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| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | November 16, 2009 | Modified ‘Related Sections’ and approved suppliers |
| 3 | September 28, 2010 | Minor revisions |
| 4 | December 16, 2014 | First draft review comments (AV). |
| 5 | June 8, 2015 | Second Draft for Review (AV) |
| **6** | **September 16, 2015** | **Updated, Finalized Specification – Reference eDOCS #5823638-v4 (AV)** |

NOTE:

This is a CONTROLLED Document. Any documents appearing in paper form are not controlled and should be checked against the on-line file version prior to use.

**Notice:** This Document hardcopy must be used for reference purpose only.

**The on-line copy is the current version of the document.**

# GEneral

* 1. Related Sections

*[Under "Related Sections", identify other Sections that are related to, and/or dependent on, the work results or information specified elsewhere. The list should be limited to Sections with specific information that the reader might expect to find in this Section, but is specified elsewhere. For example, if hardware for aluminum entrances is specified in the aluminum entrance Section, a cross-reference would be appropriate in the finish hardware Section. The purpose of this cross-referencing is for information only, to aid in finding those other requirements—not to define the scope of the Section.*

*Cross-referencing here may also be used to coordinate assemblies or systems whose components may span multiple Sections and which must meet certain performance requirements as an assembly or system.*

*Contractor is responsible for coordination of the Work.*

*This Section is to be completed/updated during the design development by the Consultant. If it is not applicable to the Section for the specific project, it may be deleted.]*

*[List Sections specifying installation of products supplied but not installed under this Section and indicate specific items.]*

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Execution requirements for ...[item]... specified under this Section.

*[List Sections specifying products installed but not supplied under this Section and indicate specific items.]*

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Product requirements for ...[item]... for installation under this Section.

[List Sections specifying related requirements.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: [Optional short phrase indicating relationship].

#### Section 01300 – Submittals

#### Section 01425 – Computerized Maintenance Management System Data Requirements

#### Section 01810 – Equipment Testing and Facility Commissioning

#### Section 15950 – HVAC Systems Testing, Adjusting, and Balancing

## References

*[Delete .1 if Section 01060 – Regulatory Requirements is included in Contract Documents.]*

### Comply with the latest edition of the following statutes, codes, standards, and all amendments thereto:

#### Air Movement and control Association, Inc. (AMCA):

##### ANSI/AMCA 203-90 (R2011), Field Performance Measurement of Fan Systems.

#### American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

##### 2011 ASHRAE Handbook - HVAC Applications.

#### Associated Air Balance Council (AABC):

##### AABC National Standards for Field Management and Instrumentation Total System Balance 2002.

#### National Environmental Balancing Bureau (NEBB):

##### Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems, 2005 – seventh edition.

##### Procedural Standards for Measuring Sound and Vibration, second edition – September 2006.

#### Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA):

##### HVAC Testing, Adjusting, and Balancing Manual.

## Measurement and Payment

*[Choose one of the following payment language provisions that best suits the individual project.*

*If this Section is not specifically referenced by an item in the Bid Form, please use the following language:*

.1 The work of this Section will not be measured separately for payment. All costs associated with the work of this Section shall be included in the Contract Price.

*OR If this Section is specifically referenced in the Bid Form, use the following language and identify the relevant item in the Bid Form:*

.1 All costs associated with the work of this Section shall be included in the price(s) for Item No(s). \_\_\_ in the Bid Form.

*If the work of this Section is to be measured and paid for by several different methods, please amend the standard wording given above to reflect the different methods of measurement and payment.*]

## Submittals

### Informational Submittals, in accordance with Section 01300 - Submittals:

#### Documentation of experience record of testing authority.

#### Documentation of current AABC or NEBB certifications for those technicians in responsible charge of the work under this Contract.

#### Submit detailed test and balance procedures, including test conditions for the systems to be tested, prior to the beginning of the Work.

#### Written verification of calibration of testing and balancing equipment.

#### Balancing Log Report following completion of system adjustments including test results, adjustments, and rebalancing procedures.

## Quality Assurance

### Air Balancing and Test Agency Qualifications:

#### Air Balancing and Test Agency to be retained and all costs borne by the Contractor.

#### Certification by AABC of NEBB for testing, adjusting and balancing of HVAC systems.

#### Corporately and financially independent organization functioning as an unbiased testing authority.

#### Professionally independent of manufacturers, suppliers, and installers of HVAC equipment being tested.

#### Have a proven record of at least five similar projects.

#### Employer of engineers and technicians regularly engaged in testing, adjusting and balancing of HVAC equipment and systems.

# PRODUCTS

## Materials

### Provide materials, tools, test equipment, computers and instrumentation required to complete the work of this Section.

### Test Hole Plugs: Plug test holes in ducts with plugs made for that purpose and replace any insulation removed.

### Drives for Belt-Driven Fans:

#### Furnish cast iron or flanged steel sheaves.

#### Sheaves and belt combination shall be capable of providing 150 percent of motor horsepower.

## Motorized Damper

### Approved Suppliers:

#### Belimo Air Controls Canada Inc.

#### Honeywell International Inc.

#### Johnson Controls

#### Approved Equivalent

## Fire Alarm System

### Approved Suppliers:

#### *[Consultant to provide names of three acceptable products]*

#### Approved Equivalent

## Building Thermostat

### Approved Suppliers:

#### Ashcroft Inc.

#### Honeywell International Inc.

#### Emerson Electric Co. ; Fisher-Rosemount

#### Approved Equivalent

## Ventilation Damper

### Approved Suppliers:

#### T.A. Morrison & Co. Inc.

#### Ruskin Company

#### Approved Equivalent

## Ventilation Dehumidification (Electric)

### Approved Suppliers:

#### Munters Corp.

#### Dectron Internationale

#### Approved Equivalent

## Dehumidifiers (Gas)

### Approved Suppliers:

#### Thomas & Betts Canada

#### Ebac Group Ltd.

#### Approved Equivalent

## Building Heat Detector

### Approved Suppliers:

#### Honeywell International Inc.

#### Johnson Controls

#### Schneider Electric; Barber Colman.

#### Approved Equivalent

# EXECUTION

## General

### Adjust and balance air and water systems in accordance with standard procedures and recognized practices of the AABC (Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems, 2005 – seventh edition and Procedural Standards for Measuring Sound and Vibration, second edition – September 2006, or SMACNA (HVAC Testing, Adjusting, and Balancing Manual).

### [Adjust and balance the following systems:

#### [Supply, return and exhaust air systems.]

#### [Heating, cooling, dehumidification/glycol, condenser, and heat recovery water systems.]

#### [ .]]

## Adjusting and Balancing Air Side

### Preparation:

#### Prior to commencing the work of this Section, perform the following activities:

##### Review shop drawings and installed system for adequate and accessible balancing devices and test points.

##### Recommend to the Consultant dampers that need to be added or replaced in order to obtain proper air control.

##### Verify proper startup procedures have been completed on the system.

##### Verify controls installation is complete and system is in stable operation under automatic control.

##### Verify test instruments have been calibrated to a recognized standard and are within the manufacturer’s recommended calibration interval.

### General:

#### When adjustments are made to a portion of a fan system, re-read other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.

#### Lock and mark the final positions of balancing dampers with permanent felt pen.

#### [Correct fan and airflow measurements for Site elevation.]

### Equipment Data:

#### Collect the following data and include in the final report:

##### Type of unit.

##### Equipment identification number.

##### Equipment nameplate data (including manufacturer, model, size, type, and serial number).

##### Motor data (frame, kW, volts, Full Load Amps rpm, and service factor).

##### Sheave manufacturer, size, and bore.

##### Belt size and number.

##### Sheave centreline distance and adjustment limits.

##### Starter and motor overload protection data.

##### Include changes made during course of system balancing.

##### All other required information as detailed in the equipment information template and electronically up-loadable to the Region’s CMMS (Maximo). Refer to Section 01425 - Computerized Maintenance Management System Data Requirements.

### Fan Systems:

#### Measure fan system performance in accordance with ANSI/AMCA 203-90 (R2011).

#### In each system, a minimum of one air path from fan to final branch duct termination shall have dampers fully open. Achieve final air quantities by adjusting fan speed.

#### Adjust Fan Air Volumes:

##### Adjust fan speeds and motor drives for required equipment air volumes, with allowable variation of between plus 10 percent and 0 percent.

##### After final adjustments, do not operate motor above nameplate amperage on any phase.

##### After final adjustments, do not operate fan above maximum rated speed.

##### Perform airflow test readings under simulated or actual conditions of full cooling, full heating, minimum outside air, full outside air and exhaust, and full return air.

##### Provide and make drive and belt changes on motors or fans as required to adjust the equipment to the specified conditions. Drives shall be capable of delivering 150 percent of motor horsepower. Provide written notice to the air handling unit manufacturer and [Consultant] if drive or belt changes were made.

#### Adjust outside air dampers, return air dampers, relief air dampers, exhaust air dampers, and motorized louvers for maximum and minimum air requirements.

#### Read and record static pressures at unit inlet and discharge, each filter set, coils, dampers, plenums, and mixing dual-duct or adjustable-volume boxes, on every supply, return, and exhaust fan for each test condition.

#### Read and record motor amperage on all phases for each test condition.

### Air Terminal Devices:

#### Terminal Airflow Calibration: Calibrate and set the flow coefficients in terminal controller units to ensure controller readings are identical to measured values. This shall be a one-point calibration at maximum flow conditions. Record coefficient values. Provide documentation to the Consultant.

#### Test each terminal flow device at minimum and maximum flow conditions. Ensure the terminal controller is under control at the time of each test.

#### If airflow of terminal device is derived from two or more flow streams, the individual air streams shall be measured and recorded independently for each test.

#### In each terminal system, a minimum of one air path from terminal to final duct termination shall have dampers fully open.

#### Adjust air volumes on each terminal to quantity shown, with allowable variation of plus 10 percent minus 5 percent.

### Air Outlets and Inlets:

#### In each system, a minimum of one air path from fan to final branch duct termination shall have dampers fully open.

#### Adjust air volumes on supply diffusers and grilles, and on return and exhaust grilles, to the quantity shown, with allowable variation of plus or minus 10 percent.

#### Adjust diffusers and grilles for proper deflection, throw, and coverage. Eliminate drafts and noise where possible.

#### After final adjustments are made, secure dampers to prevent movement and mark final positions with permanent felt pen.

### Building Static Pressure:

#### Measure building static pressure relative to outside in perimeter entrances during normal system conditions that would yield widest range in internal building pressure.

#### Adjust building static pressure control parameters to ensure perimeter entrances are [positive] [negative]to outdoors by [12 Pa] [ ]with entrance doors closed.

#### For multi-story buildings, test pressure conditions at ground, intermediate, and upper levels.

### Zone Differential Pressure:

#### Test and adjust differential pressures by setting design flows to meet required flow direction and pressure differential during worst case conditions of systems serving zone being adjusted and of adjacent zones.

#### Zone differentials for the Work include:

##### [ ] .

##### [ ].

#### Provide written notice to the Consultant of zone leakage conditions preventing design differential requirements to be met.

## Adjusting and Balancing Water Side

### Preparation: Prior to commencing the work of this Section, perform the following activities:

#### Review shop drawings and installed system for adequate and accessible balancing devices and test ports.

#### Recommend to the Consultant devices needed to be added or replaced in order to obtain proper water control.

#### Verify proper startup procedures have been completed on system.

#### Verify controls installation is complete and that the system is in stable operation under automatic control.

#### Verify that hydronic systems have been filled and are clean. Examine a sample of strainers to ensure cleanliness.

#### Verify manual air vents have been bled and that expansion tanks and automatic air vents are functioning.

#### Verify that control valves and coil connections are complete and properly installed.

### General:

#### When adjustments are made to a portion of a water system, reread other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.

#### Correctly adjust water flow readings for mixtures other than pure water.

#### Throttling of butterfly and other non-balancing device valves shall not be allowed.

#### Lock and mark final positions of balancing devices with a centrepunch or permanent felt pen.

### Equipment Data:

#### Collect the following data and include in the final report:

##### Type of pump.

##### Equipment identification number.

##### Equipment nameplate data (including manufacturer, model, size, type, impeller size and serial number).

##### Pump capacity (flow rate and differential pressure).

##### Drive data.

##### Motor data (frame, kW, volts, Full Load Amp rpm, and service factor).

##### Starter and motor overload protection data.

##### Include changes made during course of system balancing.

##### All other required information as detailed in the equipment information template and in a format electronically up-loadable to the Region’s CMMS (Maximo). Refer to Section 01425 - Computerized Maintenance Management System Data Requirements.

### Pumps:

#### Verify impeller size through a “dead-head” test. Do not perform on positive displacement pumps.

#### Adjust water to achieve design flows at all modes of operation during single and multiple pump operation.

#### Test redundant and stand-by pumps.

#### After final adjustments, do not operate motor above nameplate amperage on any phase.

#### Read and record pressures at pump inlet and discharge for each test condition.

#### Read and record motor amperage on all phases for each test condition.

#### Record and mark final position of balancing cocks, valves, and operators with a permanent felt pen or centrepunch.

#### Provide all test results and documentation to the Consultant.

### Terminal Flow Devices:

#### Adjust water systems for required flow rates at each coil, connection, and terminal device.

#### Provide proper flow through individual fin tube sections, evaporator and condenser circuits, each boiler loop, each pump, and recirculation loops.

#### Measure and adjust flow through valves and valve bypass lines.

#### Record and mark final position of balancing cocks, valves, and operators with a permanent felt pen or centrepunch.

#### Read and record differential pressures across coils, control valves, chiller bundles, boilers, and heat exchanges.

### Tolerances:

#### Heating Water Flow Rate: Plus 10 percent to minus 10 percent.

#### Chilled Water Flow Rate: Plus 10 percent to minus 0 percent.

#### Condenser Water Flow Rate: Plus 10 percent to minus 10 percent.

## Field Quality Control

### General: Perform functional and other tests as required by Section 01810 - Equipment Testing and Facility Commissioning.

### Performance Testing:

#### Electric Heating Coil Testing:

##### Adjust system as required to achieve full output from coil.

##### Read and record amperages and voltages for all phases.

#### Heating or Sensible Cooling Coil Testing:

##### Adjust system as required to achieve design flow conditions for both air and water sides of coil.

##### Measure and record airflow rate, water flow rate, entering air temperature, entering water temperature, leaving air temperature and leaving water temperature.

##### Provide all documentation to the Consultant.

#### Cooling or Dehumidification Coil Testing:

##### Adjust system as required to achieve design flow conditions for both air and water sides of coil.

##### Measure and record airflow rate, water flow rate, entering air dry bulb and wet bulb temperatures, entering water temperature, leaving air dry bulb and wet bulb temperatures and leaving water temperature.

#### Vibration Testing:

##### Upon completion of air and water system balance, perform vibration testing as specified below for the following rotating or reciprocating equipment.

##### Vibration Test Procedures:

###### Take measurements at each bearing housing, using a calibrated electronic analyzer.

###### Record log shall include equipment symbol, location, identification, and peak-to-peak displacement in a direction parallel to shaft in a horizontal plane, and in a direction perpendicular to shaft in both horizontal and vertical planes.

###### Maximum Peak-to-Peak Amplitude Levels:

|  |  |
| --- | --- |
| Rotational Speed (rpm) | Vibration Amplitude (mils) |
| 250 | 3.5 |
| 500 | 2.0 |
| 750 | 1.5 |
| 1,000 | 1.0 |
| 1,500 | 0.75 |

###### Notify the Consultant if the amplitude exceeds upper limit specified.

###### After readjustment for vibration, measure and record only the readjusted equipment to determine its conformance with design.

### Balancing Log Report Requirements:

#### Include narrative description for each system explaining Testing, Adjusting, Balancing (TAB) methodology and assumptions used. Clearly identify test conditions for tests performed. Include control setpoint.

#### Log and record operational information from every test for each system, as necessary to accomplish the services described.

#### Include equipment data for the units tested.

#### Include reduced set of HVAC Drawings or system schematic diagrams with each element uniquely identified and indexed to the balance log.

#### Indicate recorded Site values, and velocity and mass correction factors used to provide equivalent standard air quantities.

#### Include separate section in log, if necessary, describing operating difficulties in air or water systems that could not be eliminated by the specified procedures. Identify these problems by system and location within building; include an outline or summary of condition and its effect on building, and describe corrective actions attempted and recommended.

### Quality Control Verification:

#### After adjustments have been completed and balance logs submitted to the Consultant, the balancing and testing agency shall be available to demonstrate the following:

##### Air and water balancing procedures, vibration tests, and verification of test results.

##### Perform spot tests on a maximum of 20 percent of total diffusers and grilles, on two air handling fan devices per building, and on 10 percent of total water balance fittings, with measuring equipment used in original tests, at random points selected by the Consultant.

##### Results of these spot tests shall agree with balance logs within plus or minus 10 percent. Where this accuracy cannot be verified, rebalance portions of the system as requested by Consultant.

##### At completion of rebalance procedures, perform another spot test if required by the Consultant to verify the results.

## Commissioning

### For all commissioning activities on systems where components of this Section are integral to functionality, refer to Section 01810 – Equipment Testing and Facility Commissioning.

### All inspection and testing activities shall be completed in accordance with the documentation provided to the Consultant prior to start of commissioning activities.

**END OF SECTION**