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 230500 – COMMON WORK RESULTS FOR HVAC

1. GENERAL
	* + 1. DESCRIPTION
				1. The intent of the Division 23 specifications and the accompanying drawings is to provide complete and workable systems as shown, specified and required by applicable codes. Include all work specified in Division 23 and shown on the accompanying drawings.
				2. The drawings that accompany the Division 23 specifications are diagrammatic. They do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts. Follow the drawings as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the building, subject to approval, and at no additional cost to the Port.
			2. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 017329, Cutting and Patching
				2. Section 019100, General Commissioning Requirements
				3. Section 024113, Site Demolition
				4. Section 024119, Selective Interior Demolition
				5. Section 078400, Firestopping
				6. Section 083100, Access Doors and Panels
				7. Section 099100, Painting
				8. Section 312000, Site Clearing and Earthwork
			3. REFERENCES
				1. FM Global
				2. NEMA: National Electrical Manufacturers Association

NEMA MG1: Motors and Generators

* + - * 1. OR-OSHA: Oregon Occupational Safety and Health Administration
			1. SUBMITTALS
				1. General:

Comply with the requirements of Section 013300 and the additional requirements specified herein.

* + - * 1. Shop Drawings:

The contract drawings indicate the general layout of the piping, ductwork and various items of equipment. Coordination with other trades and with field conditions is required. For this purpose, submit shop drawings of all installations not detailed on the contract drawings, and of all changes to the contract drawings.

Shop drawings shall be new drawings prepared by the Contractor and shall not be reproductions or tracings of the contract drawings. Overlay drawings with shop drawings of other trades and check for conflicts. Shop drawings shall be the same size as the contract drawings with title blocks similar to the contract drawings. Shop drawings shall identify the related contract drawing number or related reference drawing. Shop drawings shall be fully dimensioned, including both plan and elevation dimensions. Do not use shop drawings to make scope changes.

At a minimum, include the following:

Complete floor plans with sheet metal and mechanical piping to a minimum of 1/8" = 1'-0" scale.

HVAC Sheet metal and mechanical piping of mechanical and fan rooms to a minimum of 1/4" = 1'-0" scale.

Sections of congested areas to a minimum of 1/4" = 1'-0" scale.

Fabricated equipment to a minimum of 1/4" = 1'-0" scale.

Controls and instrumentation to scale and drawing sizes to suit controls supplier.

Submit shop drawings for review as required by the contract documents. Additional shop drawings may be requested when it appears that coordination issues are not being resolved in the field, or when there is a question as to whether contract documents are being complied with or the design intent is being met.

* + - * 1. Product Data:

Submit product data for review on all scheduled pieces of equipment, equipment requiring electrical connections or connections by other trades, and as required by the contract documents. Include manufacturer’s detailed shop drawings, specifications, and data sheets. Data sheets shall include capacities, RPM, BHP, pressure drop, design and operating pressures, temperatures and similar data. Manufacturer’s abbreviations or codes are not acceptable.

List the name of the motor manufacturer and service factor for each piece of equipment.

Indicate equipment operating weights including bases and weight distribution at support points.

In the case of equipment specified by specific catalog number, such as wiring devices, time switches, valves, etc., a statement of conformance will suffice.

* + - * 1. Operation and Maintenance Data:

Submit operation and maintenance data for review on all scheduled pieces of equipment, and as required by the contract documents.

* + - * 1. Commissioning Documentation:

Submit commissioning plans, schedules, and related documentation in accordance with the contract documents.

* + - 1. QUALITY ASSURANCE
				1. Materials and equipment shall be new. Work shall be of good quality, free of faults and defects.
				2. All equipment shall fit in the space provided.
				3. Systems shall be built and installed to deliver their full rated capacity at the efficiency for which they were designed.
				4. Systems shall operate at full capacity without objectionable noise or vibration.
				5. Materials and Equipment:

Each piece of equipment provided shall meet all detailed requirements of the drawings and specifications and shall be suitable for the installation.

Where two or more units of the same class of equipment are provided, use products of the same manufacturer; component parts of the entire system need not be products of the same manufacturer.

* + - * 1. Workmanship:

Install all materials in a neat and workmanlike manner.

Follow manufacturer’s directions. If they are in conflict with the contract documents, obtain clarification before starting work.

* + - * 1. Cutting and Patching:

Cutting, patching and repairing for the proper installation and completion of the work specified in this division, including plastering, masonry work, concrete work, carpentry work, firestopping, and painting, shall be performed by skilled craftsmen of each respective trade in conformance with the appropriate division of work. Additional openings required in building construction shall be made by drilling or cutting.

Fill holes which are cut oversize so that a tight fit is obtained around the objects passing through.

Do not pierce beams or columns without permission of the Port and then only as directed.

New or existing work that is cut or damaged shall be restored to its original condition. Where alterations disturb existing finishes, the surfaces shall be repaired, refinished, and left in condition existing prior to commencement of work.

* + - 1. PROJECT CONDITIONS
				1. Coordinate exact requirements governed by actual work conditions. Check all information and report any discrepancies before fabricating work. Report changes in time to avoid unnecessary work.
				2. Comply with the requirements of Section 017000, Execution Requirements, for investigation prior to penetration of floor slabs.
			2. PROVISIONS FOR LARGE EQUIPMENT
				1. Make provisions for the necessary openings in the building to allow for admittance of all equipment.
1. PRODUCTS
	* + 1. ACCESS PANELS
				1. Provide access panels where indicated and where required to access valves, fire/smoke dampers, balancing dampers, and other appurtenances requiring operation, service, or maintenance. Review locations prior to installation. Comply with the requirements of Section 083100.
			2. PIPE AND DUCT SLEEVES
				1. Interior Wall and Floor Sleeves: 18-gauge galvanized steel.
				2. Exterior Wall Sleeves: Cast iron.
				3. On-Grade Floor Sleeves: Cast iron.
			3. FLOOR, WALL, AND CEILING PLATES
				1. Provide stamped split-type plates as follows:

Floor Plates: Cast brass, chromium plated.

Wall and Ceiling Plates: Spun aluminum.

* + - 1. SEALANT
				1. General Purpose: Tremco Dymeric Sealant or equal.
				2. Floor Penetration Sealant: Hydro Ban by Laticrete., or pre-bid approved equal.
				3. Firestop Sealant: See Section 078400.
			2. MACHINERY GUARDS
				1. Provide guards for protection on all rotating and moving parts of equipment. Provide guards for all metal fan drives and motor pulleys, even if they are enclosed in a metal cabinet.
				2. Design guards so they do not restrict air flow at fan inlets resulting in reduced capacity.
				3. Provide shaft holes in guards for easy use of tachometers at pulley centers. Guards shall be easily removable for pulley adjustment or for removal and changing of belts.
				4. Guards shall meet OR-OSHA requirements including back plates.
				5. Provide inlet and outlet screens on all fans in plenums or where exposed to personnel.
			3. ELECTRICAL EQUIPMENT
				1. General: All equipment and installed work shall be as specified under Division 26, Electrical.
				2. Motors:

Motors shall be furnished as integral part of driven equipment. Motors shall be built to NEMA standards for the service intended. The motors shall be rated for the voltage specified, suitable for operation within the range of 10 percent above to 10 percent below the specified voltage. Energy efficient motors shall be Century E‑plus, Baldor Super E, Westinghouse Life Line, General Electric Energy Saver, Toshiba, or equal.

Designed for a synchronous speed as scheduled.

Motors 1/2 hp and Larger: 3-phase, 60 cycles, 460V, service factor of 1.15, unless specifically noted otherwise.

Motors 1/3 hp and Below: 1-phase, 60 cycle ac, 115V unless specifically noted otherwise, complete with integral thermal protection.

Have built-in thermal overload protection or be protected externally with separate thermal overload devices with low-voltage release or lockout. Hermetically sealed motors shall have quick trip devices.

Motors controlled by variable speed drives shall be inverter duty rated and shall have Class F insulation or better. Motors shall be able to withstand repeated voltage peaks of 1600 volts with rise times of 0.1 microseconds and greater, in accordance with NEMA Standard MG1, Part 31.

Life expectancy of bearings shall exceed 100,000 hours of direct couple and 40,000 hours with belt.

Motors served from variable frequency drives shall be equipped with a shaft grounding system utilizing brush grounding kits to provide a path for current to flow between the shaft and the motor frame.

Frequency drive manufacturers shall provide necessary filters and line reactor type equipment to protect motors from excessive voltage spikes that may exceed insulation requirements of NEMA MG1, Part 31. Use SGS or equal.

For motors 20 hp and greater, submit the following supplemental data:

Number of stator slots.

Number of rotor bars.

Load current.

Stator resistance.

Stator configuration delta or wye.

Bearing manufacturer and part numbers.

Motors shall have a three-year warranty.

* + - * 1. Starters: See Division 26, Electrical. Starters shall be suitable for performing the control functions required, with the exception of self-contained equipment and where the starters are furnished as part of the control package.
				2. Equipment Wiring: Interconnecting wiring within or on a piece of mechanical equipment shall be provided with the equipment unless shown otherwise on the drawings. This does not include the wiring of motors, starters and controllers specified in Division 26, Electrical.
				3. Control Wiring: All control wiring for mechanical equipment shall be as specified in Section 230900.
1. EXECUTION
	* + 1. DEMOLITION AND SALVAGE
				1. Prior to any demolition activities, coordinate safe-off of live utilities with the Port.
				2. Remove or relocate ductwork, piping, control wiring, devices and equipment encountered in existing areas affected by this work as indicated on the drawings.
				3. Protect equipment identified to be salvaged. Remove salvaged equipment prior to demolition of adjacent services. Arrange with the Port for storage and return of salvaged equipment.
				4. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations. Prior to demolition, verify that demolished services will not affect the operation of existing systems that are to remain and notify the Port.
				5. Demolition Service/System Requirements:

Locate, identify, disconnect, and seal or cap off indicated mechanical systems serving areas to be selectively demolished.

Demolish all service back to nearest active main or point of future connection as indicated. Verify with Port extent of demolition prior to proceeding if extent is not clear.

The Port will arrange to shut off indicated services/systems when requested by the Contractor.

Where demolished systems contain refrigerant or another regulated chemical, the systems shall be drained with contents captured and properly disposed of prior to demolishing the system. Coordinate with the Port regarding environmental regulations.

If services/systems are required to be removed, relocated, or abandoned: Before proceeding with selective demolition, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

Remove all accessories associated with removed utilities including supports, hangers, braces, clips, etc., in their entirety.

Patch penetrations of walls and floors related to demolished services restoring existing fire separations, assembly ratings, and waterproofing membranes.

* + - 1. SYSTEM WATER DISPOSAL
				1. Do not drain water from systems treated with chemicals, such as heating hot water, chilled water, and stem systems into the sanitary or storm sewers without written approval from the Port.
			2. ACCESS PANELS
				1. Install in accordance with manufacturer’s recommendations, coordinated with architectural features. Review intended locations with the Port prior to installation.
			3. SLEEVES
				1. General:

Lay out work prior to concrete forming. Do all cutting and patching required. Reinforce sleeves to prevent collapse during forming and pouring.

Sleeve all core-drilled penetrations unless detailed otherwise on the drawings.

Sleeves shall be large enough to allow clearance around pipe in accordance with NFPA 13. When pipe is insulated, insulation shall pass continuously through sleeve with 3/4-inch clearance between insulation and sleeve.

* + - * 1. Interior Wall Sleeves:

Pack with fiberglass insulation.

Terminate sleeve flush with face of wall unless indicated otherwise.

* + - * 1. Below-Grade Exterior Wall Sleeves: Sleeves shall be large enough to allow for caulking and made watertight. Install link seal and size based on pipe and sleeve. Secure sleeves against displacement.
				2. Above-Grade Exterior Wall Sleeves: Similar to interior wall sleeves, except caulk outside with sealant.
				3. Sleeves Through Floors:

Extend 1 1/2 inch above finished floor, except waste stacks using carriers shall have sleeve flush with floor.

Do not support pipes by resting pipe clamps on floor sleeves. Provide supplementary members so pipes are floor-supported.

Make penetrations watertight by sealing gap between sleeve and the floor with floor penetration sealant as specified in Part 2.

* + - * 1. Sleeves Through Fire-Rated Floors: Install the same as sleeves through floors, except:

Make penetrations through floor watertight by sealing gap between sleeve and floor with floor penetration sealant as specified in Part 2, and

Provide firestopping system both inside and outside of sleeve as specified in Section 078400 and in accordance with the recommendations of FM Global.

* + - * 1. Sleeves Through Fire-Rated Walls:

Provide firestopping system as specified in Section 078400 and in accordance with the recommendations of FM Global.

* + - * 1. On-Grade Floor Sleeves: Same as for below-grade exterior wall sleeves, except caulked from inside.
				2. Sleeves Through Roof: Extend 8 inches above roof.
				3. Sleeves specified or indicated at fire/smoke damper penetrations shall take precedence over this article.

Only use when work in the PDX terminal is adjacent to the baggage handling system. If the work is in Concourses B and C or the terminal building, south of Grid AF, change “34 inches” to “30 inches” in the last sentence of paragraph A

* + - 1. INSTALLATION ADJACENT TO BAGGAGE HANDLING SYSTEM (BHS)
				1. Where possible, do not install piping, ducts, equipment, or other mechanical items above conveyors or catwalks. If in the opinion of the Contractor a pipe or conduit must be located above a conveyor or catwalk, request permission from the Port and do not proceed unless and until permission is granted. Where such permission is granted, install the item as high as possible above the conveyor or catwalk. Prior to installing items above or within 4 feet of any conveyor or catwalk component, coordinate the location in the field with the Port’s baggage handling system manager. When crossing above a conveyor or catwalk, install pressurized piping tight to the structure and ceiling deck even if the installation creates vertical bends in the piping. If installing above the conveyor, the bottom of any item shall never be less than 34 inches above the conveyor bed.
				2. Do not support pipe, ductwork, equipment, etc., from the BHS equipment or its supporting structure.
			2. FIRESTOPPING
				1. Comply with the requirements of Section 078400.
				2. Provide fire-rated assemblies at all penetrations of 1 hour or more.
			3. CLEANING
				1. Clean HVAC equipment, piping and ductwork of stampings and markings (except those required by codes), iron cuttings, and other refuse.
				2. Clean scratched or marred painted surfaces of rust or other foreign matter and paint with matching color industrial enamel, except as otherwise noted.
			4. EQUIPMENT PROTECTION
				1. Keep HVAC pipe, ductwork and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect HVAC piping, conduit, ductwork, and equipment against dirty water, chemical, or mechanical damage both before and after installation. Restore damaged or contaminated piping, conduit, and equipment to original conditions or replace at no additional cost to the Port.
				2. Protect bright finished shafts, bearing housings, and similar items until in service. No rust will be permitted.
				3. Cover or otherwise suitably protect equipment and materials stored on the job site.
				4. Provide filters at all openings in operating systems on return or exhaust ductwork.
			5. ACCESSIBILITY
				1. Conveniently locate variable and constant volume boxes, control panels, hardware and devices, valves, thermometers, gauges, and other equipment or specialties requiring frequent reading, adjustments, inspection, repairs, or removal and replacement.
				2. Install thermometers and gauges to be easily read from floors, platforms, and walkways.
				3. Provide 36 inches clear access space on each side of variable and constant volume terminal units containing control valves, actuators, electrical disconnect, and DDC controls. Coordinate with other trades the locating of light fixtures, fire sprinkler piping, as well as other equipment, piping, and conduit to avoid obstructing access to serviceable components of terminal units. Provide access panels in linear metal, wood slat, gypsum board, or other hard ceilings to permit convenient access to terminal units.
				4. Provide access panels in linear metal, wood slat, gypsum board, or other hard ceilings and walls to permit convenient access to fire/smoke dampers, and isolation, emergency shut-off, and other valves.
			6. FLOOR, WALL AND CEILING PLATES
				1. Install plates on HVAC piping and ductwork passing through finished walls, floors, ceilings, partitions and plaster furrings. Plates shall completely cover opening around pipe and duct.
				2. Secure wall and ceiling plates to pipe, insulation, or structure.
				3. Plates shall not penetrate insulation vapor barriers.
				4. Plates are not required in mechanical rooms or unfinished spaces.
			7. ELECTRICAL EQUIPMENT
				1. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in the dedicated electrical space around electrical equipment.
				2. The area above the dedicated electrical space shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks, or breaks in such foreign systems.
				3. Unions in mechanical piping shall not be installed in dedicated electrical or IT spaces, or above or below ceilings.
				4. Low point drains in mechanical piping shall not be installed in dedicated electrical or IT spaces, or above or below ceilings. If this cannot be avoided, the low point drain connection shall be extended outside of the electrical or IT space.
				5. Protect outdoor electrical equipment from accidental spillage or leakage from piping systems.
			8. EQUIPMENT CONNECTIONS
				1. Make final connections to equipment in accordance with manufacturer’s instructions, shop drawings, and as indicated.
				2. Piping:

Connections shall include heating hot water, chilled water, steam supply, steam vent and condensate.

Provide easily accessible unions and gate valves in all piping at equipment, steam drip trap assemblies, and any other fittings required for complete installation.

Piping connections shall be independently supported to prevent undue strain on equipment.

* + - 1. PAINTING
				1. Comply with the requirements of Section 099100.
				2. Equipment Rooms and Finished Areas:

Insulation: Not painted.

Miscellaneous Iron Work, Structural Steel Stands, Uninsulated Tanks, Equipment Bases: Paint one coat of black enamel.

Steel Valve Bodies and Bonnets: Paint one coat of black enamel.

Brass Valve Bodies: Not painted.

Equipment Without Factory Finish: Paint one coat of grey machinery enamel. Do not paint nameplates.

Grilles, Diffusers, Registers: Paint sheet metal and visible ductwork behind grilles, diffusers, and registers flat black.

Galvanized Ductwork: Not painted.

Edit if items will be exposed to exterior elements.

Hangers and Uninsulated Piping: Not painted.

* + - * 1. Concealed Spaces (above ceilings, not visible):

Insulation: Not painted.

Hangers, Uninsulated Piping, Miscellaneous Iron Work, Valve Bodies and Bonnets: Not painted.

* + - * 1. Exterior Black Steel: Wire brush and apply two coats of rust-inhibiting primer and one coat of grey exterior machinery enamel.
				2. Roof Mounted Equipment: Paint two coats of exterior machinery enamel. Color as selected by the Port.
			1. POWER-ACTUATED FASTENERS
				1. Power-actuated fasteners are not allowed.
			2. ADJUSTING AND CLEANING
				1. Before operating equipment or systems, make thorough check to determine that systems have been flushed and cleaned as required and equipment has been properly installed, lubricated, and serviced. Check factory instructions to see that installations have been made properly and that recommended lubricants have been used.
				2. Use particular care in lubricating bearings to avoid blowing out seals from over-lubrication. Check equipment for damage that may have occurred during shipment, after delivery, or during installation. Repair damaged equipment or replace with new equipment as directed by the Port.

Delete only if Section 019100, General Commissioning Requirements, is not included in the contract.

* + - 1. COMMISSIONING
				1. Complete all phases of work so the system, equipment, and components can be checked out, started, calibrated, operationally tested, adjusted, balanced, functionally tested, and otherwise commissioned. Complete systems, including all subsystems, so they are fully functional.
				2. Perform commissioning as specified in Section 019100, the technical sections, and this section. Unless specified otherwise in the technical sections, provide factory startup services for the following items of equipment:

Air handling equipment.

Heating equipment.

Cooling equipment.

Special purpose equipment.

Pumps.

* + - * 1. Participation in Commissioning:

Provide skilled technicians to checkout, startup, calibrate, and test systems, equipment, and components.

* + - * 1. Resolution of Deficiencies:

Corrective work shall be completed to permit timely completion of the commissioning process.

END OF SECTION 230500