This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

1. GENERAL
	* + 1. DESCRIPTION
				1. This section describes adjustment, testing, and balancing of air systems, hydronic systems, and miscellaneous mechanical equipment.
			2. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 230900, Instrumentation and Controls for HVAC
				2. Section 232400, Prefabricated Piping Systems
				3. Section 232500, HVAC Water Treatment
			3. REFERENCES
				1. AABC: Associated Air Balance Council
				2. NEBB: National Environmental Balancing Bureau
			4. SUBMITTALS
				1. Submit the following:

Balancing Log: Include all air and water outlets, actual field-measured air and water volume and percentage of design volumes. Provide drawings identifying locations of all outlets.

Equipment Data Sheets: Indicate actual equipment performance, model numbers, bearing and belt data, motor nameplate data, and final balanced motor data.

Additional Data: Submit all additional data as provided by AABC or NEBB Standard forms.

Instrument Certification: When requested, submit certificate of calibration for all equipment to be used.

Adjustment and Balancing Plan and Schedule.

Use only if Commissioning Section 019100 is included in the project manual.

Coordinate with commissioning plan and schedule.

* + - 1. QUALITY ASSURANCE

For Port originated work, use A. For Tenant originated work, use B.

* + - * 1. Acceptable Testing, Adjustment, and Balancing Firms: Northwest Engineering Services, or pre-bid approved equal.
				2. Acceptable Testing, Adjustment, and Balancing Firms: Northwest Engineering Services, no substitution.
				3. Industry Standards: Testing, adjustment, and balancing shall be conducted in a manner recognized by the AABC or NEBB and recorded on forms similar to those published by the AABC or NEBB.
				4. Instrument Certification: All instruments used shall be accurately calibrated and certified within six months of balancing and maintained in good working order.
				5. Test Observation: If requested, conduct tests in the presence of the Port.
				6. Pre-Balancing Conference: Prior to starting balancing, general techniques shall be reviewed with the Port.
			1. PROJECT CONDITIONS
				1. Perform balancing on existing systems prior to any system revisions being made.
				2. Do not perform testing, adjusting, and balancing work until heating, ventilating, and air‑conditioning equipment has been completely installed, operational testing of control system is complete, and hydronic systems have been cleaned and treated per requirements of Section 232500, HVAC Water Treatment.
				3. Conduct testing and balancing with clean filters in place. Verify that other related work regarding system cleaning has been completed prior to performing hydronic testing and balancing.
			2. SIX-MONTH CALLBACK
				1. An addition to the requirements of the contract, within 6 months after completion of test and balance work, the Port, at its discretion, may request a recheck or resetting of any equipment or device listed in the test reports.
1. PRODUCTS

Not Used.

1. EXECUTION
	* + 1. AIR SYSTEMS
				1. General: Measurements shall be in accordance with recognized procedures and practices of the AABC or NEBB. Record on appropriate forms.
				2. Preliminary:

Identify and list size, type, and manufacture of all equipment to be tested, including air outlets and inlets.

Use manufacturer’s ratings for equipment to make required calculations except where field test shows ratings to be impractical.

* + - * 1. Execution:

Adjust fan speeds and motor drives for required air volume, within +5 percent maximum. Set speed to provide air volume at farthest run without excess static pressure. Provide additional sheaves and belts as required to accomplish speed adjustment.

Read and adjust air supply, return, and exhaust fan units to deliver design conditions at minimum O.S.A. and at 100 percent O.S.A.

Adjust all automatic dampers, outside air, return air, and exhaust dampers for design conditions.

Read static air pressure conditions on all air handling equipment, including filter and coil pressure drops, and total pressure across the fan. Use a Dwyer Series 400 air velocity meter, or equal, for final static pressures at equipment and where critical readings are required.

Measure temperature conditions across all outside air, return air, and exhaust dampers to check leakage.

Read and record motor data and amperage draw.

For variable volume systems, establish minimum static pressure required at sensing point to permit operation over entire VAV range.

* + - * 1. Distribution:

Read and adjust all air outlets to design air volumes, within +10 percent maximum. Advise the Port if deficiencies are noted to enable proper corrective actions.

Evaluate all building and room pressure conditions to determine adequate supply and return air conditions.

Evaluate all building and room pressure conditions to determine adequate performance of the system to maintain temperatures without draft.

Perform multipoint pitot traverses to confirm instrumentation, shaft tightness, fan operation, etc. Pitot traverses shall be performed using a Dwyer Series 400 air velocity meter, or equal, only with applicable duct probe.

Mark all balancing dampers.

* + - 1. HYDRONIC SYSTEMS
				1. General: Make measurements in accordance with recognized procedures and practices of the AABC or NEBB. Record on appropriate forms.
				2. Preliminary:

List complete data of tested equipment, and verify against contract documents.

Open all line valves to full open position, close coil by-pass stop valves, then set mixing control valve to full coil flow.

For each pump:

Verify rotation.

Test and record pump shutoff head.

Test and record pump wide-open head.

Verify proper water level in expansion tanks in system.

Verify that air vents in high points of water are properly installed and operating freely.

* + - * 1. Central Equipment:

Verify all conditions at all coils for required performance at design conditions.

Verify conditions at all primary source equipment for performance of design conditions.

Read and record pump heads, motor data, and amperage draw.

* + - * 1. Distribution:

Read and adjust water flow for design conditions.

Set all memory stops and mark position of adjuster on balancing valves.

* + - * 1. Variable Flow Chilled and Heating Water Systems: Coordinate with control system installer and the Port to establish procedures for balancing coils and establishing control setpoints. Chilled water systems are extensions of the existing variable flow systems and shall be balanced with respect to those existing systems.
			1. ELECTRIC HEATING EQUIPMENT
				1. Test and record voltage and amperage readings at each electric heating device while fully energized and at part load conditions (each step) to verify proper operation.
				2. Record data on appropriate forms.
			2. AUTOMATIC CONTROL SYSTEM
				1. In cooperation with control manufacturer’s representative, set and adjust automatically operated devices to achieve required sequence of operations.
				2. Verify all controls for proper operation and calibration and list controls requiring adjustment by control system installer.
			3. COORDINATION
				1. Coordinate work between balancing agency and other trades to ensure rapid completion of the work.
				2. Engage the balancing agency to assist with:

Checkout, startup, calibration of instrumentation, and operational, functional, and final acceptance test plans, procedures, checklists and reports.

Development of systems manuals.

Development of operation and maintenance manuals and training plan.

Use only if Commissioning Section 019100 is included in the project manual.

Development of commissioning plans and schedules.

* + - * 1. Deficiencies noted during the course of air balancing in the mechanical installation shall be promptly reported to the Port to allow corrective action to proceed.
				2. Provide periodic review of progress as requested.

END OF SECTION 230593