

**1 PART 1 GENERAL****2 DESCRIPTION**

3 Work Included: After completion of the work of installation, test and regulate all components of the new  
4 heating, air conditioning and ventilating systems to verify air volumes and heating-cooling flow rates indicated  
5 on the Drawings.

**7 Balancing Organization:**

8 Balancing of the Heating and Air Conditioning Systems: Performed by a firm providing this service  
9 established in the State of Oregon.

10 Balancing Organization: Approval by Architect. Air Balancing Specialties, Neudorfer Engineers,  
11 Northwest Engineering Services, or approved.

12 Provide all necessary personnel, equipment, and services.

13  
14 Balancer shall perform work as a Contractor to the General Contractor directly, not through the Mechanical  
15 Contractor.

**17 QUALITY ASSURANCE**

18 Balancing of the Heating and Air Conditioning Systems: Agency shall be a current member of NEBB or  
19 AABC specializing in the adjusting and balancing of systems specified with a minimum of 10 years  
20 documented experience.

21  
22 Testing, adjusting, and balancing shall be performed under direct field supervision of a Certified NEBB  
23 Supervisor or a Certified AABC Supervisor.

24  
25 See Commissioning Specification for additional requirements.

**27 SUBMITTALS**

28 See Section in Division 1, Administrative Requirements, for submittal procedures.

29  
30 Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

31  
32 Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of  
33 systems and equipment to achieve specified performance.

34 Submit under provisions of Section 23 05 00.

35 Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and  
36 equipment data required.

37 Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for  
38 Architect and for inclusion in operating and maintenance manuals.

39 Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and  
40 indexing tabs, with cover identification at front and side. Include set of reduced Drawings with air  
41 outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.  
42 Include detailed procedures, agenda, sample report forms, and copy of AABC National Project  
43 Performance Guaranty or other certifying agency prior to commencing system balance.

44 Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE 111, NEBB  
45 forms, or forms containing information indicated in Schedules.

46 Include the following on the title page of each report:

- 47 Name of testing, adjusting, and balancing agency.
  - 48 Address of testing, adjusting, and balancing agency.
  - 49 Telephone number of testing, adjusting, and balancing agency.
  - 50 Project name.
  - 51 Project location.
  - 52 Project Architect and Owner.
  - 53 Project Engineer.
  - 54 Project Contractor.
  - 55 Project altitude.
  - 56 Report date.
- 57

1 Project Record Documents: Record actual locations of flow measuring stations and balancing valves and  
2 rough setting.

3  
4 Provide a list of equipment, air supply, return and exhaust, heating water, and chilled water systems not in  
5 compliance with tolerances subsequently specified.

## 6 **PART 2 PRODUCTS**

7 -- NOT USED --

## 8 **PART 3 EXECUTION**

### 9 EXAMINATION

10 Verify that systems are complete and operable before commencing work. Ensure the following conditions:

11 Systems are started and operating in a safe and normal condition.

12 Temperature control systems are installed complete and operable.

13 Proper thermal overload protection is in place for electrical equipment.

14 Final filters are clean and in place. If required, install temporary media in addition to final filters.

15 Duct systems are clean of debris.

16 Fans are rotating correctly.

17 Fire and volume dampers are in place and open.

18 Air coil fins are cleaned and combed.

19 Access doors are closed and duct end caps are in place.

20 Air outlets are installed and connected.

21 Duct system leakage is minimized.

22 Hydronic systems are flushed, filled, and vented.

23 Pumps are rotating correctly.

24 Proper strainer baskets are clean and in place.

25 Service and balance valves are open.

26

27 Submit field reports. Report defects and deficiencies noted during performance of services which prevent  
28 system balance.

29

30 Beginning of work means acceptance of existing conditions.

31

### 32 INSTALLATION TOLERANCES

33 Air Handling Systems: Adjust to within plus 10 percent or minus 5 percent of design for supply systems and  
34 +/- 10 percent of design for return and exhaust systems.

35

36 Air Outlets and Inlets: Adjust total to within plus 10 percent or minus 5 percent of design to space. Adjust  
37 outlets and inlets in space to within +/- 10 percent of design.

38

39 Hydronic Systems: Adjust to within +/- 10 percent of design.

40

### 41 ADJUSTING

42 Ensure recorded data represents actual measured or observed conditions.

43

44 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored.  
45 Set and lock memory stops.

46

47 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has  
48 been rectified.

49

50 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to  
51 electrical switch boxes, and restoring thermostats to specified settings.

52

53 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as  
54 selected and witnessed by the Owner.

55

- 1 AIR SYSTEM PROCEDURE
- 2 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air
- 3 quantities.
- 4
- 5 Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- 6
- 7 Measure air quantities at air inlets and outlets.
- 8
- 9 Adjust noise distribution system to obtain uniform space temperatures free from objectionable drafts and
- 10 noise.
- 11
- 12 Use volume control devices to regulate air quantities only to the extent that adjustments do not create
- 13 objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and
- 14 splitters.
- 15
- 16 Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch
- 17 air quantities by damper regulation.
- 18
- 19 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- 20
- 21 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total
- 22 pressure across the fan. Make allowances for 50 percent loading of filters.
- 23
- 24 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- 25
- 26 Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- 27
- 28 Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance
- 29 variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- 30
- 31 Measure building static pressure and adjust supply, return, and exhaust air systems to provide required
- 32 relationship between each to maintain approximately 0.02" (12.5 Pa) positive static pressure near the building
- 33 entries.
- 34
- 35 For variable air volume system powered units, set volume controller to air flow setting indicated. Confirm
- 36 connections are properly made and confirm proper operating for automatic variable air volume temperature
- 37 control. Adjust drives to maximum airflow for highest static condition (maximum amps of motor). Allow VFD
- 38 to regulate airflow per specification.
- 39
- 40 Space pressure Control, Return Fan Speed Endpoints: For variable air volume system with terminal unit
- 41 zoning, attain return fan speed control endpoints based on the following values for the given operating mode.
- 42 Coordinate with the HVAC Control Contractor for system setup and provide values when determined.
- 43

Return Fan Speed Endpoint Values				
Mode	Supply Fan Speed Hi/Lo Reset Limits	Desired Space Pressure (InH2O)	Economizer Position	Return Fan Speed
Full Heating (All terminal units are operating at heating flow setpoints)	TBD – Noted during the full heating condition	<b>Ideal - 0.02</b> Acceptable Test Range: 0.01 – 0.03	Min-Min (25% of the minimum ventilation requirement)	Minimum Return Fan Speed-TBD
Full Cooling (All terminal units are operating at cooling flow setpoints)	TBD – Noted during the full cooling condition	<b>Ideal - 0.02</b> Acceptable Test Range: 0.01 – 0.03	Min-Max (100% of the minimum ventilation requirement)	Maximum Return Fan Speed-TBD

## 1 WATER SYSTEM PROCEDURE

2 Adjust water systems to provide required or design quantities. This includes domestic HVAC systems.

3  
4 Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates  
5 for system balance. Where flow metering devices are not installed, base flow balance on temperature  
6 difference across various heat transfer elements in the system.

7  
8 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal  
9 testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

10  
11 Effect system balance with automatic control valves fully open to heat transfer elements.

12  
13 Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use  
14 service or shut-off valves for balancing unless indexed for balance point.

15  
16 Where available pump capacity is less than total flow requirements or individual system parts, full flow in one  
17 part may be simulated by temporary restriction of flow to other parts.

18  
19 Where automatic flow control valves are installed (Dynamic devices, not circuit setters) record listed flow rate  
20 of device based on field verification. Testing is not required.

21  
22 Balancing Contractor shall be trained on balancing procedures by certified representative of differential  
23 pressure control valves.

24  
25 SCHEDULES

26 Equipment Requiring Testing, Adjusting, and Balancing:

27     Packaged rooftop heating/cooling units

28     Air coils

29     Fans

30     Air terminal units

31     Air inlets and outlets

32  
33 Report:

34     Summary Comments:

35         Design versus final performance

36         Notable characteristics of system

37         Description of systems operation sequence

38         Summary of outdoor and exhaust flows to indicate amount of building pressurization

39         Nomenclature used throughout report

40         Test conditions

41     Instrument List:

42         Instrument

43         Manufacturer

44         Model number

45         Serial number

46         Range

47         Calibration date

48  
49 Electric Motors:

50     Manufacturer

51     Model/frame

52     HP/BHP

53     Phase, voltage, amperage; nameplate, actual, no load

54     RPM

55     Service factor

56     Starter size, rating, heater elements

57     Sheave make/size/model

58

59

- 1 Air Moving Equipment:
- 2 Location
- 3 Manufacturer
- 4 Model number
- 5 Serial number
- 6 Arrangement/Class/Discharge
- 7 Air flow, specified and tested
- 8 Return air flow, specified and tested
- 9 Outside air flow, specified and tested
- 10 Total static pressure (total external), specified and tested
- 11 Inlet pressure
- 12 Discharge pressure
- 13 Sheave make/size/bore
- 14 Number of Belts/Make/Size
- 15 Fan RPM
- 16
- 17 Return Air/Outside Air:
- 18 Identification/location
- 19 Supply air flow, design and tested
- 20 Return air flow, design and tested
- 21 Outside air flow, design and tested
- 22 Return air temperature
- 23 Outside air temperature
- 24 Mixed air temperature, design and tested
- 25
- 26 Exhaust Fans:
- 27 Location
- 28 Manufacturer
- 29 Model number
- 30 Serial number
- 31 Air flow, specified and tested
- 32 Total static pressure (total external), specified and tested
- 33 Inlet pressure
- 34 Discharge pressure
- 35 Sheave Make/Size/Bore
- 36 Number of Belts/Make/Size
- 37 Fan RPM
- 38
- 39 Duct Traverses:
- 40 System zone/branch
- 41 Duct size
- 42 Area
- 43 Design velocity
- 44 Design air flow
- 45 Test velocity
- 46 Test air flow
- 47 Duct static pressure
- 48 Air temperature
- 49 Air correction factor
- 50
- 51 Terminal Unit Data:
- 52 Manufacturer
- 53 Type, constant, variable, single, dual duct
- 54 Identification/number
- 55 Location
- 56 Model number
- 57 Size
- 58 Minimum static pressure
- 59 Minimum air flow, design and tested

## TESTING, ADJUSTING AND BALANCING

23 05 90-6

- 1 Maximum air flow, design and tested
- 2 Inlet static pressure, design and tested

3

### Air Distribution Tests:

- 4 Air terminal number
- 5 Room number/location
- 6 Terminal type
- 7 Terminal size
- 8 Area factor
- 9 Design velocity
- 10 Design air flow
- 11 Test (final) velocity
- 12 Test (final) air flow
- 13 Percent of design air flow

14

## DETAILED REQUIREMENTS

### Adjusting and Balancing:

15

16 Adjust and balance all portions of the mechanical systems to produce indicated results within limits of  
17 minus 5 or plus 10 percent or as subsequently directed by the Architect.

18 Balancing data may be spot checked with instruments similar to that used by the balancing firm.

19 If, in the judgment of the Architect, the discrepancies warrant additional adjustment, readjust and  
20 rebalance the systems at no additional project cost.

21

22

23

24

25

26

END OF SECTION