BE ADDRESSABLE. SMOKE DAMPERS AND COMBINATION SMOKE/FIRE DAMPERS SHALL INCLUDE A KEYED REMOTE TEST SWITCH LOCATED IN AN ACCESSIBLE LOCATION. FIELD COORDINATE THE LOCATION OF TEST SWITCHES WITH THE ARCHITECT AND ENGINEER PRIOR INSTALLATION.

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J.) PROVIDE REMOTE CONTROLLED DAMPER ACTUATORS FOR BALANCING DAMPERS INSTALLED IN INACCESSIBLE LOCATION. PROVIDE RUSKIN ZPD25 OR APPROVED EQUAL.

KEY NOTES:

1. 3"Ø FURNACE FLUE AND VENT UP.
2. 10"Ø DUCTWORK UP TO ROOFTOP EXHAUST FAN.
3. OFFSET DUCTWORK HIGH TO ALLOW DISH HOOD EXHAUST TO PASS BELOW SUPPLY DUCTWORK.
4. 4"Ø EXHAUST DUCTWORK UP
5. 8"Ø KITCHEN HOOD DUCTWORK UP
6. OFFSET 10"Ø SUPPLY DUCT UNDER OA DUCT.
7. 3"Ø FURNACE FLUE AND VENT UP. OFFSET AROUND FURNACE DUCTWORK BEFORE ROUTING UP.
8. 4"Ø EXHAUST DUCTWORK UP. OFFSET AROUND FURNACE DUCTWORK.
9. 16"X12" OA DUCT UP TO INTAKE PENTHOUSE
10. OFFSET 10"Ø SUPPLY DUCT UP INTO STRUCTURE AND BACK DOWN. COORDINATE WITH STRUCTURAL PLANS.
11. EXPOSED DUCTWORK WITH DUCT MOUNTED GRILLES.
12. 8"Ø HOOD EXHAUST ROUTED UNDER SUPPLY DUCTWORK IN SOFFIT AND THRU WALL FOR TERMINATION WITH L-9.
13. 8"Ø HOOD EXHAUST UP AND THRU WALL FOR TERMINATION WITH L-9.
14. OFFSET 10"Ø EXHAUST UP INTO STRUCTURE.
15. 10"Ø EXHAUST DUCT ROUTED IN STRUCTURE. COORDINATE WITH STRUCTURAL PLANS.
16. PLENUM PRESSURE SENSOR CONNECTED TO PLENUM RELIEF FAN.
17. TRANSITION DUCTWORK UP TO SOFFIT
18. EF-6 & EF-7 CONTROLLED BY SAME PRESSURE SENSOR AND SPEEDS ARE SYNCHRONIZED
19. 8" EXHAUST DUCTWORK UP TO SOFFIT AND TO LOUVER.
20. 8" EXHAUST DUCTWORK ROUTED IN STRUCTURE

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Revision Number	Revision Date
1	05/02/19

JOB #	4668.052
DATE:	03.06.2019

LEVEL 1 MECHANICAL PLAN

M2.1

GENERAL MECHANICAL NOTES

A.) IT SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR TO FIELD COORDINATE THE LOCATION OF EQUIPMENT ROUTING OF ALL DUCTWORK AND PIPING WITH ALL OTHER TRADES.

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D.) VERIFY THE LOCATION OF THERMOSTATS AND SENSORS WITH THE ARCHITECT AND ENGINEER PRIOR TO INSTALLATION. INSTALL THERMOSTATS 48" ABOVE FINISHED FLOOR PER ADA REQUIREMENTS.

E.) PROVIDE AND INSTALL SEISMIC BRACING FOR ALL EQUIPMENT, DUCTWORK AND PIPING PER THE REQUIREMENTS OF THE INTERNATIONAL BUILDING CODE.

F.) FLEXIBLE DUCTWORK BETWEEN BRANCH DUCTS AND GRILLES, REGISTERS OR DIFFUSERS SHALL BE LIMITED TO 5FT.

G.) PROVIDE AND INSTALL FIRE, SMOKE AND/OR COMBINATION SMOKE/FIRE DAMPERS WHERE DUCTWORK PASSES THROUGH FIRE RATED ASSEMBLIES. ASSOCIATED DUCT DETECTORS SHALL BE ADDRESSABLE. SMOKE DAMPERS AND COMBINATION SMOKE/FIRE DAMPERS SHALL INCLUDE A KEYED REMOTE TEST SWITCH LOCATED IN AN ACCESSIBLE LOCATION. FIELD COORDINATE THE LOCATION OF TEST SWITCHES WITH THE ARCHITECT AND ENGINEER PRIOR INSTALLATION.

H.) SEAL ALL DUCT AND PIPE PENETRATIONS THROUGH FIRE RATED ASSEMBLIES WITH A UL-APPROVED FIRE STOP SYSTEM.

I.) PROVIDE ACCESS DOORS TO ALLOW SERVICE AND INSPECTION OF EQUIPMENT, VALVES, DAMPERS AND DEVICES INSTALLED ABOVE NON-REMOVABLE CEILINGS.

J.) PROVIDE REMOTE CONTROLLED DAMPER ACTUATORS FOR BALANCING DAMPERS INSTALLED IN INACCESSIBLE LOCATION. PROVIDE RUSKIN ZPD25 OR APPROVED EQUAL.

KEY NOTES:

1 10"X10" UP TO ROOF MOUNTED EXHAUST FAN
2 6" SUPPLY DUCT UP TO LEVEL 3 FLOOR MOUNTED DIFFUSER.
3 6" RETURN DUCT UP TO LEVEL 3 FLOOR MOUNTED GRILLE.
4 FURNACE FLUE AND INTAKE TERMINATED ON ROOF WITH CONCENTRIC VENT KIT.
5 8" HOOD EXHAUST DN.
6 ERV DUCTWORK ROUTED IN STRUCTURE.
7 COORDINATE DUCTWORK WITH STRUCTURAL BEAM.
8 4"Ø EXHAUST ROUTED IN STRUCTURE AND UP TO ROOF
9 3"Ø FURNACE FLUE AND VENT DN IN WALL AND UP TO ROOF. TERMINATE WITH CONCENTRIC VENT KIT.
10 6"Ø EXHAUST ROUTED IN STRUCTURE AND UP TO ROOF
11 4"Ø EXHAUST DN IN WALL.
12 4"Ø EXHAUST DN IN WALL. 8"Ø EXHAUST ROUTED IN STRUCTURE AND UP TO ROOF.
13 8"Ø EXHAUST ROUTED IN STRUCTURE AND UP TO ROOF.
14 4"Ø EXHAUST UP/DN IN WALL.
15 4"Ø EXHAUST ROUTED IN STRUCTURE AND UP.
16 4"Ø DRYER EXHAUST UP IN CHASE TO ROOF.
17 4"Ø DRYER EXHAUST UP IN WALL.
18 4"Ø OA DUCT ROUTED IN STRUCTURE AND UP TO ATTIC.
19 MANUFACTURERS ACCESS RETURN AIR PANEL WITH BUILT IN RETURN GRILLE & TELESCOPING DUCT

MONTANA
ERIC J. WEBBER
No. 41999 PE
LICENSED PROFESSIONAL ENGINEER

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Revision Number	Revision Date

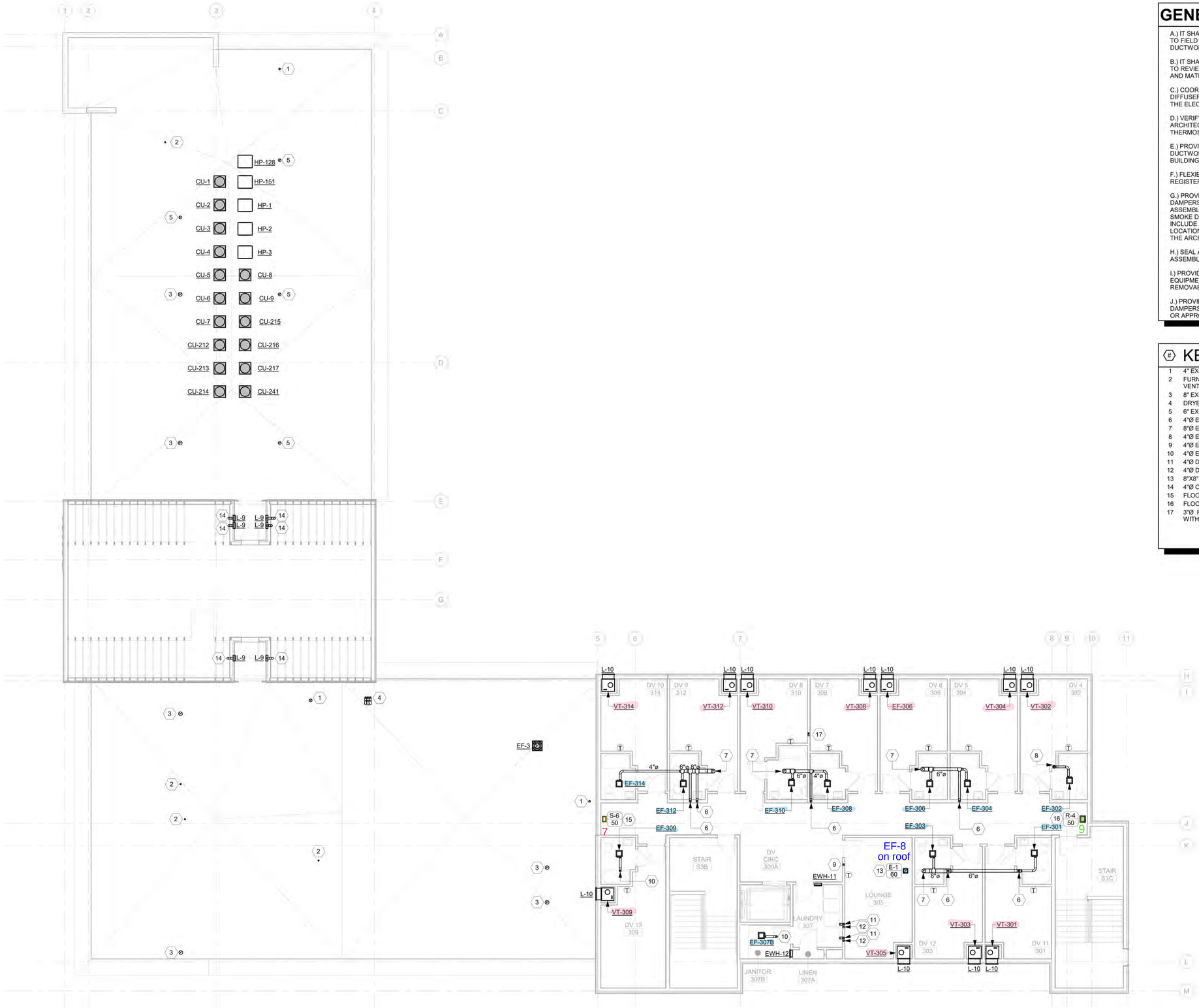
JOB # 4668.052
DATE: 03.06.2019

LEVEL 2 MECHANICAL PLAN

M2.2

1 LEVEL 2 MECHANICAL PLAN
1/8" = 1'-0"

NORTH



1 LEVEL 3 MECHANICAL PLAN
1/8" = 1'-0"

NORTH

GENERAL MECHANICAL NOTES

A.) IT SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR TO FIELD COORDINATE THE LOCATION OF EQUIPMENT ROUTING OF ALL DUCTWORK AND PIPING WITH ALL OTHER TRADES.

B.) IT SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR TO REVIEW THE DRAWINGS FOR ALL DISCIPLINES AND PROVIDE ALL LABOR AND MATERIALS REQUIRED FOR A COMPLETE INSTALLATION.

C.) COORDINATE THE INSTALLATION OF GRILLES, REGISTERS AND DIFFUSERS WITH THE ARCHITECTURAL REFLECTED CEILING PLANS AND THE ELECTRICAL LIGHTING PLANS.

D.) VERIFY THE LOCATION OF THERMOSTATS AND SENSORS WITH THE ARCHITECT AND ENGINEER PRIOR TO INSTALLATION. INSTALL THERMOSTATS 48" ABOVE FINISHED FLOOR PER ADA REQUIREMENTS.

E.) PROVIDE AND INSTALL SEISMIC BRACING FOR ALL EQUIPMENT, DUCTWORK AND PIPING PER THE REQUIREMENTS OF THE INTERNATIONAL BUILDING CODE.

F.) FLEXIBLE DUCTWORK BETWEEN BRANCH DUCTS AND GRILLES, REGISTERS OR DIFFUSERS SHALL BE LIMITED TO 5FT.

G.) PROVIDE AND INSTALL FIRE, SMOKE AND/OR COMBINATION SMOKE/FIRE DAMPERS WHERE DUCTWORK PASSES THROUGH FIRE RATED ASSEMBLIES. ASSOCIATED DUCT DETECTORS SHALL BE ADDRESSABLE. SMOKE DAMPERS AND COMBINATION SMOKE/FIRE DAMPERS SHALL INCLUDE A KEYED REMOTE TEST SWITCH LOCATED IN AN ACCESSIBLE LOCATION. FIELD COORDINATE THE LOCATION OF TEST SWITCHES WITH THE ARCHITECT AND ENGINEER PRIOR INSTALLATION.

H.) SEAL ALL DUCT AND PIPE PENETRATIONS THROUGH FIRE RATED ASSEMBLIES WITH A UL-APPROVED FIRE STOP SYSTEM.

I.) PROVIDE ACCESS DOORS TO ALLOW SERVICE AND INSPECTION OF EQUIPMENT, VALVES, DAMPERS AND DEVICES INSTALLED ABOVE NON-REMOVABLE CEILINGS.

J.) PROVIDE REMOTE CONTROLLED DAMPER ACTUATORS FOR BALANCING DAMPERS INSTALLED IN INACCESSIBLE LOCATION. PROVIDE RUSKIN ZPD25 OR APPROVED EQUAL.

KEY NOTES:

1	4" EXHAUST DN
2	FURNACE FLUE AND INTAKE TERMINATED ON ROOF WITH CONCENTRIC VENT KIT.
3	8" EXHAUST DUCT DN. TERMINATE ON ROOF WITH ROOF CAP.
4	DRYER EXHAUST DN. TERMINATE WITH GOOSENECK
5	6" EXHAUST DUCT DN. TERMINATE ON ROOF WITH ROOF CAP.
6	4"Ø EXHAUST DN IN WALL.
7	8"Ø EXHAUST ROUTED IN STRUCTURE AND UP TO ROOF.
8	4"Ø EXHAUST ROUTED IN STRUCTURE AND UP.
9	4"Ø EXHAUST DN IN WALL AND UP TO ROOF.
10	4"Ø EXHAUST ROUTED IN STRUCTURE AND UP TO ROOF
11	4"Ø DRYER EXHAUST UP IN WALL TO ROOF
12	4"Ø DRYER EXHAUST DN IN WALL AND UP TO ROOF.
13	8"X8" EXHAUST DUCT TO FAN ON ROOF.
14	4"Ø OA DUCT DN.
15	FLOOR MOUNTED SUPPLY GRILLE
16	FLOOR MOUNTED RETURN GRILLE
17	3"Ø FURNACE FLUE AND VENT DN IN WALL AND UP TO ROOF. TERMINATE WITH CONCENTRIC VENT KIT.

MONTANA ERIC J. WEBBER No. 41999 PE LICENSED PROFESSIONAL ENGINEER

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Revision Number	Revision Date

JOB # 4668.052
DATE: 03.06.2019

LEVEL 3 MECHANICAL PLAN

M2.3

Appendix J

Functional Performance Testing Summaries

Laura Howe

From: Laura Howe
Sent: Thursday, March 18, 2021 4:32 PM
To: Colin Lane; Kim Reineking; Ross Balfour
Cc: Chris Haskell; bmether@siriusconst.com; Marc Umile (mumile@siriusconst.com); Tim Kester; Eric J. Webber; Stacie Peterson
Subject: YWCA Commissioning testing today - update

Hi All-

Below is a summary of HVAC commissioning testing today at the YWCA Meadowlark Building. HVAC equipment on the 2nd and 3rd floors was tested.

The following equipment was tested:

2nd floor	3rd floor
ERV-1 VT-225, VT-259 EWH-7 EF-245, EF-246	VT-303 EWH-7

Incomplete Tests

1. ERV heat recovery performance, supply temperature control and duct heater operation. The controls were not set up so the temperature sensor calibrations could not be verified, and the duct heater would not operate to control the supply air temperature. The outside air temperature was too close to the room temperature to assess the performance of the heat recovery system because there was no delta T.
2. Exhaust fan testing occupancy control (automatic off) was unsuccessful because other trades entered rooms.
3. VTs – The units were not ready for testing. Factory startup had not occurred, and the thermostats had not been set up. It was reported that there is currently a work around programmed into the units, and it is not clear if that impacts today's tests.
4. EWHs – Did not attempt power failure recovery test because it requires a breaker to be thrown, and this can be done when lighting is tested and others will not be disrupted with the test.

Tests to repeat

1. ERV all sequences. Needs cool temperatures to test heat recovery performance.
2. VTs, if sequencing or configuration changes.
3. Two EF on 2nd floor, 1 EF on 3rd floor. All sequences need to be tested.
4. Two EWHs – power failure recovery.

Testing Deficiencies

1. VTs – The sequencing is not per the plans. The plans call for heat pump (compressor) heating above 30°F and electric heat below that. This is intended to limit the use of electric heat and conserve energy. The units reportedly will use electric heat whenever the differential between room temperature and setpoint is greater than 5°F -15°F (depending on outdoor conditions) and therefore is not locked out above any temperature. This sequencing will utilize electric heat if night setbacks are implemented that cause a

morning rise in the setpoint more than 5°F. In this case, every morning warmup could call for electric heat.

2. VTs – The mechanical contractor reported that the lockout temperature for the electric heat is set at 36°F due to a pending lawsuit (unrelated to this project) regarding the drain pan heaters. The drain pan heaters are programmed off, and the electric heat lockout is set to protect them from freezing.

3. VTs – Condensate drains were not installed on VT-303 and the drain was not connected on VT-259.
4. VTs - There are small gaps in the corners of the gaskets between the walls and unit plenums on VT-259 with minor gaps on VT-303. I recommend all installations be inspected and gaps sealed.
5. VT-259 – Room temperature sensor calibration failed test. Sensor read 63°F and field measurement was 65.6°F.

Findings

1. VTs -There was no occupied/unoccupied programming set up in the thermostats. There were no setpoint limits configured, they could be adjusted as low as 64°F and over 80°F. If the programming of the units significantly changes with factory startup, additional testing may be needed to verify that sequencing. Fan setting (hi/low) is user adjustable.
2. VTs- While in heating, when ice was applied to the outside air temperature sensor, the compressor shut off and the electric heat was the sole heat source. I was unable to verify if the electric heat was actually off above 36°F (while staying within 4°F differential). Two units produced a low enough discharge air temperature (74°F) in heating that it was clear the electric heat was not on. The third unit did go up to 90°F discharge air temperature, however the electric heat operation could not be verified to be on or off during this time. The third unit was in heating for an extended time before the compressor would lockout (on simulated low OAT), so it is possible that the compressor ramped up enough to produce such a warm temperature by itself. The compressors do modulate so the DAT is going to vary based on the call for heating or cooling.

Successful Tests

1. VTs– When the ventilation switch was ON, it was confirmed that ventilation fans run and air flows even if the VTAC unit (supply fan, compressor) was off. The VTAC unit goes off when the thermostat is satisfied. This will provide ventilation during all times the ventilation switch is ON even though the VTAC unit is not running.
2. VTs - The sequencing as found was tested successfully. All three units passed general heating, cooling, ventilation airflow, fan hi/lo operation, temperature sensor calibration (with one exception), and power failure recovery. There is a preset +/-3°F deadband between heating and cooling.
3. EWH – successfully responded to adjusting the thermostat dial, on and off.

I will not be conducting lighting testing this weekend as only the 2nd and 3rd floors are ready. Since the majority of the lighting testing is in the basement and 1st floor, I'll wait until those are ready so we can do all the lighting at once. I will need the spaces I am testing to be vacant.

Both startup (factory or mechanical contractor) and TAB need to be fully completed before testing any additional equipment.

Thanks,
Laura

Laura Howe, PE, BCxP, LEED AP

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Laura Howe

From: Laura Howe
Sent: Sunday, April 4, 2021 2:53 PM
To: Kim Reineking; Darin van Oosterhout; Fred Talarico
Cc: Chris Haskell; bmether@siriusconst.com; Marc Umile (mumile@siriusconst.com); Stacie Peterson; Ross Balfour; Eric J. Webber; Colin Lane
Subject: YWCA Commissioning testing today - update

Hi Kim-

I conducted lighting commissioning testing today at the YWCA Meadowlark Building. I tested all of the lighting zones on the 1st through 3rd floors. Below is a summary of the testing results. I typically use 20 mins as a threshold for flagging a lighting control zone as deficient test.

Deficiencies

1. 103, 106, 128, 129, 151, 154, 155, 156, 158, 255 – These lights never automatically turned off.
2. 154, 155, 156, 158 – These lights never automatically turned off. Brian mentioned that these are often triggered by hallway traffic. If so, this would result in a deficiency when retested. I recommend confirming whether or not this occurs, and if so adjust the OS to ensure they are not falsely tripped by hallway traffic.
3. 105 - These lights did not turn off within 20 minutes. They eventually did turn off, but it took over 30 mins.
4. 130 – Fixtures "G" over kitchen islands have no dimming. **DCE** please confirm if correct.
5. 171, & 100D – These lights did not turn off within 20 minutes. They eventually did turn off, but it took over 45 mins.
6. 178 – (A)-These lights did not turn off within 20 minutes. They eventually did turn off, but it took 33 mins. (B)-Fixtures "U" are not installed. (C)-Each set of switches for the kitchen has a dimmer switch with nothing apparently controlled. The plans show those switches to be used for Fixtures "U". (D)-Fixtures S3 had no dimming and no automatic control. They only turned off by using switch "K" with the key. **DCE** please confirm if correct.
7. 256 – The fixture closest to the door does not dim. The lights did not automatically turn off within 20 minutes, they stayed on for 38 minutes.
8. 100A Lobby – (A) - Switching is not per plans. There is a 3rd switch on the west wall, which allows the recessed and pendant lights to be switched and dimmed separately. The dimmer for the recessed lights is on that west wall, while the dimmer for the pendants are on the other end of the reception desk. Recommend reconfiguring so all dimming is done on the west wall. (B) – fixtures T/T2 not installed, they were replaced with U. **DCE** confirm if correct.
9. S1A stair (SW) – All lights in this stairway were fully illuminated (not dimmed) during all observations.
10. S1B stair (East) & S1C stair (NE-DV) – These lights were a mix of always bright, always dim, and responsive/unresponsive to motion. Request DCE clarify the intended operation of these. There were bright fixtures in spaces with lots of natural light, and dim fixtures in spaces without much natural light. Their response did not seem consistent with expected photo-occupancy control.
11. OS outside 156 - poor sensitivity – These lights did not turn on until I had walked well into the lighting zone (past first light).

Findings

109 – This OS may be blocked by a wall corner from use within the space. Recommended YWCA monitor and report if operation is unacceptable. The duration to off is quite short (7 min) and extending that may help. Recommend Kim inform the YWCA staff.

Recommendations

100A lobby – Refer to deficiencies above
Resolve all deficiencies

Tests to repeat
All deficiencies

Testing remaining
Basement lighting
Exterior lighting

Please let me know if you have any questions. I'll be back on site tomorrow and Tuesday (at least) for HVAC testing of the 1st floor and remaining tests and retests for the 2nd & 3rd floors.

Thanks,
Laura

Laura Howe, PE, BCxP, LEED AP

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Laura Howe

From: Laura Howe
Sent: Tuesday, April 13, 2021 2:01 PM
To: Colin Lane; Kim Reineking; Ross Balfour
Cc: Chris Haskell; bmether@siriusconst.com; Marc Umile (mumile@siriusconst.com); Tim Kester; Eric J. Webber; Stacie Peterson
Subject: YWCA Commissioning testing April 5-9

Hi Team-

Here is my update for commissioning testing at the YWCA Meadowlark last week. Overall testing went very well. There are some pending tests for me to complete and then a few tests that will need to be repeated. This list is in addition to the lists provided on 3/18/21 (HVAC) and 4/4/21 (lighting). I'll be compiling the preliminary commissioning report and will get it to the NCAT editors early next week. It should not be too long after this that I can submit it to you, and then the final commissioning report will come once all deficiencies are resolved, with a goal of that being completed by the end of May.

Please let me know if you have any questions.

Laura

General Notes and recommendations

- Nearly every device that serves non-sleeping rooms was tested to verify operation and installation. A couple of wall heaters were the only devices not tested, and furnaces (FNs) FN's 2, 3 & 4 had "summary" testing which verified the basic sequencing and equipment operation.
- Furnace Zoning – update zoning names in as-built docs (example FN9 - kitchen is zone 1, not dining).
- Update as-builts indicating installed rooftop equipment locations (some condensing units were relocated due to refrigeration line length limitations).
- Furnace sequencing – update sequences of operation with actual sequencing (how many zones must be in heating/cooling to call, switching between heating/cooling when zones have opposite modes)
- Need startup reports from GCPH for HVAC devices
- Preliminary TAB received, NCAT will review and respond

General Deficiencies:

- Furnace zone thermostats (other than Zone1) seem to allow overlap of heating and cooling setpoints, and cooling takes priority. Recommend GCPH investigate and recommend resolution.

FN1

- Furnace DX needs refrigeration charge (cooling DAT 52°F). Outstanding deficiency.
- Re-test heat pump (HP1) operation and power failure – need more cooling load to conduct this test.
- Thermostat read 1.4°F high. The calibration was adjusted and resolved during testing.

FN2

- Needs refrigeration charge (cooling DAT 50°F). Outstanding deficiency.
- Calibration for thermostats in zones 3, 4, and 6 were deficient. The calibration was adjusted and resolved during testing.

FN3

- No deficiencies

FN4

- Needs refrigeration charge (cooling DAT 54°F). Outstanding deficiency.
- Calibration for the thermostat in zone 5 was deficient (2.8°F low). The calibration was adjusted and resolved during testing.

FN5

- There was a gap in the FN casing allowing air leakage. This was resolved during testing.

FN6

- No deficiencies

FN7

- Furnace 7 zone control board is failed. The failure was discovered while testing "opposite mode" operation (where some zones in cooling, some in heating). FN7 was left with the thermostats locked out and in heating only until the board can be replaced and system retested.
- Calibration for thermostats in zones 1 and 9 were deficient. The calibration was adjusted and resolved during testing.

FN8

- Calibration for the thermostat in zone 4 was deficient (4.3°F high). The calibration was adjusted, the offset limit was reached, and the thermostat still read 2 degrees high. Recommend replacing this thermostat.

FN9

- The zone controller is powered from a separate circuit than the FN, and that controller powers the OAD. Shutting off the disconnect to the FN did not close the OAD in the power failure test. Recommend: DCE review and respond if this acceptable.
- Power failure testing - 2nd stage cooling (fan coils and heat pump) – after power was returned, the fan coils resumed being ON (blowing air, but no heat pump operation) even if there was no longer a call for 2nd stage. They stayed ON until another call for 2nd stage cooling happened, and then shut off correctly when that call ended. GCPH reports that this is a limitation of the Daikin FC/HPs, as they must see the call for 2nd stage cooling change, when it begins and when it ends. If the call ends during a power failure, the fan coils continue to operate. Recommend: DCE review and respond if this acceptable.
- The zone diffuser for the Domestic Violence (DV) entrance foyer has a significant whistle most frequently observed when this damper was at its minimum position (ventilation air only). Because this foyer is open to most other DV spaces, including the kitchen, dining, and living rooms, I recommend setting this damper minimum to zero and letting the ventilation air be delivered through the kitchen and dining room zones when the foyer is not calling for heating or cooling. Recommend: DCE review and respond with recommendation.

Basement Tox Alert and Exhaust fan

- No deficiencies

ERV

- No deficiencies

Dish wash hood EF and MAU

- Neither fan turned on when dishwasher door opened as the plans specify.
- The fans turned on when the dishwasher cycle starts (by closing the door) and run for 10 minutes after the cycle is finished. GCPH worked with the electrician and they recommend the dishwasher programming be modified to enable the sequencing to start the fans when the door is open or the dishwasher is running, and continue to run for another 10 minutes after the cycle ends. Recommend MMW coordinate with dishwasher supplier and DCE for resolution.

Wall heaters

- WH-1 adjustment knob is broken. Deficiency

- Some units were installed in different locations than the plans, reportedly due to wall construction conflicts.

Bathroom exhaust fans

- No testing deficiencies.

Minisplit air conditioners

- No testing deficiencies.
- Need more cooling load on dishwash room heat pump (HP128) to confirm operation and power failure recovery.

VTACs

- Updated thermostat programming verified and tested

Basement lights

- Lights did not activate soon enough (not until nearly underneath many fixtures) and did not stay on long enough (less than 1 minute). Contractor noted that they adjusted the settings and increased the ON time to 10 minutes.

Pending testings

- Exterior lights – confirm lights come on at dark
- HP1 power failure recovery
- HP128 power failure recovery
- Basement EF2 – confirm 24x7 operation once motor is replaced

Retests required

- FN7 mixed mode, cooling zone control, and cooling DAT (refrigerant charge). CU7 operation and power failure recovery
- Basement lights
- Furnace zone thermostats – overlap of heating and cooling setpoints
- Refrigerant charges/DAT (FN1, 2, 4)
- FN8 room temperature sensor calibration after replacement
- Dishwash hood EF and MAU

Laura Howe, PE, BCxP, LEED AP

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Laura Howe

From: Laura Howe
Sent: Monday, April 19, 2021 2:32 PM
To: Colin Lane; bmether@siriusconst.com
Cc: Fred Talarico; Tim Kester; Ross Balfour; Kim Reineking; Chris Haskell; Marc Umile (mumile@siriusconst.com)
Subject: YWCA Commissioning update
Attachments: 2021-04-13 20.41.30.jpg

Hi All-

Commissioning update for the YWCA Meadowlark building. On 4/15 I confirmed the automatic operation of the exterior lights and all worked as designed when the lights came on at 8:35 PM. Sunset was at 8:22. Photo attached because it looked pretty nice at dusk!

I have also reviewed the HVAC TAB report and find no issues to report other than the outstanding equipment needs to be balanced and the report finalized.

Thanks!
Laura

Laura Howe, PE, BCxP, LEED AP

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Laura Howe

From: Laura Howe
Sent: Tuesday, May 4, 2021 8:33 AM
To: Kim Reineking; Colin Lane; Fred Talarico
Cc: Chris Haskell; Brian Mether; Marc Umile; Ross Balfour
Subject: YWCA Meadowlark Commissioning lighting retesting

Good morning –

Last evening I retested lighting at the YWCA Meadowlark, and found the following:

Lighting that passed retests:
100D, 105, 128, 129, 151, 154, 158, 171, 178, 255, stairwells, basement/garage.

Deficiencies:
103, 156 – lights did not turn off automatically. 156 may have been repeated activated by hallway traffic (keeping it on), the OS light turned on when walking by the doorway.
106, 155- lights turned on with hallway traffic.

Clarification needed:
130- lights over islands do not have dimming. Is this acceptable **MMI**?
256- the fixture closest to the door does not dim. Is this acceptable **MMI**?
Front lobby – no fixtures T/T2, U seems to be installed instead. Is this acceptable **MMI**?

Please let me know if you have any questions,

Laura

Laura Howe, PE, BCxP, LEED AP

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Laura Howe

From: Laura Howe
Sent: Thursday, May 6, 2021 4:04 PM
To: Colin Lane; Kim Reineking; Ross Balfour
Cc: Stacie Peterson; Chris Haskell; Brian Mether; Marc Umile; Tim Kester; Eric J. Webber
Subject: YWCA Meadowlark HVAC testing update

Hi All-

Yesterday I retested the HVAC outstanding deficiencies at the YWCA Meadowlark building with Garden City Plumbing and Heating. All HVAC deficiencies are now resolved. One additional deficiency was discovered while retesting FN7, specifically the Zone 5 thermostat would not respond to a call for cooling. GCPH corrected the issue immediately and the entire furnace system retested successfully. Below is a briefing of each test that was completed with in **BOLD**:

Furnaces and DX cooling

a) Zone thermostats – Retest setpoint overlap adjustment. **Confirmed that when either heating or cooling setpoint is adjusted, the alternate setpoint tracked so as not to allow setpoint overlap. Resolved**

b) Refrigerant charge in FN-1, FN-2, and FN-4. Warm weather is required to charge these units. **Discharge air temperatures from these three units were acceptable, ranging from 42°F - 46°F. Resolved**

c) FN-7 – Retest opposite mode operation after zone control board is replaced. Complete cooling testing in all zones. No special climatic conditions are required. **Opposite mode operation worked correctly, however the Z5 thermostat would not respond to heating or cooling by opening the zone damper. GCPH worked on the thermostat, corrected the issue, and testing was completed successfully. Resolved**

d) FN-8 - Zone 4 thermostat – Retest calibration after it is replaced. **The calibration of this unit was tested, and it was indeed still off by over 2°F, and the calibration was able to be adjusted further. Once adjusted, the sensor read correctly. Resolved**

Second stage cooling fan coils and heat pumps serving FN-1 and FN-9

a) HP-1 power-failure recovery (FN-1). **Testing was successful and the heat pump operated normally and recovered from a power failure correctly after the disconnect was cycled. Resolved.**

Mini-splits

a) Dish room unit (HP-128) power failure recovery. **Testing was successful and the heat pump operated normally and recovered from a power failure correctly after the disconnect was cycled. Resolved.**

Exhaust Fans

a) EF-2 (garage continuous exhaust fan) – Not yet tested. Waiting on replacement motor. **Testing was successful, the unit was operating normally and recovered from a power failure correctly when the power switch was cycled. Resolved.**

b) DHEF-1 – Operation with dishwasher door. No special climatic conditions are required. **This was resolved by MMW's acceptance of the current operation.**

Makeup Air Unit

c) Operation with dishwasher door. No special climatic conditions are required. **This was resolved by MMW's acceptance of the current operation.**

Electric wall heater 15's knob is still missing, and it is on order. EEP recommends YWCA staff remove all the knobs to prevent tampering and excessive energy consumption. We recommend setting them semiannually, to their chosen temperature setpoint in the winter, and completely off in the summer.

That wraps up all the HVAC commissioning testing. Please let me know if you have any questions and thank you for a great wrap up to this testing.

Laura

Laura Howe, PE, BCxP, LEED AP

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Appendix K

Functional Performance Testing Reports - HVAC

Dishwasher Ventilation System (DHEF-1 & MAU-1) - Functional Performance Test

YWCA Meadowlark

Participants Date 4/7/2021

Laura Howe	NCAT/EEP	Tim Kester	Garden City Plumbing and Heating
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Prerequisites

Air side TAB complete	X	Startup report provided	X

Testing Goals

Operational Checks	Exhaust airflow	
Makeup air airflow	Makeup-air unit duct heater	

Sensor Calibration Checks

General	Sensor reading	Field Measurement	Pass/ Fail
Discharge Air Temperature (DH)	70°F	70°F	PASS

Operational Checks

	Makeup Air Unit	Exhaust Fan
Unit operation, no unusual noise, vibration, etc	OK	OK
Duct heater operation, no unusual noise, vibration, etc	OK	-

Test #1 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
A – Power failure recovery – Exhaust Fan				
Cut power to unit	Shut of disconnect	• Unit shuts off • Air velocity drops to zero at diffuser	Yes Yes	
Resume normal operation	Turn disconnect back on	• Unit turns on and resumes normal operation • Air velocity confirmed at diffuser	Yes Yes	
B – Power Failure recovery – Makeup air unit				
Cut power to unit	Shut of disconnect	• Unit shuts off • Air velocity drops to zero at diffuser	Yes Yes	
Resume normal operation	Turn disconnect back on	• Unit turns on and resumes normal operation • Air velocity confirmed at diffuser	Yes Yes	
Comments:				

Test #2 Verify Operation with Dishwasher PASS

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start – Both units off, dishwasher off				
	Open dishwasher	• No change	Yes	
	Close dishwasher	• Makeup air unit turns on • Exhaust fan turns on	Yes – airflow from supply grilles Yes – airflow in exhaust hood confirmed	
	Wait 10 minutes after dishwasher turns on	• After 10 mins, both fans turn on	Yes, MAU and EF off	
Resume Normal Operation				
Comments: This test was initially failed on 4/7/21. The units did not turn on when the dishwasher door opened. Instead they turned on when the dishwasher door closed and the unit started. Ultimately the Owner accepted this operation due to equipment limitations.				

Test #3 Verify Ductheater Operation PASS

	Test Procedure	Expected response	Actual Response	Pass/ Fail
MAU off				
	Close dishwasher to turn on MAU	• MAU turns on	Yes	
	Keep DH setpoint at 70°F	• Ductheater controls to a SAT of 70°F	Yes – maintains 70°F	
Resume Normal Operation			OK	
Comments:				

END OF FUNCTIONAL PERFORMANCE TEST

Parking Garage Tox-Alert (EF-1) - Functional Performance Test

YWCA Meadowlark

Participants Date 4/9/2021

Laura Howe	NCAT/EEP	Tim Kester & Vemco Tim	Garden City Plumbing and Heating & Vemco
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Prerequisites

Air side TAB complete	X	Startup report provided	X

Testing Goals

Operational Checks	Exhaust airflow	Power Failure
Automatic gas detection		

Operational Checks

Toxalert, no alarms in normal conditions	
Unit operation, no unusual noise, vibration, etc	OK

Test #1 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
A – Power failure recovery – Exhaust Fan				
Cut power to unit	Shut of disconnect switch	• Unit shuts off	Yes	
Resume normal operation	Turn disconnect switch back on	• Unit turns on and resumes normal operation	Yes	
Comments:				

Test #2 Verify Operation with Test Gases **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start – ToxAlert normal, fan off	Introduce CO calibration gas to sensor	• ToxAlert Alarms • Fan turns on	Yes Yes	
	Remove CO calibration gas	• Tox Alert alarm clears • Fan turns off	Yes Yes	
	Introduce NOx calibration gas to sensor	• ToxAlert Alarms • Fan turns on	Yes Yes	
	Remove NOx calibration gas	• Tox Alert alarm clears • Fan turns off	Yes Yes	
Resume Normal Operation				
Comments: Test conducted by Vemco and observed by EEP.				

END OF FUNCTIONAL PERFORMANCE TEST

Parking Garage EF-2 - Functional Performance Test

YWCA Meadowlark

Participants Date 5/5/2021

Laura Howe	NCAT/EEP	Tim Kester	Garden City Plumbing and Heating
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Prerequisites

Air side TAB complete	X	Startup report provided	X

Testing Goals

Operational Checks	Exhaust airflow	Power Failure

Operational Checks

Unit operation, no unusual noise, vibration, etc	OK

Test #1 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
A – Power failure recovery – Exhaust Fan				
Cut power to unit	Shut of disconnect switch	• Unit shuts off	Yes	
Resume normal operation	Turn disconnect switch back on	• Unit turns on and resumes normal operation (24/7 run)	Yes	
Comments:				

END OF FUNCTIONAL PERFORMANCE TEST

Bathroom Exhaust Fans - Functional Performance Test

YWCA Meadowlark

Participants Date 4/9/2021

Laura Howe	NCAT/EEP	NA	
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Goals

Verify exhaust flow	Occupancy control	On/off

Test #1 Verify Exhaust, occupancy control

Test Procedure	Expected response	Actual Response	Actual Response	Actual Response	Actual Response	Actual Response	Actual Response	Actual Response
Fan ID		**EF103**	**EF105A**	**EF107**	**EF123**	**EF148**	**EF149**	**EF150**
Enter room	• Fan turns on (lights also) • Note operation, vibration/ noise	Yes OK	Yes OK	Yes OK	Yes OK	Yes OK	Yes OK	Yes OK
Test air velocity	• Verify airflow velocity to verify flow	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wait for occ timer to shut fan off	• Did it shut off automatically?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Turn switch off	• Lights and fan turn off	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Turn switch on	• Lights and fans turn on	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pass?		Yes	Yes	Yes	Yes	Yes	Yes	Yes

END OF FUNCTIONAL PERFORMANCE TEST

Bathroom Exhaust Fans - Functional Performance Test

YWCA Meadowlark

Participants Date 4/9/2021

Laura Howe	NCAT/EEP	NA	
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Goals

Verify exhaust flow	Occupancy control	On/off

Test #1 Verify Exhaust, occupancy control

Test Procedure	Expected response	Actual Response	Actual Response	Actual Response	Actual Response	Actual Response	Actual Response	Actual Response
Fan ID		**EF242**	**EF244**	**EF245**	**EF246**	**EF254**		
Enter room	• Fan turns on (lights also) • Note operation, vibration/ noise	Yes OK	Yes OK	Yes OK	Yes OK	Yes OK		
Test air velocity	• Verify airflow velocity to verify flow	Yes	Yes	Yes	Yes	Yes		
Wait for occ timer to shut fan off	• Did it shut off automatically?	Yes	Yes	Yes	Yes	Yes		
Turn switch off	• Lights and fan turn off	Yes	Yes	Yes	Yes	Yes		
Turn switch on	• Lights and fans turn on	Yes	Yes	Yes	Yes	Yes		
Pass?		Yes	Yes	Yes	Yes	Yes		

END OF FUNCTIONAL PERFORMANCE TEST

Energy Recovery Ventilator (ERV-1) - Functional Performance Test

YWCA Meadowlark

Participants Date 4/5/2021

Laura Howe	NCAT/EEP	Tim Kester	Garden City Plumbing and Heating
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Prerequisites

Air side TAB complete	X	Startup report provided	X

Testing Goals

Supply temperature control (min 70)	On/off and damper operation	Power failure & recovery

Sensor Calibration Checks

General	Sensor reading	Field Measurement	Pass/ Fail
Discharge Air Temperature	80°F	80°F	PASS

Operational Checks

Unit operation, no unusual noise, vibration, etc	OK
Damper operation, no unusual noise	OK
Dampers fully open and closure	OK
Verify timeclock has operation 24x7	Yes

Test #1 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
A – Power failure recovery				
Cut power to unit	Shut of disconnect	• Unit shuts off • All dampers close	Yes Yes	
Resume normal operation	Turn disconnect back on	• Unit turns on and resumes normal operation • Dampers open	Yes Yes	
Comments:				

Test #2 Verify Operation and Duct heater **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start – Unit running, duct heater off	Measure air temperatures	• Outside air temp • Exhaust air temp • Return air temp • Supply air temp • Duct heater status	36.5°F 52.4°F 64.5°F 63°F ON	
Test duct heater	Conduct when colder than 60 outside Turn duct heater on	• Supply air temp • Duct heater status • Is DH DAT setpoint = 70°F • Heat recovery efficiency (calc)	63°F On 68°F 94%	

Repeat duct heater test at higher setpoint	Raise setpoint to 80	• Supply air temp • Duct heater status • Is DAT of DH = 80?	63°F On 80°F - Yes	
Resume Normal Operation				
Comments: DH temp had enough variability that a DH DAT=68°F when the setpoint was 70°F, is adequate.				

END OF FUNCTIONAL PERFORMANCE TEST

VTAC - Functional Performance Test

YWCA Meadowlark.....

Tag	VT-255	Date	3/18/2021 & 4/9/2021
Device Location	2nd floor lounge	Service Area	2nd floor lounge

Participants

Laura Howe	NCAT/EEP	Tim Kester	Garden City Plumbing and Heating
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Prerequisites

Air side TAB complete	Yes	Startup report provided	Yes

Testing Goals

Room temperature control	Heating and electrical supplemental heating	Cooling
Ventilation Fan operation	Power failure recovery	

Preliminary Settings

Variable	Initial Setting	Returned post testing?
Ventilation switch, on/off		Leave in ON

Sensor Calibration Checks

General	Sensor reading	Field Measurement	Pass/ Fail
Room Air Temperature	64°F	64°F	PASS

Installation and Operational Checks

Unit/fan operation, no unusual noise, vibration, etc	OK
Compressor operation, no unusual noise, vibration, etc	OK
Check exterior wall seal for gaps	OK - good

Test #1 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Power failure recovery				test date: 3/18/2021
Start with unit running				
Cut power to unit	Shut of disconnect	• Unit Shuts off	Yes	
Resume Normal Operation	Turn disconnect back on	• Unit turns on and resumes normal operation	Yes	
Comments:				

Test #2 Verify Room Air Temperature Control - heating **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start – Unit running	Apply ice pack to sensor to simulate a cool room.	• Note space temp setpoint • Space temperature drops • Unit goes into heat pump heating • DAT rises, note • Electric heat stays off	Sp 65°F, 66°F temp at start Yes Yes, heating Yes OK	
Call for more heating	Remove ice from thermostat Raise setpoint on thermostat	• Space temperature returns to normal • Note space temp setpoint • Unit goes into heat pump heating • DAT, note • Electric heat stays off	Yes, 66°F SP raised to 69°F Yes heating DAT 75°F and rising, (OK low load) OK	
Test auxiliary electric strip heat	Simulate OAT below 30°F* – put sensor on ice	• Heat pump shuts down • Electric strip heat turns on. • Note unit response, DAT	Yes, compressor off Yes, 85°F DAT and rising	
Resume Normal Operation	Return setpoint to original	• Unit resumes normal operation	Yes, compressor on	
Comments: *Unit currently has a 36°F lockout temperature on the compressor by Friedrich. Once Friedrich resolves issues, this lockout will need to be removed from every VTAC unit in the building.				

Test #3 Verify Room Air Temperature Control – Cooling **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Simulate a call for cooling	Lower space temp setpoint	• Note space temp setpoint • Note space temperature • Unit goes into cooling • DAT drops, note	64°F 68°F Yes 57°F (OK, low load)	
	Lower setpoint more	• Note space temp setpoint • Unit stays in cooling • DAT drops, note	Sp already at low limit Yes 57°F and dropping to 40°F -OK	
Resume normal operation	Return setpoint to original	• Space Temperature returns to normal • Unit resumes normal operation	Yes satisfied, compressor off, fan off.	
Comments:				

Test #4 Verify Ventilation Airflow **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start: Unit running in floating, ventilation air off, OAT must be significantly different than room temp for this test to be valid.				
	Measure air velocity unit off and vent fan switch off	• Note supply air velocity, should be zero	zero	
	Turn ventilation air switch on Measure air velocity	• Note supply air velocity, flow should be observed	80 fpm	
Resume normal operation		•		
Comments:				

Test #5 Verify Thermostat Programming **PASS**

Test date: 4/9/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start: Unit running in floating, ventilation air off, OAT must be significantly different than room temp for this test to be valid.				
	Verify thermostat programming settings	• VTAC settings: (#7, #10, #11, #16 all NA) #2=0.5°F #3=1°F #4=-0.5°F #5=5 min #6=1 min #8=23 (11 pm) #9=0 (midnight) #12=15 min #13=65°F #14=15 mins #15=78°F #17=64°F #18=76°F #19=1°F #20=1 #21=3 #22=0	Yes to all	
Test setpoint deadband settings	Lower setpoint	• Start satisfied • Lower setpoint 1 degree • Unit should not change, stay satisfied	Yes Yes, from 68°F to 67°F	
	Lower setpoint further	• Lower setpoint 1 more degree • Unit turns on in cooling • Note DAT	Yes, from 67°F to 66°F Yes, compressor on 54°F, OK	

	Return to original	• Raise setpoint back to original • Unit turns off, satisfied • Vent fan continues to run	Yes, to 68°F Yes, off Yes, ventilation fan runs	
Heating 1st/2nd stage deadband	Raise setpoint to 70	• Unit turns on, heating 1st stage, note DAT	Yes, on and DAT 75°F (OK, low load)	
Heating 2nd stage	Raise setpoint 2 more degrees	• 2nd stage heating activates, note DAT	Yes, to 72°F Yes, DAT 90°F	
Resume Normal Operation	Return setpoint to original	• Unit shuts off satisfied	Yes	
Comments:				

END OF FUNCTIONAL PERFORMANCE TEST

VTAC - Functional Performance Test

YWCA Meadowlark.....

Tag	VT-259	Date	3/18/2021 & 4/9/2021
Device Location	2nd floor office 259	Service Area	2nd floor office 259

Participants

Laura Howe	NCAT/EEP	Tim Kester	Garden City Plumbing and Heating
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Prerequisites

Air side TAB complete	Yes	Startup report provided	Yes

Testing Goals

Room temperature control	Heating and electrical supplemental heating	Cooling
Ventilation Fan operation	Power failure recovery	

Preliminary Settings

Variable	Initial Setting	Returned post testing?
Ventilation switch, on/off		Leave in ON

Sensor Calibration Checks

General	Sensor reading	Field Measurement	Pass/ Fail
Room Air Temperature	63°F Adjusted to 66°F	65.6°F	Initial Fail **PASS**

Installation and Operational Checks

Unit/fan operation, no unusual noise, vibration, etc	OK
Compressor operation, no unusual noise, vibration, etc	OK
Check exterior wall seal for gaps	**Corner Gaps**

Test #1 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Power failure recovery				test date: 3/18/2021
Start with unit running				
Cut power to unit	Shut of disconnect	• Unit Shuts off	Yes	
Resume Normal Operation	Turn disconnect back on	• Unit turns on and resumes normal operation	Yes	
Comments:				

Test #2 Verify Room Air Temperature Control - heating **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start – Unit running	Apply ice pack to sensor to simulate a cool room.	• Note space temp setpoint • Space temperature drops • Unit goes into heat pump heating • DAT rises, note • Electric heat stays off	Sp 64°F, 64°F temp at start Yes - 59°F Yes, heating Yes OK	
Call for more heating	Remove ice from thermostat Raise setpoint on thermostat	• Space temperature returns to normal • Note space temp setpoint • Unit goes into heat pump heating • DAT, note • Electric heat stays off	Yes, 63°F SP raised to 67°F Yes heating DAT 76°F and rising, (OK low load) OK	
Test auxiliary electric strip heat	Simulate OAT below 30°F* – put sensor on ice	• Heat pump shuts down • Electric strip heat turns on. • Note unit response, DAT	Yes, compressor off Yes, 85°F DAT and rising	
Resume Normal Operation	Return setpoint to original	• Unit resumes normal operation	Yes, compressor on	

Comments: *Unit currently has a 36°F lockout temperature on the compressor by Friedrich. Once Friedrich resolves issues, this lockout will need to be removed from every VTAC unit in the building.

Test #3 Verify Room Air Temperature Control – Cooling **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Simulate a call for cooling	Lower space temp setpoint	• Note space temp setpoint • Note space temperature • Unit goes into cooling • DAT drops, note	67°F 67°F Yes 57°F (OK, low load)	
	Lower setpoint more	• Note space temp setpoint • Unit stays in cooling • DAT drops, note	Sp lowered to 64°F Yes 50°F and dropping-OK	
Resume normal operation	Return setpoint to original	• Space Temperature returns to normal • Unit resumes normal operation	Yes satisfied, compressor off, fan off.	

Comments:

Test #4 Verify Ventilation Airflow **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start: Unit running in floating, ventilation air off, OAT must be significantly different than room temp for this test to be valid.				
	Measure air velocity unit off and vent fan switch off	• Note supply air velocity, should be zero	zero	
	Turn ventilation air switch on Measure air velocity	• Note supply air velocity, flow should be observed	60 fpm	
Resume normal operation		•		
Comments: Note the ventilation air is unheated/uncooled when the thermostat is satisfied and the unit's fan and compressor are off. This could result in occupants feeling colder air coming out of the supply grille during those times and this is normal.				

Test #5 Verify Thermostat Programming **PASS**

Test date: 4/9/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start: Unit running in floating, ventilation air off, OAT must be significantly different than room temp for this test to be valid.				
	Verify thermostat programming settings	• VTAC settings: (#7, #10, #11, #16 all NA) #2=0.5°F #3=1°F #4=-0.5°F #5=5 min #6=1 min #8=23 (11 pm) #9=0 (midnight) #12=15 min #13=65°F #14=15 mins #15=78°F #17=64°F #18=76°F #19=1°F #20=1 #21=3 #22=0	Yes to all	
Test setpoint deadband settings	Lower setpoint	• Start satisfied • Lower setpoint 1 degree • Unit should not change, stay satisfied	Yes Yes, from 70°F to 69°F	
	Lower setpoint further	• Lower setpoint 1 more degree • Unit turns on in cooling	Yes, from 69°F to 68°F Yes, compressor on	

	Return to original	• Raise setpoint back to original • Unit turns off, satisfied • Vent fan continues to run	Became satisfied during test at 68°F Yes, off Yes, ventilation fan runs	
Heating deadband	Raise setpoint one degree	• No change, unit stays off	Yes	
Heating 1st stage stage	Raise setpoint 1 more degree	• 1st stage heating activates,	Yes, to 70°F	
Resume Normal Operation	Return setpoint to original	• Unit shuts off satisfied	Yes	
Comments:				

END OF FUNCTIONAL PERFORMANCE TEST

VTAC - Functional Performance Test

YWCA Meadowlark.....

Tag	VT-305	Date	3/18/2021 & 4/9/2021
Device Location	2nd floor office 305	Service Area	2nd floor office 305

Participants

Laura Howe	NCAT/EEP	Tim Kester	Garden City Plumbing and Heating
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Prerequisites

Air side TAB complete	Yes	Startup report provided	Yes

Testing Goals

Room temperature control	Heating and electrical supplemental heating	Cooling
Ventilation Fan operation	Power failure recovery	

Preliminary Settings

Variable	Initial Setting	Returned post testing?
Ventilation switch, on/off		Leave in ON

Sensor Calibration Checks

General	Sensor reading	Field Measurement	Pass/ Fail
Room Air Temperature	63°F Adjusted to 66°F	65.6°F	Initial Fail **PASS**

Installation and Operational Checks

Unit/fan operation, no unusual noise, vibration, etc	OK
Compressor operation, no unusual noise, vibration, etc	OK
Check exterior wall seal for gaps	**Corner Gaps**

Test #1 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Power failure recovery				test date: 3/18/2021
Start with unit running				
Cut power to unit	Shut of disconnect	• Unit Shuts off	Yes	
Resume Normal Operation	Turn disconnect back on	• Unit turns on and resumes normal operation	Yes	
Comments:				

Test #2 Verify Room Air Temperature Control - heating **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start – Unit running	Apply ice pack to sensor to simulate a cool room.	• Note space temp setpoint • Space temperature drops • Unit goes into heat pump heating • DAT rises, note • Electric heat stays off	Sp 64°F, 64°F temp at start Yes - 59°F Yes, heating Yes OK	
Call for more heating	Remove ice from thermostat Raise setpoint on thermostat	• Space temperature returns to normal • Note space temp setpoint • Unit goes into heat pump heating • DAT, note • Electric heat stays off	Yes, 63°F SP raised to 67°F Yes heating DAT 76°F and rising, (OK low load) OK	
Test auxiliary electric strip heat	Simulate OAT below 30°F* – put sensor on ice	• Heat pump shuts down • Electric strip heat turns on. • Note unit response, DAT	Yes, compressor off Yes, 85°F DAT and rising	
Resume Normal Operation	Return setpoint to original	• Unit resumes normal operation	Yes, compressor on	

Comments: *Unit currently has a 36°F lockout temperature on the compressor by Friedrich. Once Friedrich resolves issues, this lockout will need to be removed from every VTAC unit in the building.

Test #3 Verify Room Air Temperature Control – Cooling **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Simulate a call for cooling	Lower space temp setpoint	• Note space temp setpoint • Note space temperature • Unit goes into cooling • DAT drops, note	67°F 67°F Yes 57°F (OK, low load)	
	Lower setpoint more	• Note space temp setpoint • Unit stays in cooling • DAT drops, note	Sp lowered to 64°F Yes 50°F and dropping-OK	
Resume normal operation	Return setpoint to original	• Space Temperature returns to normal • Unit resumes normal operation	Yes satisfied, compressor off, fan off.	

Comments:

Test #4 Verify Ventilation Airflow **PASS**

Test date: 3/18/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start: Unit running in floating, ventilation air off, OAT must be significantly different than room temp for this test to be valid.				
	Measure air velocity unit off and vent fan switch off	• Note supply air velocity, should be zero	zero	
	Turn ventilation air switch on Measure air velocity	• Note supply air velocity, flow should be observed	60 fpm	
Resume normal operation		•		
Comments: Note the ventilation air is unheated/uncooled when the thermostat is satisfied and the unit's fan and compressor are off. This could result in occupants feeling colder air coming out of the supply grille during those times and this is normal.				

Test #5 Verify Thermostat Programming **PASS**

Test date: 4/9/2021

	Test Procedure	Expected response	Actual Response	Pass/ Fail
Start: Unit running in floating, ventilation air off, OAT must be significantly different than room temp for this test to be valid.				
	Verify thermostat programming settings	• VTAC settings: (#7, #10, #11, #16 all NA) #2=0.5°F #3=1°F #4=-0.5°F #5=5 min #6=1 min #8=23 (11 pm) #9=0 (midnight) #12=15 min #13=65°F #14=15 mins #15=78°F #17=64°F #18=76°F #19=1°F #20=1 #21=3 #22=0	Yes to all	
Test setpoint deadband settings	Lower setpoint	• Start satisfied • Lower setpoint 1 degree • Unit should not change, stay satisfied	Yes Yes, from 70°F to 69°F	
	Lower setpoint further	• Lower setpoint 1 more degree • Unit turns on in cooling	Yes, from 69°F to 68°F Yes, compressor on	

	Return to original	• Raise setpoint back to original • Unit turns off, satisfied • Vent fan continues to run	Became satisfied during test at 68°F Yes, off Yes, ventilation fan runs	
Heating deadband	Raise setpoint one degree	• No change, unit stays off	Yes	
Heating 1st stage stage	Raise setpoint 1 more degree	• 1st stage heating activates,	Yes, to 70°F	
Resume Normal Operation	Return setpoint to original	• Unit shuts off satisfied	Yes	
Comments:				

END OF FUNCTIONAL PERFORMANCE TEST

Mini-split Air Conditioner - Functional Performance Test

YWCA Meadowlark

Tag	**FC/HP-128**	**Date**	**5/5/2021**
Device Location	**Dish Room**	**Service Area**	Dish Room

Participants

Laura Howe	NCAT/EEP	Tim Kester	Garden City Plumbing and Heating
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Goals

Room temperature control	Cooling	Return from power failure

Operational Checks

FC operation, no unusual noise, vibration, etc	OK

Test #1-Verify Room Air Temperature Control – Cooling **PASS**

	Test Procedure	Expected response	Actual Response	Pass/Fail
Simulate a call for cooling	Lower space temperature setpoint.	• Note space temp setpoint • Unit turns on and goes into cooling • DAT cold? note	Yes Yes	
Resume normal operation	Put setpoint back to original	• Unit shuts down	Yes	

Test #2 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/Fail
Power failure recovery				
Start –CU running				
	Cut power to unit	• CU shuts off	Yes	
Resume normal operation	Turn power switch back on	• Unit Starts back up • Unit properly responds to thermostat, note status	Yes Yes	

END OF FUNCTIONAL PERFORMANCE TEST

Mini-split Air Conditioner - Functional Performance Test

YWCA Meadowlark

Tag	**FC/HP-151**	**Date**	**5/5/2021**
Device Location	**Dish Room**	**Service Area**	Dish Room

Participants

Laura Howe	NCAT/EEP	Tim Kester	Garden City Plumbing and Heating
Commissioning Provider Name	Company Name	Mechanical Contractor	Company Name

Testing Goals

Room temperature control	Cooling	Return from power failure

Operational Checks

FC operation, no unusual noise, vibration, etc	OK

Test #1-Verify Room Air Temperature Control – Cooling **PASS**

	Test Procedure	Expected response	Actual Response	Pass/Fail
Simulate a call for cooling	Lower space temperature setpoint.	• Note space temp setpoint • Unit turns on and goes into cooling • DAT cold? note	Yes Yes	
Resume normal operation	Put setpoint back to original	• Unit shuts down	Yes	

Test #2 Test Interlocks and Safeties **PASS**

	Test Procedure	Expected response	Actual Response	Pass/Fail
Power failure recovery				
Start –CU running				
	Cut power to unit	• CU shuts off	Yes	
Resume normal operation	Turn power switch back on	• Unit Starts back up • Unit properly responds to thermostat, note status	Yes Yes	

END OF FUNCTIONAL PERFORMANCE TEST

Appendix L

Functional Performance Testing Reports - Lighting

Energy Efficiency Program

Lighting Controls - Functional Performance Test

YWCA Meadowlark – lighting testing

Testing Date: April 4, 2021

Room #	Verify no false "on" from adjacent traffic. Start: all off. Walk by room to confirm no false trip.	Verify automatic on. Go in room, confirm lights turn on.	Verify switching, occupancy sensors, dimming - per plans	Leave room to test auto-off. Note time left room:	Verify lights turn off automatically. Note time lights turn off:	Calculate duration lights stayed on:	Pass?
130/131	Yes	Yes	Yes to all except possible no dimmer over islands	9:45	-	OK	Pass
123	Yes	Yes	Yes	9:42	9:58	16 mins	Pass
103	Yes	Yes	Yes	9:55	**Did not turn off**	NA	**Fail**
101	Yes	Yes	Yes	9:30	9:42	12 mins	Pass
121/122	Yes	Yes	Yes	9:31	9:42	11 mins	Pass
100B-W	Yes	Yes	Yes	9:48	9:59	11 mins	Pass
125	Yes	Yes	Yes	9:32	9:45	13 mins	Pass
100B-hall	Yes	Yes	Yes	10:00	10:15	15 mins	Pass
100B-circ	Yes	Yes	Yes	10:00	10:15	15 mins	Pass
102	Yes	Yes	Yes	10:00	10:16	16 mins	Pass
104	Yes	Yes	Yes	10:03	10:13	10 mins	Pass
105	Yes	Yes	Yes	10:20	**Did not turn off (10:50)**	NA	**Fail**
106	Yes	Yes	Yes	10:20	**Did not turn off (10:50)**	NA	**Fail**
108	Yes	Yes	Yes	10:22	10:29	7 mins	Pass
109	Yes	Yes	Yes	10:22	10:29	7 mins	Pass
107	NA-closed door	Yes	Yes	10:24	10:45	21 mins	Pass
161	OK	Yes	Yes	10:27	10:45	18 mins	Pass
162	OK	Yes	Yes	10:27	10:45	18 mins	Pass
163	OK	Yes	Yes	10:27	10:45	18 mins	Pass
164	OK	Yes	Yes	10:26	10:45	19 mins	Pass
165	OK	Yes	Yes	10:25	10:45	20 mins	Pass
166	OK	Yes	Yes	10:25	10:45	20 mins	Pass
100A – lobby	OK	OK	**Not per plans**	-	-	NA	**Fail**
151	OK	Yes	Yes	10:56	-	-	Pass

Energy Efficiency Program

Room #	**Verify no false "on" from adjacent traffic.** Start: all off. Walk by room to confirm no false trip	**Verify automatic on**. Go in room, confirm lights turn on.	Verify switching, occupancy sensors, dimming - per plans	**Leave room to test auto-off** Note time left room:	**Verify lights turn off automatically** Note time lights turn off:	Calculate duration lights stayed on:	Pass?
Stairwell S1A	**Always on**	Yes	**Not dimming properly**	-	-	-	**Fail**
154	OK	Yes	Yes	10:48	**Did not turn off (11:27)**	NA	**Fail**
155	OK	Yes	Yes	10:48	**Did not turn off (11:27)**	NA	**Fail**
156	OK	Yes	Yes	10:48	**Did not turn off (11:27)**	NA	**Fail**
157	OK	Yes	Yes	10:49	-	-	Pass
158	OK	Yes	Yes	10:49	-	-	Pass
160	OK	Yes	Yes	10:49	11:02	13 mins	Pass
143	OK	Yes	Yes	10:50	11:04	14 mins	Pass
142	OK	Yes	Yes	10:50	11:04	14 mins	Pass
150	OK	Yes	Yes	10:51	11:05	14 mins	Pass
167	OK	Yes	Yes	10:51	11:05	14 mins	Pass
144	OK	Yes	Yes	10:52	11:00	8 mins	Pass
145	OK	Yes	Yes	10:52	11:00	8 mins	Pass
146	OK	Yes	Yes	10:52	11:05	13 mins	Pass
147	OK	Yes	Yes	11:05	-	OK	Pass
148	OK	Yes	Yes	10:52	11:05	13 mins	Pass
178	**No**	Yes	**No – missing fixture U/ switch not complete. No dimming over island**	-	-	OK	**Fail**
172	Yes	Yes	Yes	11:24	<11:56	<32 mins	Pass
171	Yes	Yes	Yes	11:24	**Did not turn off (12:00)**	NA	**Fail**
171A	Yes	Yes	Yes	11:24	11:37	15 mins	Pass
179	Yes	Yes	Yes	11:24	11:37	15 mins	Pass
176	Yes	Yes	Yes	11:21	11:37	16 mins	Pass
100D (DV circ)	Yes	Yes	Yes	11:22	11:37	15 mins	Pass
173	Yes	Yes	Yes	11:22	11:37	15 mins	Pass

Energy Efficiency Program

Room #	**Verify no false "on" from adjacent traffic.** Start: all off. Walk by room to confirm no false trip	**Verify automatic on**. Go in room, confirm lights turn on.	Verify switching, occupancy sensors, dimming - per plans	**Leave room to test auto-off** Note time left room:	**Verify lights turn off automatically** Note time lights turn off:	Calculate duration lights stayed on:	Pass?
105A	Yes	Yes	Yes	11:30	11:41	11 mins	Pass
105B	Yes	Yes	Yes	11:30	11:41	11 mins	Pass
Stairwell S1C (DV)	Yes	-	-	-	**Not dimming properly**	-	**Fail**
221	Yes	Yes	Yes	12:15	12:27	12 mins	Pass
225	Yes	Yes	Yes	12:13	12:24	9 mins	Pass
223	Yes	Yes	Yes	12:35	12:56	28 mins	Pass
223A	No lights	-	-	-	-	-	-
258	Yes	Yes	Yes	11:48	12:08	20 mins	Pass
259	Yes	Yes	Yes	12:09	12:25	16 mins	Pass
256	Yes	Yes	**1st light does not dim**	12:08	12:56	48 mins	**Fail**
254	Yes	Yes	Yes	11:47	12:06	19 mins	Pass
252	Yes	Yes	Yes	11:46	12:06	20 mins	Pass
255	Yes	Yes	Yes	11:49	**Did not turn off (12:23)**	NA	**Fail**
257	Yes	Yes	Yes	11:50	12:09	19 mins	Pass
257B	Yes	Yes	Yes	11:50	12:09	19 mins	Pass
242	Yes	Yes	Yes	11:51	12:11	20 mins	Pass
243	No lights	-	-	-	-	-	-
244	Yes	Yes	Yes	11:52	12:22	30 mins	Pass
245	Yes	Yes	Yes	11:52	12:22	30 mins	Pass
246	Yes	Yes	Yes	11:52	12:23	31 mins	Pass
233	Yes	Yes	Yes	12:18	12:28	10 mins	Pass
Stairwell S1C	Yes	-	-	-	**Not dimming properly**	-	**Fail**
305	Yes	Yes	Yes	12:39	12:54	15 mins	Pass
307	Yes	Yes	Yes	12:40	12:54	14 mins	Pass
307B	Yes	Yes	Yes	12:40	12:54	14 mins	Pass
Note: The "time lights turned off" is the earliest time that the lights were observed to be off. In many cases, the lights were off before that time stamp and the ON duration was shorter than calculated with this off time.							

END OF FUNCTIONAL PERFORMANCE TEST

Energy Efficiency Program

Lighting Controls - Functional Performance Test

YWCA Meadowlark – lighting testing

Testing Date__April 15, 2021__

Room #	Verify no false "on" from adjacent traffic. Start: all off. Walk by room to confirm no false trip	Verify automatic on. Go in room, confirm lights turn on.	Leave room to test auto-off. Note time left room:	Verify lights turn off automatically. Note time lights turn off:	Calculate duration lights stayed on:	Pass?
Basement Garage	NA	Yes – must get very close to each fixture before it turns on	NA	NA	**1-2 minutes**	**Fail**

END OF FUNCTIONAL PERFORMANCE TEST

Energy Efficiency Program

Lighting Controls - Functional Performance Test

YWCA Meadowlark – lighting retesting of deficiencies

Testing Date: May 3, 2021

Room #	Verify no false "on" from adjacent traffic. Start: all off. Walk by room to confirm no false trip	Verify automatic on. Go in room, confirm lights turn on.	Leave room to test auto-off. Note time left room:	Verify lights turn off automatically. Note time lights turn off:	Calculate duration lights stayed on:	Pass?
128-dish	OK	Yes	5:58	6:13	15 mins	Pass
103	OK	Yes	5:50	**Did not turn off (6:13)**	NA	**Fail**
105	OK	Yes	5:52	6:15	23 mins	Pass
106	**No, hallway activity turned lights on**	Yes	5:52	6:17	25 mins	**Fail**
156	OK	Yes	6:10	**Did not turn off (6:31)**	NA	**Fail**
155	**No, hallway activity turned lights on**	Yes	5:54	6:09	15 mins	**Fail**
154	OK	Yes	5:55	6:11	16 mins	Pass
178, 171, 100D	OK	Yes	6:12	6:30	18 mins	Pass
178 -switching and fixtures	Switching is now correct	Fixture U installed	No dimmer over islands OK	NA	NA	Pass
158-mech	OK	Yes	6:00	6:17	17 mins	Pass
129	OK	Yes	6:05	6:17	12 mins	Pass
151	OK	Yes	5:56	6:16	20 mins	Pass
255	OK	Yes	6:02	6:21	19 mins	Pass
256-fixture dimming	No change – accepted by DC	NA	NA	NA	NA	Pass
130-island dimmers	No change – confirmed OK by DC	NA	NA	NA	NA	Pass
SW Stair	NA	Yes – lights go bright from dim	NA	Yes	NA	Pass
NE Stair	NA	Yes – lights go bright from dim	NA	Yes	NA	Pass
Basement Garage	NA	Yes	6:25	6:38	<13 min	Pass

END OF FUNCTIONAL PERFORMANCE TEST