SECTION 262416 – PANELBOARDS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

MasterSpec includes provisions for LEED v4, LEED v4.1, IgCC/ASHRAE 189.1, Green Globes, and CALGreen. Sustainable design requirements may be inserted in the Section Text using the hypertext links.

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes:

Panelboards.

Disconnecting and overcurrent protective devices.

* + - * 1. Products Installed, but Not Furnished, under This Section:

**<Insert products identified in "Existing Products to be Modified" Article or "Existing Products to be Removed and Reinstalled" Article>.**

* + - * 1. Related Requirements:

Always retain first three subparagraphs below.

Section 018116 "Facility Environmental Requirements" specifies temperature, humidity, acoustical, and other field conditions applicable to the Work specified in this Section.

Section 018123 "Facility Seismic and Wind Criteria" specifies seismic hazard, wind hazard, other structural design conditions applicable to the Work specified in this Section.

Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other requirements applicable to the Work for electrical, communications, and electronic safety and security systems on Project, including wiring methods.

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 260529 "Hangers and Supports for Electrical Systems" specifies concrete bases and supports for panelboards installed by this Section.

Section 260548 "Vibration and Seismic Controls for Electrical Systems" specifies seismic control devices, mounting devices, and anchoring devices installed by this Section.

Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

Section 260573 "Power System Studies" specifies short-circuit current studies, overcurrent protective device coordination studies, and arc-flash hazard analysis studies.

Section 260913 "Electrical Power Monitoring" specifies power monitoring and control systems installed by this Section.

Section 262813 "Fuses" specifies fuses and spare-fuse cabinets installed by this Section.

Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits" specifies Type 1 and Type 2 surge protective devices installed by this Section.

Section 262417 “Panelboards for Existing Cabinets” specifies Panelboards and sizing requirements for using existing Panelboard Cabinets.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project. Include only essential definitions or acronyms not well understood by the affected industry or trade.

* + - * 1. MCCB: Molded-case circuit breaker.
				2. VPR: Voltage protection rating.
			1. ACTION SUBMITTALS

Action submittals are submittals requiring responsive action and return of reviewed documents to Contractor.

* + - * 1. Product Data: For each type of product. In addition to information identified in Section 013300 "Submittal Procedures," submit the following:

Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

Retain subparagraph below if special manufacturer's extended warranties are specified.

Include manufacturer's sample extended warranty language.

* + - * 1. Shop Drawings: For each panelboard and related equipment:

Include dimensioned plans, elevations, sections, and details.

Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.

Detail bus configuration, current, and voltage ratings.

Short-circuit current rating of panelboards and overcurrent protective devices.

Retain first subparagraph below if series rating of overcurrent protective devices is used. If some, but not all, devices are series rated, indicate on Drawings which are fully rated and which series rated.

Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.

Retain first subparagraph below if SPD is factory mounted in panelboard.

Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.

Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

Include wiring diagrams for power, signal, and control wiring.

Key interlock scheme drawing and sequence of operations.

Retain subparagraph below if final system short-circuit and coordination studies will be performed by designer or assigned to independent consultant. These curves are also beneficial to Owner for future additions or reevaluations of settings of overcurrent protective devices.

Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include Internet link for electronic access to downloadable PDF of coordination curves.

* + - * 1. Field quality-control reports.
			1. INFORMATIONAL SUBMITTALS

Informational submittals are submittals that require review by Architect, but they do not require Architect's responsive action and return of reviewed documents to Contractor, provided submittals comply with requirements. If rejected, submittals with responsive action must be returned to Contractor.

Retain option in "Panelboard Schedules" Paragraph below if retaining "Load Balancing" Paragraph in "Adjusting" Article.

* + - * 1. Panelboard Schedules: For installation in panelboards.[ **Submit final versions after load balancing.**]
				2. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
				3. Shop Drawings; include the following for each panelboard:

Detail for installation of panelboard when using in existing cabinet including verification of size and spacing requirements of panelboard in existing cabinet.

Voltage and current rating.

Panelboard short circuit rating. Indicate if rating is Fully Rated Equipment Rating, or where acceptable, UL listed Integrated Equipment Short Circuit Rating.

Circuit breaker enumeration (frame, ATE, poles, I.C.).

Indicate if circuit breakers are suitable for the panelboards’ Fully Rated Equipment Rating, or where acceptable, are series connected devices which have been test verified and listed with UL (include documentation proving the compatibility of the proposed circuit breaker combinations). Circuit breakers do not have to be listed as series connected devices when all of the circuit breaker interrupting ratings are equal to, or greater than, the short circuit rating of the panelboard.

Accessories.

Retain first paragraph below if requirements in Part 3 say "in accordance with manufacturer's published instructions."

* + - * 1. Manufacturer's published instructions.
				2. Field Reports:

Manufacturer's field reports for field quality-control support.

Field reports for voltage monitoring and adjusting.

Field reports for infrared scanning.

* + - 1. CLOSEOUT SUBMITTALS

Submittals for record documents, operation and maintenance data, software, and software documentation are specified in Section 260010 "Supplemental Requirements for Electrical."

* + - * 1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director’s Representative.
				2. Warranty documentation.
			1. MAINTENANCE MATERIAL SUBMITTALS

See Section 017700 "Closeout Procedures" for submission of maintenance material items.

Retain paragraphs below as needed to coordinate with requirements specified in "Maintenance Material Items" Article.

* + - * 1. Spare parts.
				2. Special tools.
			1. QUALIFICATIONS

Coordinate with Section 260010 (I don’t see this section in our V: drive files) "Supplemental Requirements for Electrical" for submission of qualification credentials.

* + - * 1. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.

On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

* + - * 1. Quality Control Submittals:

List of Completed Installations: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations that can prove the proposed products have operated satisfactorily for one year.

Company Field Advisor Data: Include:

Name, business address and telephone number of Company Field Advisor secured for the required services.

Certified statement from the Company listing the qualifications of the Company Field Advisor.

Services and each product for which authorization is given by the Company listed specifically for this project.

* + - * 1. Contract Closeout Submittals:

System acceptance test report.

Certificate: Affidavit, signed by the Company Field Advisor and notarized, certifying that the system meets the contract requirements and is operating properly.

Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director’s Representative.

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

See "Testing and Inspecting" Article in the Evaluations for guidance on which option to retain in paragraph below.

* + - * 1. Handle and prepare panelboards for installation in accordance with [**NECA 407**] [**NEMA PB 1**].
			1. WARRANTY

When warranties are required and available, verify with Owner's counsel that special warranties stated in this article are not less than remedies available to Owner, after one-year correction period specified in the Contract, under Contractor's general warranty and prevailing local laws.

Verify durations of extended-warranty periods needed.

* + - * 1. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

Extended-Warranty Period: [**Two**] <**Insert number**> years from date of Substantial Completion; full coverage for labor, materials, and equipment.

Retain "Special Manufacturer Extended Warranty" Paragraph below if Project requires that a special manufacturer extended warranty take over when the special Installer extended warranty expires. To benefit Owner, manufacturer extended-warranty period must be longer than Installer extended-warranty period.

* + - * 1. B. Special Manufacturer Extended Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

Initial Extended-Warranty Period: [**Three**] [**Four**] <**Insert number**> years from date of Substantial Completion; [**full**] [**prorated**] coverage for labor, materials, and equipment.

Retain transient voltage surges option in "Follow-On Extended-Warranty Period" Subparagraph below if assembly includes surge protective devices. Retain "origin" option if recipient assumes ownership of goods when they are shipped. Retain "destination" option if seller retains ownership of goods until they are delivered. Damaged shipping containers labeled "FOB Origin" cannot be returned to sender, but carrier is liable to recipient for delay and damage claims.

Follow-On Extended-Warranty Period: [**Five**] <**Insert number**> years from date of Substantial Completion; [**full**] [**prorated**] coverage for materials[ **that failed because of transient voltage surges**] only, free on board [**origin**] [**destination**], freight prepaid.

1. PRODUCTS

Manufacturers and products listed in this Section are neither recommended nor endorsed by the AIA or Deltek. Before selecting manufacturers and products, verify availability, suitability for intended applications, and compliance with minimum performance requirements. Product options commonly available from manufacturers are included in square brackets throughout the Section Text. Not every manufacturer listed can provide every option offered; verify availability with manufacturers. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

* + - 1. EXISTING PRODUCTS TO BE MODIFIED
				1. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>.**
				2. Description: **<Insert description of existing product, including special features, options, and finishes that may impact the Work>.**

Sustainable Design Features:

* + - * 1. Accessories: **<Insert accessories included with existing product>.**
			1. EXISTING PRODUCTS TO BE REMOVED AND REINSTALLED
				1. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>.**
				2. Description: **<Insert description of existing product, including special features, options, and finishes that may impact the Work>.**

Sustainable Design Features:

* + - * 1. Accessories: <Insert accessories included with existing product>.
			1. PERFORMANCE REQUIREMENTS
				1. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

Retain first paragraph below for projects in seismic areas. Coordinate with "Informational Submittals" Article for submittal of manufacturer's seismic qualification certification.

* + - * 1. Fabricate and test panelboards in accordance with IEEE 344 to withstand seismic forces specified in Section 018123 "Facility Seismic and Wind Criteria."
				2. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
				3. Comply with NEMA PB 1.
				4. Enclosures: [**Flush**] [**and**] [**Surface**]-mounted, dead-front cabinets.

Rated for environmental conditions at installed location.

See "Enclosures" Article in the Evaluations for discussion of enclosure types. Coordinate first five subparagraphs below with Drawings (by identifying the designated areas) or schedules (by including the required enclosure type). Availability of some enclosure types is limited by a panelboard's ampacity rating, included devices, or physical size; consult manufacturers for availability of, and limitations on, other than Type 1 enclosures.

Indoor Dry and Clean Locations: UL 50E, [**Type 1**] <**Insert type**>.

Outdoor Locations: UL 50E, [**Type 3R**] <**Insert type**>.

Kitchen and Wash-Down Areas: UL 50E, [**Type 4X**] <**Insert type**>, [**stainless steel]<Insert material>.**

Other Wet or Damp Indoor Locations: UL 50E, [**Type 4**] <**Insert type**>.

Select first option in first subparagraph below for areas subject to lighter levels of contaminants and second option for areas subject to heavier levels.

Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, [**Type 5**] [**Type 12**].

Height: 7 ft (2.13 m) maximum.

Retain one of first two subparagraphs below. Verify with manufacturer for availability of "door-in-door" construction in other than NEMA 1 style panelboards.

Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.

Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.

First two subparagraphs below are optional features. Coordinate with Drawings.

Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

Coordinate "Finishes" Subparagraph below with "Enclosures" Paragraph above. Back boxes are also available painted. Revise if required to include special finishes to match, for example, stainless steel, epoxy, and fiberglass-reinforced polyester.

Finishes:

Panels and Trim: [**Steel**] [**and**] [**galvanized steel**], factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

Back Boxes: [**Galvanized steel**] [**Same finish as panels and trim**].

Retain "Fungus Proofing" Subparagraph below for installations in humid tropical environments.

Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

* + - * 1. Phase, Neutral, and Ground Buses:

In "Material" Subparagraph below, first option is standard with most manufacturers up to 400 A; second option costs more for 400 A and less but is standard for 600 A and above.

Material: [Tin-plated aluminum] [Hard-drawn copper, 98 percent conductivity].

Plating must run entire length of bus.

Bus must be fully rated for entire length.

Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.

Subparagraph below is an optional feature. Ground and neutral buses in panelboards are also referred to as "bars" in manufacturers' literature. Coordinate with Drawings.

Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

Include instructions in "Conductor Connectors" Paragraph below if special sizing or oversizing of lugs is required, if allowing optional use of aluminum for circuits sized for copper conductors, or when upsizing conductors for voltage drop.

* + - * 1. Conductor Connectors: Suitable for use with conductor material and sizes.

Material: **[Tin-plated aluminum] [Hard-drawn copper, 98 percent conductivity].**

Terminations must allow use of 75 deg C rated conductors without derating.

Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.

Main and Neutral Lugs**: [Compression] [Mechanical**] type, with lug on neutral bar for each pole in panelboard.

See "Mechanical-Type versus Compression-Type Lugs" Article in the Evaluations for guidance on using compression versus mechanical lugs in "Ground Lugs and Bus-Configured Terminators" Subparagraph below.

Ground Lugs and Bus-Configured Terminators: [**Compression**] [**Mechanical**] type, with lug on bar for each pole in panelboard.

Retain "Quality-Control Label" Paragraph below for panelboards that incorporate one or more main service disconnecting and overcurrent protective devices and that are used as the service entrance, outside feeder, or separately derived source means of disconnect and overcurrent protection.

* + - * 1. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

Retain "Future Devices" Paragraph below if future provisions are required.

* + - * 1. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

Percentage of Future Space Capacity: [**5**] [**10**] [**20**] <**Insert number**> percent.

* + - * 1. Panelboard Short-Circuit Current Rating:

Retain one or both subparagraphs below for series-rated system or system that has panelboards and circuit breakers rated for full value of short-circuit current available at location of equipment.

Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.

Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.

Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.

Panelboards and overcurrent protective devices rated 240 V or less must have short- circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.

Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

* + - 1. PANELBOARDS

Copy and revise first paragraph below for each configuration indicated on the Drawings. Insert drawing designation. Use these designations on the Drawings to identify each product.

* + - * 1. UL QEUY - Distribution Panelboard <**Insert drawing designation**>:

Power panelboards, as specified in this article, fall under requirements of "Distribution Panelboards" in NEMA PB 1.

As produced by Cutler-Hammer/Eaton Corp. with LT Trim (Eaton EZ Trim shall not be considered), General Electric Co., Siemens or Square D Co.

Retain "Source Limitations" Subparagraph below to limit sources for this product type.

Source Limitations: Obtain products from single manufacturer.

Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

For assistance with finding guide information for UL Category Control Numbers and identifying UL- approved manufacturers, consult the UL Product iQ database at <https://iq.ulprospector.com/>.

Distribution Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.

Standard Features:

Power panelboards, as standard, do not have doors; consult manufacturers for availability and types of doors. Retain "Doors" Subparagraph below if panelboards have doors.

Doors: Secured with vault-type latch with tumbler lock; keyed alike.

For doors more than **36 inch** high, provide two latches, keyed alike.

Select one of first two options in "Mains" Subparagraph below for panelboards with main overcurrent protective devices; select third option for panelboards with only main lugs for the incoming feeder. Consult manufacturers for limitations on ratings for each type of device selected.

Mains: [**Circuit breaker] [Fused switch] [Lugs only**].

Location: [**Top] [Bottom] [Convertible between top and bottom].**

Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

Retain one of first three subparagraphs below. Allowing only bolt-on circuit breakers will exclude Square D (Schneider Electric), which uses plug-in types with a positive-locking feature, as an approved manufacturer. Note that plug-in types with a positive-locking feature are available from other manufacturers with some restrictions on size. At the time of this update, Square D did not offer bolt-in breakers for Power Panelboards.

Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: **[Plug-in circuit breakers] [Bolt-on circuit breakers] [Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal].**

Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: [**Bolt-on circuit breakers] [Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal].**

Branch Overcurrent Protective Devices: Fused switches.

Other Available Features Required by Project:

Retain and revise one or more of 11 subparagraphs below to suit Project.

Retain "Surge Suppression" Subparagraph below unless field-mounted SPDs are used. Retain "Type 1" option for service equipment where the device is installed ahead of the service disconnect. Retain "Type 2" option for panelboards on the load side of the service disconnect. Field-mounted SPDs are specified in Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits."

Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD [**Type 1**] [**Type 2**].

Isolated ground bus in "Isolated Ground Bus" Subparagraph below is sometimes physically located above and attached to the equipment ground bus with standoff insulators. Frequently and incorrectly, contractors connect equipment grounding conductors to this bus instead of to the equipment ground bus. This can be hazardous if separate equipment grounding and isolated ground conductors are not both included in the feeder serving the panelboard.

Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

Retain "Full-Sized Neutral," "Extra-Capacity Neutral Bus," or both subparagraphs below. If retaining both, indicate on Drawings which panelboards have extra-capacity neutrals.

Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.

Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors must be sized for double-sized or parallel conductors as indicated on Drawings.

Do not mount neutral bus in gutter.

Feed-Through Lugs: [**Compression**] [**Mechanical**] type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

In "Subfeed (Double) Lugs" Subparagraph below, NEMA PB 1 allows subfeed lugs to be located on the load or line side of main devices or on main-lugs-only panelboards; however, coordinate with specific manufacturers as some have restrictions on which options are available.

Subfeed (Double) Lugs: [**Compression**] [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

Gutter-Tap Lugs: [**Compression**] [**Mechanical**] type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra- capacity neutral bus.

Indicate on Drawings which panelboards have split buses, including those with contactors that control a portion of the panelboard.

Split Bus: Vertical buses divided into individual vertical sections.

Contactors can be incorporated to switch the entire panelboard or only a portion of the circuits. Coordinate with Drawings and schedules to indicate contactor connections, type, quantity of circuits controlled, current ratings, external control circuits, and number of poles. Verify with manufacturers for their respective limitations on short-circuit ratings and availability of contactors, which may not be available in all sizes or from all manufacturers.

Contactors in Main Bus: NEMA ICS 2, Class A, [**electrically**] [**mechanically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

Retain "Internal Control-Power Source" or "External Control-Power Source" Subparagraph below. If control- power transformer is used, specify capacity and associated fuses on Drawings. If branch circuit is used, identify circuit on Drawings. Use of branch circuit also requires a warning sign identifying sources of remote circuit.

Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

External Control-Power Source: [**120 V branch circuit**] [**24 V control circuit**] <**Insert requirement**>.

**<Insert additional desired product options>.**

Copy and revise first paragraph below for each configuration indicated on the Drawings. Insert drawing designation. Use these designations on the Drawings to identify each product

* + - * 1. UL QEUY - Lighting and Appliance Branch-Circuit Panelboard <**Insert drawing designation**>:

Panelboards, as specified in this article, comply with requirements of "Lighting and Appliance Branch-Circuit Panelboards" in NEMA PB 1.

As produced by Cutler-Hammer/Eaton Corp. with LT Trim (Eaton EZ Trim shall not be considered), General Electric Co., Siemens or Square D Co.

Retain "Source Limitations" Subparagraph below to limit sources for this product type.

Source Limitations: Obtain products from single manufacturer.

Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

For assistance with finding guide information for UL Category Control Numbers and identifying UL- approved manufacturers, consult the UL Product iQ database at <https://iq.ulprospector.com/>.

Lighting and Appliance Branch-Circuit Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.

Standard Features:

Retain "Mains" Subparagraph below if mains are not indicated on Drawings.

Mains: **[Circuit breaker] [or] [lugs only].**

Location: **[Top] [Bottom] [Convertible between top and bottom].**

Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

Branch Overcurrent Protective Devices: [**Plug-in**] [**Bolt-on**] circuit breakers, replaceable without disturbing adjacent units.

Other Available Features Required by Project:

Retain and revise one or more of 13 subparagraphs below to suit Project.

Retain "Surge Suppression" Subparagraph below unless field-mounted SPDs are used. Retain "Type 1" option for service equipment where the device is installed ahead of the service disconnect. Retain "Type 2" option for panelboards on the load side of the service disconnect. Field-mounted SPDs are specified in Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits."

Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD [**Type 1**] [**Type 2**].

Isolated ground bus in "Isolated Ground Bus" Subparagraph below is sometimes physically located above and attached to the equipment ground bus with standoff insulators. Frequently and incorrectly, contractors connect equipment grounding conductors to this bus instead of to the equipment ground bus. This can be hazardous if separate equipment grounding and isolated ground conductors are not both included in the feeder serving the panelboard.

Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

Retain "Full-Sized Neutral," "Extra-Capacity Neutral Bus," or both subparagraphs below. If retaining both, indicate on Drawings which panelboards have extra-capacity neutrals.

Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.

Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors must be sized for double-sized or parallel conductors as indicated on Drawings.

Do not mount neutral bus in gutter.

Feed-Through Lugs: [**Compression**] [**Mechanical**] type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

In "Subfeed (Double) Lugs" Subparagraph below, NEMA PB 1 allows subfeed lugs to be located on the load or line side of main devices or on main-lugs-only panelboards; however, coordinate with specific manufacturers as some have restrictions on which options are available.

Subfeed (Double) Lugs: [**Compression**] [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

Gutter-Tap Lugs: [**Compression**] [**Mechanical**] type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra- capacity neutral bus.

Indicate on Drawings which panelboards have split buses, including those with contactors that control a portion of the panelboard.

Split Bus: Vertical buses divided into individual vertical sections.

Contactors can be incorporated to switch the entire panelboard or only a portion of the circuits. Coordinate with Drawings and schedules to indicate contactor connections, type, quantity of circuits controlled, current ratings, external control circuits, and number of poles. Consult manufacturers for their respective limitations on and availability of short-circuit ratings for their contactors. Also check for availability of electrically held contactors, which may not be available in all sizes or from all manufacturers.

Contactors in Main Bus: NEMA ICS 2, Class A, [**electrically**] [**mechanically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

Retain "Internal Control-Power Source" or "External Control-Power Source" Subparagraph below. If control- power transformer is used, specify capacity and associated fuses on Drawings. If branch circuit is used, identify circuit on Drawings. Use of branch circuit also requires a warning sign identifying sources of remote circuit.

Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

External Control-Power Source: [**120 V branch circuit**] [**24 V control circuit**] <**Insert requirement**>.

If retaining "or" option in "Doors" Subparagraph below, indicate on the Drawings which door type applies to each panel.

Doors: Door-in-door construction with concealed hinges; secured with **[flush] [or] [multipoint]** latch with tumbler lock; keyed alike**.[ Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.]**

Column-Type Panelboards: Single row of overcurrent devices **[with narrow gutter extension] [and] [overhead junction box equipped with ground and neutral terminal buses].**

Column-Type Panelboard Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

**<Insert additional desired product options>.**

Copy and revise first paragraph below for each configuration indicated on the Drawings. Insert drawing designation. Use these designations on the Drawings to identify each product.

* + - * 1. UL QEUY - Electronic-Grade Panelboard <**Insert drawing designation**>:

Electronic-grade panelboards are frequently assembled by integrators or contractors using prefabricated panelboards complying with UL 67 and with SPD modules installed in them.

As produced by Cutler-Hammer/Eaton Corp. with LT Trim (Eaton EZ Trim shall not be considered), General Electric Co., Siemens or Square D Co.

Retain "Source Limitations" Subparagraph below to limit sources for this product type.

Source Limitations: Obtain products from single manufacturer.

Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

For assistance with finding guide information for UL Category Control Numbers and identifying UL- approved manufacturers, consult the UL Product iQ database at <https://iq.ulprospector.com/>.

Electronic-Grade Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.

Standard Features:

Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

Factory-Installed, Integral SPD:

UL 1449 distinguishes locations for which an SPD is listed for installation and designates these as Type 1, Type 2, and Type 3. Type 3 SPDs are point-of-use units; an example would be plug strips with surge protection built in. Type 2 SPDs are permanently installed on the load side of the main service disconnect. Type 1 SPDs are intended for installation on the line side of the main service disconnect, although they can also be installed on the load side. See the Evaluations for Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits" for more information on SPD types.

Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase may not be less than [**100 kA**] <**Insert value**>. Peak surge current rating must be arithmetic sum of ratings of individual MOVs in given mode.

Retain one of first two subparagraphs below. Verify compatibility of peak surge current rating and clamping voltage. Reference to UL 1449 is to its third edition.

Protection modes and UL 1449 VPR for grounded wye circuits with [**480Y/277 V**] [**208Y/120 V**], three-phase, four-wire circuits may not exceed the following:

Line to Neutral: **[1200 V for 480Y/277 V] [700 V for 208Y/120 V].**

Line to Ground: **[1200 V for 480Y/277 V] [700 V for 208Y/120 V].**

Neutral to Ground: **[1200 V for 480Y/277 V] [700 V for 208Y/120 V].**

Line to Line: **[2000 V for 480Y/277 V] [1200 V for 208Y/120 V].**

Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits may not exceed the following:

Line to Neutral: 700 V.

Line to Ground: 700 V.

Neutral to Ground: 700 V.

Line to Line: 1200 V.

See "UL 1449 Requirements for Surge Protective Devices" Article in the Evaluations for discussion on SCCR selection in "SCCR" Subparagraph below.

SCCR: Equal to [**SCCR of panelboard in which installed] [or exceed 100 kA] [or exceed 200 kA] [or exceed ] <Insert value**>.

See "UL 1449 Requirements for Surge Protective Devices" Article in the Evaluations for discussion on Inominal selection in "Inominal Rating" Subparagraph below. Type 1 SPD should be tested to 20 kA; Type 2 should be tested to either 20 kA or 10 kA.

Nominal Rating: [**20 kA**] [**10 kA**].

Buses:

Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.

Copper equipment and isolated ground buses.

Doors: Secured with vault-type latch with tumbler lock; keyed alike.

Copy and revise paragraph below for each configuration indicated on the Drawings.

Insert drawing designation. Use these designations on the Drawings to identify each product.

* + - * 1. UL QEUY - Load Center **<Insert drawing designation>:**

Load centers are not covered by NEMA PB 1; however, they are normally UL listed under either UL 67 or manufacturer's UL File Number.

As produced by Cutler-Hammer/Eaton Corp. with LT Trim (Eaton EZ Trim shall not be considered), General Electric Co., Siemens or Square D Co.

Retain "Source Limitations" Subparagraph below to limit sources for this product type.

Source Limitations: Obtain products from single manufacturer.

Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

For assistance with finding guide information for UL Category Control Numbers and identifying UL- approved manufacturers, consult the UL Product iQ database at <https://iq.ulprospector.com/>.

Electronic-Grade Type Panelboards: UL CCN QEUY; including UL 67.

Standard Features:

Select first option in "Mains" Subparagraph below for load centers with main overcurrent protective devices; select second option for load centers with only main lugs for the incoming feeder.

Mains: **[Circuit breaker] [or] [lugs only].**

Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

Doors: Concealed hinges secured with flush latch with tumbler lock; keyed alike.

Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

* + - 1. DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES
				1. As produced by Cutler-Hammer/Eaton Corp., General Electric Co., Siemens or Square D Co.

Coordinate "MCCB" and "Fused Switch" paragraphs below with Drawings. See the "Circuit Breakers" Article in the Evaluations for guidance on making selections.

* + - * 1. MCCB: Comply with UL 489, with [**series-connected rating**] [**interrupting capacity**] to meet available fault currents.

Thermal-Magnetic Circuit Breakers:

Inverse time-current element for low-level overloads.

Instantaneous magnetic trip element for short circuits.

Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

Electronic Trip Circuit Breakers:

RMS sensing.

Field-replaceable rating plug or electronic trip.

Digital display of settings, trip targets, and indicated metering displays.

Multi-button keypad to access programmable functions and monitored data.

Ten-event, trip-history log. Each trip event must be recorded with type, phase, and magnitude of fault that caused trip.

Integral test jack for connection to portable test set or laptop computer.

Field-Adjustable Settings:

Retain one or more of first four subparagraphs below and coordinate required adjustable settings with Section 260573 "Power System Studies." See "Electronic RMS Trip versus MCCBs" Paragraph in "Circuit Breakers" Article in the Evaluations for additional guidance on specifying full- or standard-function features.

Instantaneous trip.

Long- and short-time pickup levels.

Long- and short-time adjustments.

Ground-fault pickup level, time delay, and I squared T response.

Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

Retain first subparagraph below for GFCI circuit breakers for personnel ground-fault protection as required by NFPA 70; retain second subparagraph for GFPE circuit breakers (e.g., for self-limiting, heat-trace cables) as required by NFPA 70. GFCI, GFPE, and AFCI circuit breakers are only available fully rated up to interrupting ratings of 22 kA. For panelboards subject to fault currents above 22 kA, series ratings must be used.

GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).

GFPE Circuit Breakers: Class B ground-fault protection (30 mA trip).

Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single- pole configuration.

Subfeed Circuit Breakers: Vertically mounted.

MCCB Features and Accessories:

Not all accessories and options listed in subparagraphs below are available for every rating and from every listed manufacturer. Verify availability and unique characteristics with manufacturers selected. Indicate on Drawings features that apply to selected overcurrent devices.

Standard frame sizes, trip ratings, and number of poles.

Breaker handle indicates tripped status.

UL listed for reverse connection without restrictive line or load ratings.

See "Mechanical-Type versus Compression-Type Lugs" Article in the Evaluations for guidance on lugs.

Lugs: [**Compression**] [**Mechanical**] style, suitable for number, size, trip ratings, and conductor materials.

Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.

Select first option in "Ground-Fault Protection" Subparagraph below for solid-state trip units; select second option for thermal-magnetic units. If selecting second option, also retain "Shunt Trip" Subparagraph below.

Ground-Fault Protection: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground- fault indicator.

Communication Capability: [**Circuit-breaker-mounted**] [**Universal-mounted**] [**Integral**] [**Din-rail-mounted**] communication module with functions and features compatible with power monitoring and control system.

For "Shunt Trip" Subparagraph below, 120 V units trip at 55 percent or more of rated voltage; all other voltages trip at 75 percent or more of rated voltage.

Shunt Trip: [**120 V**] [**24 V**] <**Insert voltage**> trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.

Device specified in "Handle Padlocking Device" Subparagraph below can be used as a safety disconnect device if it has fixed attachment and is configured to allow locking in the off position.

Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [**on**] [**off**] [**on or off**] position.

Device specified in "Handle Clamp" Subparagraph below is not, and should not be used as, a safety device; it is used for holding the circuit-breaker handle in designated position to avoid accidental interruption of important circuits such as circuits for fire-alarm control panel or emergency lighting.

Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage [**without intentional**] [**with field-adjustable 0.1- to 0.6-second**] time delay.

Rating Plugs: Three-pole breakers with ampere ratings greater than [**150**] <**Insert value**> A must have interchangeable rating plugs or electronic adjustable trip units.

Auxiliary Contacts: [**One, SPDT switch**] [**Two, SPDT switches**] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.

Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.

Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key must be removable only when circuit breaker is in off position.

Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground- fault protection function with other upstream or downstream devices.

Multipole units enclosed in [**single housing with single handle**] [**or**] [**factory assembled to operate as single unit**].

Some manufacturers offer shunt-trip operators for their fused switches; however, most do not recommend using this feature for providing ground-fault protection on switches rated 1000 A and above in panelboards; they recommend using MCCBs or switches specified in Section 262413 "Switchboards." Consult manufacturers for availability and limitations if this feature is required.

* + - * 1. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

Provide fuses and spare fuse cabinet.

Fused Switch Features and Accessories:

Standard ampere ratings and number of poles.

Mechanical cover interlock with manual interlock override, to prevent opening of cover when switch is in on position. Interlock must prevent switch from being turned on with cover open. Operating handle must have lock-off means with provisions for three padlocks.

Accessories and options, in addition to the one in "Auxiliary Contacts" Subparagraph below, may be available for some ratings and from some listed manufacturers. Consult manufacturers for availabilities and unique characteristics.

Auxiliary Contacts: [**One**] [**Two**] normally open and normally closed contact(s) that operate with switch handle operation.

* + - 1. MAINTENANCE MATERIAL ITEMS

Retain "Spare Parts" Paragraph below if requested by Owner and spare parts are required for maintenance. Spare parts are components that occasionally fail and may be needed to repair products; for example, circuit breakers and fuses.

* + - * 1. Spare Parts: Furnish to Owner spare parts, for repairing panelboards and related equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents.[ **Include the following:**]

Coordinate with Section 262813 "Fuses" for quantities of spare fuses and spare-fuse cabinet to be provided.

Yale No. 511S locks with brass cylinder rosette, blind fastened from inside of door. 2 No. 47 keys with each lock (Exception: Not more than 7 keys, total) Keys: [**Two**] <**Insert number**> spares for each type of panelboard cabinet lock.

Circuit Breakers Including GFCI and GFPE Types: [**Two**] <**Insert number**> spares for each panelboard.

Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

**<Insert extra materials>.**

Retain "Special Tools" Paragraph below if requested by Owner and special tools are required for installation or maintenance. Special tools are items that would not be available from a typical hardware store; for example, keys, circuit-breaker test sets, circuit-breaker racking handles, circuit-breaker hoists, and battery hoists.

* + - * 1. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to panelboards and related equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents.[ **Include the following:**]

Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

Retain "Portable Test Set" Subparagraph below for circuit breakers with solid-state trip devices.

Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

1. EXECUTION
	* + 1. EXAMINATION
				1. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

Referenced NECA and NEMA standards in first paragraph below include similar requirements. See "Testing and Inspecting" Article in the Evaluations.

* + - * 1. Receive, inspect, handle, and store panelboards in accordance with [**NECA 407**] [**NEMA PB 1.1**].
				2. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
				3. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
				4. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. INSTALLATION
				1. Comply with manufacturer's published instructions.

NFPA 70 and NECA NEIS 1 are already specified in Section 260010 "Supplemental Requirements for Electrical." Retain "Reference Standards" Paragraph below to specify other standards applicable to Work specified in this Section.

* + - * 1. Reference Standards:

Referenced NECA and NEMA standards in "Panelboards" Subparagraph below include similar requirements. See "Testing and Inspecting" Article in the Evaluations.

Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with [**NECA 407**] [**NEMA PB 1.1**].

Consult Director’s Representative for resolution of conflicting requirements.

* + - * 1. Special Techniques:

Equipment Mounting:

Retain first subparagraph below to require panelboards to be installed on cast-in-place concrete equipment bases.

Install floor-mounted panelboards on cast-in-place concrete equipment base(s).

Even if floor mounted, all panelboard cabinets must still be securely attached to a vertical wall or surface.

Attach panelboard to vertical finished or structural surface behind panelboard.

Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in first subparagraph below provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

Mount surface-mounted panelboards to steel slotted supports **5/8 inch, 1- 1/4 inch** in depth. Orient steel slotted supports vertically.

Retain first subparagraph below for projects in seismic areas. Indicate seismic-control device type in supported equipment schedule on Drawings.

Provide seismic control devices.

Retain "Temporary Lifting Provisions" Subparagraph below for large floor-mounted distribution panelboards.

Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

Retain first subparagraph below if seismic controls are required for Project. Coordinate with Drawings.

Provide mounting and anchoring devices.

Verify that, whatever height is selected for top of trim in first subparagraph below, the operating handle of top-most switch or circuit breaker, in on position, is not higher than 79 inch (2 m) above finished floor or grade. Verify with authorities having jurisdiction whether maximum breaker height is governed by OSHA regulations, which may require a much lower height for panels.

Mount top of trim **7.5 ft** above finished floor unless otherwise indicated.

Mount panelboard cabinet plumb and rigid without distortion of box.

Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

Install overcurrent protective devices and controllers not already factory installed.

First subparagraph below assumes that settings are indicated on Drawings or a coordination report is available for Contractor to use.

Set field-adjustable, circuit-breaker trip ranges.

Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.

Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

Install filler plates in unused spaces.

Retain first subparagraph below if panelboards are mounted flush and ceilings are accessible or there are raised floors, or when panelboards are located in spaces that will be finished.

Stub four 1 inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 inch empty conduits into raised floor space or below slab not on grade.

Retain option in first subparagraph below if retaining "Load Balancing" Paragraph in "Adjusting" Article.

Arrange conductors in gutters into groups and bundle and wrap with wire ties[ **after completing load balancing**].

Mount spare fuse cabinet in accessible location.

* + - * 1. Remove the neutral to ground main/system bonding jumper unless the panelboard is used for a service entrance or if the panel if fed by a separately derived system. Turn the bonding jumper over to the Director’s Representative.
				2. Interfaces with Other Work:

Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

* + - 1. IDENTIFICATION
				1. Identify field-installed conductors, interconnecting wiring, and components.
				2. Install warning signs.
				3. Panelboard Nameplates: Label each panelboard with nameplate that explains the means of identifying each ungrounded system conductor by phase and system. Examples of nameplate statements:

Identification of 120/240 Volt Circuit Conductors:

2 wire circuit - white\*, black.

3 wire circuit - white\*, black, red.

4 wire circuit - white\*, black, red, blue.

\*White is used only as neutral. Where neutral is not required, black, red, or black, red, blue is used for phase to phase circuits.

Identification of 277/480 Volt Circuit Conductors:

2 wire circuit - natural gray\*\*, brown.

3 wire circuit - natural gray\*\*, brown, yellow.

4 wire circuit - natural gray\*\*, brown, yellow, orange.

\*\*Natural gray is used only as neutral. Where neutral is not required, brown, yellow, or brown, yellow, orange is used for phase to phase circuits.

Retain "Device Nameplates" Paragraph below if nameplates are required for individual overcurrent devices in power panelboards.

* + - * 1. Device Nameplates: Label each branch circuit device in power panelboards with nameplate.
				2. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.
				3. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
				4. Circuit Directory:

A circuit directory is required by NFPA 70 for panelboards and load centers. Retain one of first two subparagraphs below. Retain first subparagraph to provide the directory on a manufacturer supplied card that may be housed in one of the two methods indicated. Retain second to provide a directory on a printed sheet protected by plastic and mounted inside door. Computer-generated directories with more detail data to describe circuits are becoming an inexpensive option.

Provide directory card inside panelboard door, mounted in **[transparent card holder] [metal frame with transparent protective cover].**

Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

Retain option in subparagraph below if retaining "Load Balancing" Paragraph in "Adjusting" Article.

Create directory to indicate installed circuit loads[ **after balancing panelboard loads**]; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

* + - 1. FIELD QUALITY CONTROL
				1. Administrant for Low-Voltage Electrical Tests and Inspections:

Retain one of four subparagraphs below to specify who administers and performs tests and inspections. Coordinate testing responsibilities with Owner or Tenant before retaining first subparagraph.

[**Director’s Representative**] will engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

Administer and perform tests and inspections[ **with assistance of factory-authorized service representative**].

Retain "Acceptance Testing Preparation" and "Tests and Inspection" paragraphs below to describe tests and inspections to be performed.

* + - * 1. Acceptance Testing Preparation:

Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

Test continuity of each circuit.

Retain first paragraph below to require that field quality-control tests be witnessed. Local ordinance or custom may require that authorities having jurisdiction witness the testing.

* + - * 1. Field tests and inspections must be witnessed byDirector’s Representative.
				2. Tests and Inspections:

Retain first and second options in first subparagraph below if panelboards with factory-installed SPD are specified.

Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers[ **and low-voltage surge arrestors**] stated in NETA ATS, Paragraph 7.6 Circuit Breakers[ **and Paragraph 7.19.1 Surge Arrestors, Low-Voltage**]. [**Do not perform**] [**Perform**] optional tests. Certify compliance with test parameters.

Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

Perform the following infrared scan tests and inspections and prepare reports:

Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

Instruments and Equipment:

Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

* + - * 1. Nonconforming Work:

Panelboards will be considered defective if they do not pass tests and inspections.

Remove and replace defective units and retest.

* + - * 1. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

Include certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

Retain "Manufacturer Services" Paragraph below if manufacturer's representative is required to support or supervise the administrant specified in Section 260010 "Supplemental Requirements for Electrical" for field tests and inspections performed by Installer or third-party agencies.

Retain "supervise" option in "Manufacturer Services" Paragraph when third-party tests and inspections must be witnessed and approved by factory-authorized service representative to satisfy special extended-warranty requirements. In some cases, Installer may be factory authorized under warranty provisions to fulfill this role.

* + - * 1. Manufacturer Services: Engage factory-authorized service representative to [**support**] [**supervise**] field tests and inspections.
			1. ADJUSTING
				1. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
				2. Set field-adjustable circuit-breaker trip ranges.

Circuit changes made during load balancing may negate color-coding of phases and circuits. If load balancing proves undesirable or is to be performed by others, delete "Load Balancing" Paragraph below.

* + - * 1. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Director’s Representative of effect on phase color coding.

Measure loads during period of normal facility operations.

Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Director’s Representative . Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.

Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

* + - 1. PROTECTION
				1. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416