



**PORTLAND PUBLIC SCHOOLS  
TECHNICAL DESIGN AND CONSTRUCTION STANDARDS**

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**Submit fault duty calculations for the entire electrical distribution system for new projects. Submit fault duty calculations for panels with modification for remodel projects.**

**Submit voltage drop calculations from main service to distribution panels.**

**Coordinate with the serving utilities for remodel projects.**

- a Perform minimum 30 day load study for existing buildings or obtain serving utility 12 month peak demand and add NEC 125% factor to calculate load per NEC.**
- b For existing buildings to be remodeled perform 30 day minimum load metering log of peak and demand loads at any panel or distribution where modifications are required. 30 day load study must be completed during school year except over winter break and spring break.**
- c Upgrade service if new loads warrant.**
- d Upgrade utility transformer and distribution if new loads warrant.**
- e List information needed and needed classroom program requirements (for CIE spaces) from PPS or other early in design that may impact service upgrades. Send a check off form to the PPS program administrator for stakeholders to vet the needed design criteria.**

**Lighting**

- a Provide luminaires, branch circuiting and switching complete in compliance with the Oregon State Fire Electrical Code and all applicable codes and standards.**

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- c For items to be demolished remove wiring devices and conduit completely, do not abandon in place**
- d Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. All temporary installations shall be code compliant.**
- e Remove and restore wiring which serves usable existing outlets clear of construction or demolition**
- f If existing junction boxes will be made inaccessible or if abandoned outlets serve as feed through boxes, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets**
- g Existing lighting which is to remain, leave luminaires in proper working order; clean and re-lamp**

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**E Kitchen Class 1 Exhaust Hood**

Obtain shop drawings prior to rough in. Connect hood lights, fire suppression and control panel. Provide interlocks to exhaust, make up air, solenoid valves and shut trip breakers.

Provide note on drawings for a design walk through meeting to be held between City inspector and installing Contractors.

**F Verify with district to determine which kitchen equipment need to be on backup power:**

**G Test for proper motor rotation of poly phase motors. Provide high efficiency motors when replacement is needed.**

**H Equipment mounted above a ceiling must have enough clearance below it to accommodate a lift or ladder for future repairs.**

**2605 19 Low Voltage Electrical Power Conductors and Cables**

**A Wire and Cable Conductors**

Terminate feeder conductors with inert compression lugs.

Feeder conductors - copper; no substitution.

Aluminum wire prohibited in all sizes.

Insulation for new conductors shall be 'THN' or 'THWN' unless approved by owner.

Conductors installed in a manufacturer's standard assembly, such as a light fixture, may be solid wire.

Size feeder conductors for 125% of connected feeder load.

Grounding conductors shall be installed with all new feeders and new branch circuits.

Multiple branch circuits in the same conduit may share a common ground conductor.

Conductors used for grounding shall be No. 12 AWG minimum.

Stranded MC (Metal Clad) cable is limited to branch circuits only. . Grd      tenc



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**Ceiling tiles shall not be used as the only means of support for boxes and raceways**

**The ceiling grid shall not be used as the only means of support for boxes and raceways**

**B Lead type pipe and hangers shall not be used to anchor electrical equipment, enclosures, and conduit.**

**C Feeder conductors shall be installed in rigid conduits with threaded connections**

**D**

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- K Use of existing feeder conduit is encouraged when possible**
- L Flex conduit is prohibited as a substitute for rigid or EMT conduit.**
- M 6 feet maximum length flex conduit is allowed at devices such as motors**
- N All conduits shall be routed below the lowest level of a Metal Deck profile**
- O Minimum Conduit Size 3/4 inch for power and control unless otherwise noted**
- P Install conduit seals at boundaries where ambient temperatures differ by 10 degrees  
Fahrenheit**
- Q Exposed conduits are permitted only in the following areas**
  - Mechanical and electrical rooms or spaces where walls and ceilings will not be covered with finished materials**
  - Existing walls that are concrete or block construction**
  - Route exposed conduit parallel and perpendicular to walls, tight to finished surface**

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**Wiring for 120/208V or 120/240V systems shall be continuously color coded in accordance with the following schedule:**

- a Phase A Black**
- b Phase B (Orange - Wild leg in 240V Delta) Red**
- c Phase C Blue**
- d Neutral White**
- e Ground Green**

**Wiring for 277/480V and 120V systems shall be continuously color coded in accordance with the following schedule:**

- a Phase A Brown**
- b Phase B Orange**
- c Phase C Yellow**
- d Neutral Gray**
- e Ground Green**
- f Device labeling**

- i All junction boxes and device plates will have a neotrustrength laminated adhesive tape label with a minimum of 3/16 inch letters on clear or white background indicating the circuit number and source**

**2605 73 Electrical Distribution System Studies**

- A Provide System study for all new buildings or additions over 10,000 square feet and for projects with main service replacement. Studies to consist of r \* v**

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**260600 Schedules for Electrical**

**A Electrical Record Drawings**

**Exact routing of feeders and service conduits**

**Conduit dimensions**

**Exact location of junction boxes**

**Exact location of conduits installed for future construction Provide dimensions and depth of burial**

**All Drawings of Record shall include a core line diagram including Sub panels, and note Switch gear/Panel locations by room number:**

**All Switch gear and Panel Schedules shall be listed on Drawings of Record**

**260620 Schedules for Low Voltage Electrical Distribution**

**A Electrical Labeling**

**Name plates and labels Engaved stock melamine or lam acid plastic laminate in size and thickness indicated below provide 1/8 inch thick material**

**a Letter color: white**

**b Letter height: 1/4 inch**

**c Background color: black**

**d Locations**

**i Each distribution and control equipment enclosures and panel boards**

**ii Communications cabinets**

**iii Transformers**

**iv Disconnects and starters**

**Equipment name plates Engaved phenolic plastic, 1/16 inch thick**

**a Letter color: white**

**b Letter height: 1/4 inch**

**c Background color: black**

**Handwritten labeling is not allowed**

**Provide typewritten branch panel schedules with clear transparent covers accounting for every breaker installed**

**Label panels with engaved labels**

**Label junction boxes with panel identification, voltage, and circuit number: Label tape products are acceptable**

**Label devices with panel and circuit numbers Label tape products are acceptable**

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**Color rendering for LED data**





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**262726 Wiring Devices**

**A All devices shall be UL approved and labeled**

**Motor Starters or VFDs shall be Allen Bradley or District approved equal and located in accessible lighted areas**

**VFDs, at a minimum, shall incorporate an appropriately sized internal or external Line Reactor:**

**Duplex receptacles shall be 20AMP, Spec Grade minimum, tamper resistant.**

**GF receptacles shall be 20AMP, Spec Grade minimum**

**All receptacles shall be the grounding type**

**Use exceptions (see 2021 OHS 842) in the energy code to avoid use of controlled receptacles where possible. Use of controlled receptacles are discouraged**

**Overhead pull-down outlets with 14 AWG Cord, seismically braced Reelcraft ID2030 Cord Reels or District approved equal. Unit must be secured with one visible quick link chain loop through the hoop bolt at top of frame. See Cord Reel Detail - <https://www.pps.net/Page/15497> Under Appendix A Detail Drawings S 301 Typical Cord Reel Mount.**

**a No plastic retracting rotators allowed due to durability issues**

**Multi-outlet assemblies shall not be used where individual receptacles cannot be replaced**

**Color: ivory**

**Control switches rated 20AMP**

**Single pole, double pole 3 way and 4 way switches shall be toggle type, or keyed type when specified elsewhere in this document.**

**Light Switches shall be located adjacent to room entry doors on the door strike side**

**Device plates and covers shall be brush finish stainless steel. Plastic device covers are allowed 8 and above at wall and ceiling installations to match adjacent finish color for aesthetics and as acceptable per Electric Shop**

**Floor receptacles are discouraged in locations where they are not required by code**

**When floor receptacles are necessary, provide flush type with brass cover and flange. Types "Hibble", "Walker durt", "Steel City" or District approved equal**



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**Generator set will meet requirements for Level 1, Class 96 Type 10 system as per NEMA 110. System will be capable of providing power within 10 seconds following loss or failure of normal power supply. It will accept full load at each level of priority in single step.**

**Voltage and load rating of generator set is as indicated on drawings. Load rating to be for standby, prime, or continuous service at 0.8 power factor and derated to allow for operation of accessories (cooling fan, pumps, radiator, fan, air cleaners, lubricating oil pump, fuel injection pump, jacket water pump, governor, charging generator, alternating current generator, exciter regulator and alternator) and for service at an altitude 500 feet in -20 degree F to 110 degree F ambient temperature.**

**[HSClimate Crisis Response Policy](#) and Sustainability**

**a**

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**Emissions:** Engines must comply with current Federal EPA Tier for Exhaust Emissions and possess Best Available Control Technology to provide absolute minimum smoke, fumes, and exhaust emissions discharge.

**Engine Speed:** 1800rpm

**Safety Devices:** Engine shutdown on high engine temperature, low oil pressure, overspeed, and engine overcrank limits as selected by manufacturer.

**Engine Starting:** DC starting system with positive engagement, number and voltage of starter motor in compliance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine/generator control panel.

**Engine Jacket Heater:** Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F.

**Engine Accessories:** Fuel filter; lube oil filter; intake air filter; lube oil cooler; fuel transfer pump; fuel priming pump; gear driven water pump. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine/generator control panel.

**Mounting Unit:** to be mounted on structural steel base and be provided with spring type vibration isolators and seismic restraints as required.

**Restraints/isolators:** to be in compliance with seismic design requirements.

**C Fuel System**

**Fuel Oil:** No 2 diesel conforming to WF800 Diesel engines requiring premium fuels will not be considered.

**Fuel System Accessories:** Fuel filter; fuel/water separator; fuel cooler; fuel transfer pump; fuel priming pump; injection pumps, lines, and nozzles. Transfer pump will deliver fuel under low pressure to individual injection pumps - one for each cylinder. Nozzles will inject fuel directly into cylinder in optimum spray pattern for efficient combustion.

**Provide dual fuel filters, independently valved.**

**Unit fuel injector:** to be mounted inline each cylinder head, with external feeder lines requiring less than 5 bar (75 PSI) fuel pressure. As a function of maximizing efficient combustion and minimizing exhaust smoke levels, injection timing and duration will be electronically controlled by an engine mounted Electronic Engine Control Module, with injection pressure accomplished by piston pump driven from engine crankshaft.

**Engine Mounted integral manual fuel priming pump:** to facilitate priming and bleeding air from system.

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**Filter/Separator:** In addition to standard fuel filters provided by engine manufacturer, there will be installed primary fuel filter/water separator in fuel inlet line to engine

Unit mounted fuel piping to be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines will be minimally rated for 300 degrees F and 100PSI. Shield flexible fuel lines from potential vandalism and operational impacts such as standard equipment movement.

Fuel cooler, as required, to be mounted on radiator and cool fuel before return to day tank.

Generator to be equipped with a Fuel Technologies International fuel polishing system (Model FFI 1.5A).

**D Construction**

Provide generator with revolving field, single bearing type, coupled directly to engine flywheel through a flexible driving disc for positive alignment. Provide rotor dynamically balanced up to 25 percent overspeed.

Provide generator of heavy duty, compact design. Insulation is Class H or better on stator and rotor, as recognized by NEMA MG 1 and both will be further protected with 100 percent epoxy impregnation and overcoat of resilient insulating material on end coils to reduce possible fungus and/or abrasion deterioration. Generator is equipped with full amplitude windings for paralleling.

Permanent magnet or AREP excitation system to drive excitation current from pilot exciter mounted on rotor shaft. It will enable alternator to sustain 300 percent of rated current for ten seconds during fault condition.

**Digital Voltage Regulator:** Microprocessor based with fully programmable operating and protection characteristics. Regulator will be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. It will exhibit the following operational characteristics:

- a. Alternator output voltage maintained within plus or minus 0.25 percent at steady state conditions.
- b. Alternator output voltage maintained within plus or minus 0.25 percent of rated value for any load variation between no load and full load.
- c. Alternator output voltage drift no more than plus or minus 0.25 percent of rated value at constant temperature.

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- d Alternator output voltage drift no more than plus or minus percent of rated value within 40 degrees C change over ambient temperature range of -40 degrees C to 70 degrees C**
  - e Response time less than 20 milliseconds**
  - f Voltage buildup with alternator output as low as 6 volts**
  - g At full throttle engine starting output voltage overshoot no more than 5 percent of its rated value, with respect to volts/Hz curve Meets ISO 8853 class G2 specifications**
  - h Power dissipation 55 Wat 15 amps < 100 ma at rest**
  - i Telephone Influence Factor (TIF) of less than 50**
  - j Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to ML**
  - k SID 461 C Part 9 and VDE 875 level N**
  - l Maintain stable voltage control with 20 percent total harmonic distortion**
- Voltage regulator to include the following features**
- a Voltage level rheostat to provide alternator output voltage adjustment of minus 10 percent to plus 10 percent of nominal. This will be in addition to programmable output voltage level of minus 25 percent to plus 10 percent**
  - b Automatic gain adjustment to provide output voltage compensation for changes in load or frequency**
  - c Manual gain adjustment 0 to 10 percent to provide compensation for line losses between alternator output terminals and load**
  - d Reactive drop adjustment programmable to allow paralleling without interconnect wiring between alternators, with 10 percent minimum drop at full load and 0.8 PF**

**Provide generator output circuit breaker integral to generator output terminal enclosure**

**Remote annunciator panel to monitor breaker and report trouble signal when open**

**E Generator Set Performance**

**Provide voltage regulation from no load to rated load within band of plus or minus 0.5 percent of rated voltage. Steady state voltage stability remains within 0.5 percent band of rated voltage. Steady state voltage modulation does not exceed 1 cycle per second**

**For addition of load up to and including 100 percent of rated load, voltage dip does not exceed 15 percent of rated voltage. Voltage recovers to and maintains within steady band in not more than 1.5 seconds**

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**Frequency Regulation Steady state no load to steady state rated load Random frequency variation with any steady load not to exceed plus or minus 0.5 percent. For addition of load up to 90 percent of rated load, frequency recovers to steady state frequency band within 5 seconds**

**Alternator produces clean AC voltage waveform with not more than 5 percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3 percent in any single harmonic, and no third order harmonics or their multiples Telephone influence factor: Less than 40**

**Engine manufacturer certifies generator set to be suitable for use at installed location and rating and will meet applicable exhaust emission requirements at time of commissioning**

**E Diesel generators suitable for exterior: Interior generators are prohibited**

**Provisions shall be made for temporary connection of a load Bank Type shall be Gause Hinds ED300 or ED400 Posi-lock with all phases, Neutral and Ground present. No substitutions**

**UL200 listed**

**Referenced location, away from residential properties, secured in a kove or courtyard accessible for fuel delivery. If any part of the generator footprint is within 20 feet of exterior building walls, exhaust must be plumbed to exit above the roof line. Location(s) to be reviewed and approved by District Electrical Foreman**

**Minimum enclosures 9 gauge cyclone fence material. Fenced with schedule 40 pipe including roof supports, secured with padlocked door**

**Generator enclosure must be sound rated. Consider neighborhood noise factor. Factor and compliance with applicable noise ordinances**

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**264200 Cathodic Protection**

**A Corrosion Control**

System pipings shall be installed with corrosion control integrated into the approach

Underground systems protected by cathodic protection magnesium anodes or impressed direct current

**264313 Surge Protection Devices**

**A Same manufacturers being provided for switch boards and panel boards**

**B Compatible with the electrical system voltage, current, system configuration and intended applications and NRTL listed for such application**

**C Parallel design only with individual protection components**

**Line to Ground and Line to Line for Delta and High Resistance Grounded systems**

**Line to Ground, Line to Neutral and Neutral to Ground for Wye and Single Phase distribution systems**

**D Short Circuit Current Ratings (SCR): Suitable for location SPD is to be installed**

**E**

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**Study halls 30 foot candles**

**Science labs 50 foot candles at benches and 100 foot candles at demonstration areas**

**Shops 100 foot candles**

**Gonidas 5 10 foot candles**

**Restrooms 5 10 foot candles with 10 20 foot candles at showers and 15 30 foot candle at vanities**

**Stairways 10 20 foot candles**

**Cafeterias and similar areas 15 30 foot candles**

**Elementary and non competition/ performance gymnasium 30 minimum average foot candles of general illumination**

**Middle Schools competition/ performance gymnasium 50 75 foot candles of general illumination**

**High Schools competition/ performance gymnasium 75 foot candles of general illumination**

**Under no circumstance will any interior space exceed 21 watts/square foot.**

**D**

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**Vandal-resistant fixtures are required for gyms, cafeterias, restrooms, and non supervised spaces open to students and CUBuses, such as stairs and other common areas**

**Pendant or suspended ceiling flush mount:**

- a Fixtures hung by chains are not preferred**
- b Finish white, 85% minimum reflectance**

**E Interior Lighting- New Facilities or Full Facility fixture Upgrades**

**Provide energy efficient (LED) high quality lighting fixtures**

**Lighting fixtures are to be selected for maximum durability.**

**Fixtures hung by chains are not preferred**

**Vandal-resistant fixtures are required for gyms, cafeterias, restrooms, and non supervised spaces open to students and CUBuses, such as stairs and other common areas**

**Submit product cut sheets with lighting plans to design team and the District for review and approval. See 260000H**

- a All luminaires to be Energy and Sustainability approved**
- b For product deviation approval, submit cut sheets to the District project representative, PPS Energy and Sustainability and the PPS Electrical Shop**

**F Lighting for Classrooms**

**Where ceiling height is 11'-6" or higher, use pendant**

**E daEn1**

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**Maximum of 35 foot candles maintained at full output.**

**G Lighting for Special Education Sensory Rooms**

**LED fixtures with tunable color temperature capabilities and full range dimming down to 1% minimum (1% preferred) to allow teachers to control the color temperature and intensity of light output.**

**Fluorescent lamps with fixed color temperature are used then they should not exceed 2700K and have dimming down to 1% minimum (1% preferred).**

**All LED drivers/dimmers to be specifically designed and documented for compatibility with LED fixtures**

**Fixtures with direct lamp source to have volumetric diffusion lenses**

**Pendant mounted indirect or direct/indirect LED source is preferred**

**Vertical illumination on wall to be no less than 1/3 of the level on the work surface**

**Provide daylight dimming for fixtures within 20 feet of windows or skylights**

**Maximum of 35 foot candles maintained at full output.**

**265200 Emergency Lighting**

**A Provide an external identifier ("E") on all emergency lighting system fixtures**

**Emergency Power System Per current local and national code requirements**

**Emergency lighting required in all multi-stall restrooms**

**265300 Exit Signs**

**A Battery powered – by written request and district approval only**

**High abuse vandal resistant all conditions**

**Exit signs to be substantially white in color with green lettering**

**Approved manufactures "Tihoria Estrene", Kenall Tialmate 6500 high abuse'**

**LED or Cold Cathode or District approved equal**

**Inandescent is not allowed**

**265616 Parking Lighting and Security**

**A Fixture selection and placement for parking areas is to minimize glare to occupied spaces both within and beyond site property line in alignment with jurisdictional requirements and International Dark Sky Association (IDA) recommendations**

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**b Include dimming control for field lighting and incorporate into sequence of operations**

**c**