

ring gasket which can be compressed for positive seal between entering conduit and fitting body.

- F. Underground conduits entering areas below grade shall be arranged to drain water that may enter conduit system. Where possible conduits shall pitch away from building to exterior manholes. Junction boxes at conduit entries within building shall be provided with drain holes.
- G. Where conduits penetrate fire walls or partitions, pack openings with mineral fiber or approved insulation to maintain integrity of fire barriers.
- H. Conduit connections to pull boxes, safety switches, etc. shall be made by use of double steel locknuts. The conduit system, including pullboxes, shall form a continuously conductive grounding system.
- I. Conduits shall be protected immediately after installation by means of installing flat, noncorrosive, metallic discs and steel bushings at each end. Discs shall not be removed until necessary for pulling cable. Prior to pulling of cables, steel bushings and metallic discs shall be removed and phenolic insulating bushings shall be installed on end of each conduit of 25 mm size and over.
- J. No horizontal runs of conduits may be installed in masonry walls, except by specific permission of the Owner's representative.
- K. Conduit shall be substantially supported by pipe straps, or suitable clamps or hangers. Attached to structure of building to provide substantial and rigid installation. Joint use of hangers with heating and plumbing lines will not be permitted.
- L. Expansion joints shall be provided in conduit systems that cross building expansion joints or for raceways exceeding 30 meters. Bonding straps shall be used to provide continuous ground around expansion joint.
- M. For 20 mm and 25 mm diameter size Rigid PVC conduit embedded in concrete, provide special fitting such as adapter for joining or connecting between PVC and rigid steel conduit. Adapter fitting shall be embedded in concrete and there will be no exposed part of PVC conduit.

3.3 CONDUIT IN SLABS

- A. Conduits in structural slabs shall be placed between upper and lower layers of reinforcing steel and shall be spaced at least 200 mm apart. 20 mm conduits may be used in 110 mm and thicker slabs. 25 mm conduits may be used in 130 mm and thicker slabs. Maximum conduit size shall be 40 mm in structural concrete slabs. Conduits running parallel to slab supports such as columns, beams and walls shall not be installed less than 300 mm from such elements. Conduits shall have a minimum of 40 mm of concrete all around.

WIRES AND CABLES FOR 0-600 V CIRCUITS and POWER CABLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide building wires, power cables, control cables, flexible cords, splices, taps, and terminations as required for electrical work covered by the Contract Documents.

PART 2 PRODUCTS

2.1 BUILDING WIRES FOR 600 VOLTS AND LESS

- A. General
 - 1. Conductors shall be new and shall show the name and trademark of the manufacturer and shall be tagged showing acceptance by Underwriter's Laboratories. Conductors shall be identified in accordance with Philippine Electrical Code color coding. Conductors shall be 600 volt insulated and shall be 3.5 mm² or larger unless otherwise noted. Sizes larger than 3.5 mm² are noted on the drawings.
 - 5. Conductors shall be stranded copper.
 - 6. Conductors used in fluorescent fixture channels shall be rated 90°C.
 - 7. Conductors for power circuits shall be type THHN/THWN.
 - 8. Equipment grounding conductors shall be green or have the ends taped with green tape and shall be type TW.
 - 6. Conductors for wiring in high ambient areas shall be stranded flexible tinned copper. Silicone rubber insulated with heat and moisture resistant glass braid jacket, rated 200°C intermittent operating temperature, 180°C continuous.
- B. Insulation Types shall be as follows:
 - 1. Type THHN conductor insulation shall be polyvinyl chloride plastic. Rating shall be 90°C in wet or dry locations.
- C. Approved Product Manufacturers or approved equal.
 - 1. Insulated copper, annealed conductors:

2.2 FLEXIBLE CORDS

- A. Flexible cords shall be furnished for pendent connections to lighting fixtures and connections to portable equipment.

2.3 CONTROL CABLE

- A. Multiple conductor control cables shall be rated 600 Volts, shall have outer jacket as specified, and be suitable for installation in open, air, ducts, conduit, or direct burial.
- B. Conductors: Stranded soft copper or number shown.
- C. Insulation: As specified below with stranded IPCEA Color Coding.

2.4 POWER CABLE

- A. Power cables shall be rated as specified, 133% shall have outer jacket as specified, and be suitable for installation in open or direct burial.
- B. Conductors: Copper
- C. Insulation: XLPE Insulation, Extruded Semi-Conductive Conductor
- D. Temperature: 90 degrees C up to 250 degrees C short circuit condition

PART 3 EXECUTION

3.1 CONDUCTOR INSTALLATION

- A. Interiors of conduit shall be clean and dry before pulling wire. If dirt or moisture has entered conduits contractor shall swab them clean.
- B. Care shall be exercised while installing wire in conduits so as not to injure conductor insulation. Use only UL listed wire pulling lubricants for pulling-in conductors.
- C. Free ends and loops of wire at boxes and enclosures shall be pushed back in box and protected by blank covers or other means until the interior painting or decorating work is completed.

3.2 CONDUCTOR IDENTIFICATION

- A. The conductors of branch circuits for power and lighting shall be color coded for identification purposes in accordance with Article 5.3 of the Philippine Electrical Code. Refer to Section 16055 of these specifications.
- B. Power feeders for 600 volts and below shall be color coded by using permanent-colored, non - aging insulating tape.

- C. Branch circuits shall be connected as numbered on drawings. Test and permanently tag by circuit number each circuit wire, except neutrals, in panel gutter before connecting to panels, using numbered tapes.
- D. Terminal strips shall be lettered or numbered, and numbered or lettered tapes shall be attached to conductors connected through terminal strips.

3.3 SPLICES, TAPS AND TERMINATIONS

- A. Splices and taps of conductors 5.5 mm² and smaller shall be made using electrical spring connectors with vinyl insulating caps.
- B. Splices and taps of conductors larger than 5.5 mm² shall all be made by split-bolt type connectors. Finished splice or tap shall be insulated with one layer of vinyl backed mastic followed by two half-lapped layers of electrical tape or premolded caps or heat shrinkable tubing.
- C. Feeder conductors shall be terminated with pressure bolt type lugs.
- D. Conductors for other than feeders shall be terminated using pressure bolt type terminals. Where connections are to be made under screw heads only, install insulated crimp type spade lugs on stranded wire ends before connections are made.
- E. Connectors shall contain only one wire unless listed for multiple conductors.
- F. Feeder cables shall be continuous without splices.

3.4 TESTING

- A. Continuity shall be checked by means of a DC test device using a bell or buzzer. Circuit and phase identification tags shall comply with 3.2 above.
- B. Lighting circuit shall be identified and shall pass operational tests to see that the circuits perform functions for which they are designed.
- C. Cable connections must pass a visual inspection for workmanship and conformance with standard practice.
- D. Conductors and leads shall be tested for continuity. Feeder and branch circuits shall be given a megger test using 1000 volt motor driven megger.
 - 1. Megger tests shall be made between one conductor and ground with the other conductors grounded. Each conductor shall be tested in the same manner. Megger readings for cables connected at both ends shall be recorded.
 - 2. Each feeder conductor shall be meggered with the cable connected to the open breaker at the equipment. Connections at the other end of each of these cables shall be as follows:

WIRING DEVICES

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Device plates and decorative box covers.
- D. Access floor box.

1.2 RELATED SECTIONS

- A. Section 16130 - Boxes.

1.3 REFERENCES

- A. Philippine Electrical Code
- B. NECA - Standard of Installation.
- C. NEMA WD 1 - General Requirements for Wiring Devices.
- D. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- E. NFPA 70 - National Electrical Code.
- F. PEC - Philippine Electrical Code

1.4 SUBMITTALS

- A. Product Data: Submit three (3) manufacturer's sample or catalog information showing each dimensions, colors, configuration and etc. Final selection shall be made by the Architect.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 or PEC.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.
- B. Body and Handle: Ivory plastic with toggle handle.
- C. Ratings:
 - 1. Voltage: 300 volts, AC.
 - 2. Current: 15 amperes.
- D. Ratings: Match branch circuit and load characteristics.

2.2 RECEPTACLES

- A. Description: NEMA WD 1, Heavy-duty general use receptacle.
- B. Device Body: Ivory plastic.
- C. Configuration: NEMA WD 6, type as specified and indicated.
- D. Convenience Receptacle: Type as indicated.
- E. General purpose receptacle are 20 ampere 250 volt 3 pin grounding type.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

- A. Decorative Cover Plate: Ivory, smooth plastic, modern plate.
- B. Jumbo Cover Plate: Ivory, smooth plastic, modern plate.
- C. Weatherproof Cover Plate: Gasketed cast metal with gasketed device cover. Weatherproof accessories are to be of non-corroding metal or polycarbonate enclosure with a IP56 rating.

DIGITAL KILOWATT-HOUR METER

- A. Manufacturers or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 INSTALLATION

Install in accordance with NECA "Standard of Installation."

- B. Install switches with OFF position down.
- C. Install receptacles with grounding pole .
- D. Install decorative plates on switch and receptacle in finished areas.
- E. Connect wiring devices by wrapping conductor around screw terminal.
Use jumbo size plates for outlets installed in masonry walls.

Connect the grounding terminal of each device to the equipment grounding conductor of the circuit and connect to the metallic outlet box grounding lug with a pig-tail conductor. The connection shall be made with a conductor pig-tail such that removal of the device will not interrupt the ground continuity of the downstream devices.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install wall switch 1.2 m above finished floor.
- B. Install convenience receptacle 300 mm above finished floor.
- C. Install convenience receptacle 150 mm above counter or backsplash of counter.

3.4 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.

- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.5 **ADJUSTMENT & CLEANING**

Clean installed work.

Clean exposed surfaces to remove splatters and restore finish.

Adjust devices and wall plates to be flush and level. Where outlet boxes are not within 4mm of the finish wall surface, install an extension ring or reinstall outlet box to bring it to within 4mm of the surface in order to provide secure support for the device.

Protect all devices and plates from paint and construction material. All devices and plates shall be clean, undamaged and unscratched.

LIGHTING FIXTURES

PART 1 – GENERAL

DESCRIPTION

The work required under this section consists of the supply, installation, testing and commissioning of the lighting fixtures and associated equipment and materials.

QUALITY ASSURANCE

- A. Industry Referenced Standards: The following specifications and standards are incorporated into and become part of this specification by reference. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements and errata) on the date of invitation for bids, shall apply. In text, such specifications and standards are referenced to be basic designation only.

International Electrotechnical Commission (IEC)

The National Fire Protection Association:
National Electrical Code
Underwriter's Laboratories, Inc.

Electric Lighting Fixtures
American National Standards Institute (ANSI)
C82.1, .2, .3: Ballasts
The Philippine Electrical Code

International Electrical Commission

IEC 347 Lamp Control Gear
IEC 662 High Pressure Sodium Lamps
IEC 598 Luminaires General
IEC 921 Ballasts for Fluorescent Lamps
IEC 922 Ballasts for Discharge Lamps – General

SUBSTITUTIONS

Lighting fixtures are described in the fixture schedule. A request to utilize fixtures other than those listed in the fixture schedule must be submitted for approval in accordance with these specifications. Process critical and architecturally significant fittings require substantial submittal material to be considered for substitution.

PART 2 – PRODUCTS

GENERAL

Furnish all materials specified herein or indicated on the drawings.

All lighting fixtures, ballasts and lighting controls shall be UL listed and bear a UL label or IEC equivalent.

Fixtures shall be selected from the fixture schedule from the description of the fixture with consideration to mounting, number and types of lamps, and reference notes contained in the fixture schedule and in accordance with these specifications. The fixture catalogue number is provided for easy reference only.

Ballasts and transformers shall be suitably rated for operation on electrical system voltage to which they are to be connected.

1.) Exit Signs

Emergency Exit luminaries shall:

Be of the 2x10 watt (minimum) fluorescent lamp type, with one lamp for battery operated emergency operation and the other lamp for 220V operation. Under mains failure the battery will operate the luminaries for 3 hours.

Incorporate "EXIT" lettering directional arrows as detailed in the Schedule or as determined on site.

Contains a main failure relay.

Be adequate ventilated.

Contained sealed nickel cadmium cells with the following features:

Securely fastened in position with purpose made clamps separately housed in a battery pack.

Located clear in any source.

Positioned to permit removal and replacement without removing other components, and the luminaries mounted in position.

Minimum installation life of five (5) years and a guaranteed life of 3 years when operated in accordance with the manufacturer's directions in the proposed exit luminaries.

Have reversed battery polarity protection.

Have lamp removal protection.

LED indication of charging mode.

2.) **Emergency Luminaires**

All emergency luminaires shall:

Contain visual indicator lights

Include local light switches

Contain inverter protection against damage in the event of lamp failure removal.

Contain battery packs to operate the luminaries for a period of 3 hours.

Standard luminaries specified with battery back up shall be delivered to site complete with all inverters, change over system and battery.

3.) **FLUORESCENT LIGHTING FIXTURES ACCESSORIES**

a. **Housing**

Gauge 24 cold rolled steel in white powder coated glossy paint finish with 60-80 microns thickness.

b. **Reflector**

0.4mm thick anodized aluminum in mirror finish with 86% total reflectance and 14% diffuse reflectance.

c. **Louver**

Multi-lined 0.7mm thick anodized aluminum in matt finish.

d. **Ballast**

230V/60Hz., program warm start high frequency electronic ballast, permissible voltage 198-264V, overvoltage protection 350V/2h, power factor >0.95, operating temperature -20 to +55 °C and with Philippine Standard quality and safety certification mark. ENEC conformance.

e. **Fluorescent Lamp**

T8 energy saving and tri-phosphor 36 watts w/ 3350 lumen output and 18 watts w/ 1350 lumen output color 80's TL'D energy saving lamp.

f. **Lampholder**

White Polycarbonate casing, 130 °C Temperature

G13 push-through rotary type lampholder for T8 and T12 lamp.

PART 3 – EXECUTION

FIXTURE SUPPORTS AND MOUNTING

Lighting fixtures will be installed in accordance with the manufacturer's recommended mounting methods. Provide complete details regarding the required mounting methods for each of the fittings in the location they are to be installed. All lightings shall be supported from the building structure.

Surface mounted fixtures mounted on concrete structure, sheet rock or plaster ceiling or low density acoustical tile ceilings shall be mounted with two 6mm x 40mm x 100mm metal spacers between the fixture and the ceiling, if required. HID fittings shall be provided complete with "quick mount" base for ease of maintenance.

Propose complete dimensioned, fixing details for all fittings recessed in the walk-on ceiling to enable the ceiling to be prepared for their mounting.

INSTALLATION

Verify focusing, orientation and mounting details of all fittings prior to installing.

Labels shall be positioned on fixtures so that they will not be visible under normal operating conditions of the fixtures.

Install all recessed or semi-recessed luminaires in a means enabling adequate cooling.

Install lamps in all lighting fixtures.

Do not install luminaires or transformers in thermal insulation.

Allow for repositioning of all production area fittings to ensure full coordination with process or building services pieces of equipment.

Luminaires are not be suspended off sprinkler, water, or mechanical services. Use steel pipe suspension rods or electroplated welded link chain as appropriate.

Provide unswitched active supply to each emergency luminaires, exit signs.

All lighting fixtures shall be free of light leaks, wraps, dents, and other irregularities.

CLEANING AND ADJUSTMENT

Provide replacement lamps and control gear for all fixtures in which lamps have burned out, are inoperative or for fixtures in which lamps are not providing 100% output.

- A. Hanger rods shall be galvanized steel or cadmium plated, 6 mm minimum diameter.
 - 1. Hardware rods shall be fastened to structural steel members with suitable beam clamps or to concrete inserts set flush to the surface.

2.7 **HARDWARE FINISH**

- A. Hardware finish for concrete inserts, pipe straps, nuts, bolts, washers, screws, etc. shall be galvanized or cadmium plated.

2.8 **MISCELLANEOUS**

- A. The Contractor shall furnish and install necessary locknuts, bushings, pipe clamps, ground clamps, supports, pull boxes, mounting bolts, inserts, lugs and such other materials, as may be necessary and proper in the execution of this work.

PART 3 EXECUTION

3.1 **LABOR AND SUPERVISION**

- A. Workmanship shall be in accordance with best practices of trade. Electrical work shall be installed under direct supervision of an electrical engineer.

3.2 **LAYOUT AND COORDINATION**

- A. Contractor shall be responsible for laying out work on site in conformance with contract documents and shall be responsible for damage caused by reason of inaccuracy on his part. Contractor shall take field measurements necessary for his work and shall be responsible for their accuracy.
- B. Contractor shall coordinate location of equipment, conduit, outlets, etc. in proper relationship to work specified elsewhere. When other work interferes with this locations, Contractor shall bring matter to attention of Owner's Representative whose decision will be final as to which shall take precedence. Where this is not done, Owner's Representative reserves right to make such changes in work as are necessary to avoid interference, and such changes shall not be considered as extra work.
- C. Contractor shall carefully refer to room dimensions, door swings and locations of other equipment for location of outlets. In the event of discrepancy with electrical drawings, Owner requirement shall govern. Provide electrical service and connections to items so requiring in other divisions. Contractor shall check such drawings and specifications, other than electrical, to so determine.
- D. Ceiling lighting fixture outlets shall be located for symmetrical installation of lighting fixtures between beams, walls, breaks in ceilings, etc. unless specifically shown or dimensioned on the drawings.

- E. Contractor shall keep himself fully informed of progress of general construction, and shall install his work that is concealed and built into building, in place, insufficient time to ensure proper location, without delays to work of other trades. Properly attend electrical work during progress of building-in to prevent misalignment of and damages to electrical work.

3.3 CUTTING AND PATCHING

- A. Do cutting, fitting or patching of work that may be required to make its several parts come together properly, and fit it to receive, or be received by work of others, shown upon or reasonably implied by the drawings and specifications.
- B. Avoid cutting into work of others by using sleeves, inserts, chases, etc. The Contractor, in whose work it shall be necessary to use these methods, shall build same into his work, but this Contractor shall be responsible for the correct size and location of same, and shall furnish sleeves and inserts.
- C. If necessary to cut into the work of another Contractor it shall be done by that Contractor, at this Contractor's expense or by this Contractor with the consent of the other Contractor. Patching made necessary by such cutting shall be executed in the same manner.
- D. Cutting shall be done with such tools and methods as will prevent damage to surrounding building areas or equipment, and shall be performed in a neat and orderly manner.
- E. Building structural members shall not be drilled, punched, cut, burned, or welded without approval of Owner's Representative. This Contractor will be responsible for damage he inflicts on the building structure.

3.4 DAMAGE TO OTHER WORK

- A. This Contractor shall be held responsible for damage to other work caused by this work, or through the neglect of this workmen. Patching and repairing of damaged work shall be done by workmen of the proper trade, but the cost of same shall be paid for this Contractor.

3.5 PAINTING

- A. Patched wall surfaces, boxes, or other equipment installed will be finish painted under other sections of these specifications.
- B. Factory finished equipment shall be handled with care, to avoid marring the finish. Finishes damaged during installation shall be repaired to the satisfaction of the Architect/Engineer to Owner's Representative by this Contractor. Also, prime coats shall be made and kept intact by this Contractor.

- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.5 **ADJUSTMENT & CLEANING**

Clean installed work.

Clean exposed surfaces to remove splatters and restore finish.

Adjust devices and wall plates to be flush and level. Where outlet boxes are not within 4mm of the finish wall surface, install an extension ring or reinstall outlet box to bring it to within 4mm of the surface in order to provide secure support for the device.

Protect all devices and plates from paint and construction material. All devices and plates shall be clean, undamaged and unscratched.

LIGHTING FIXTURES

PART 1 – GENERAL

DESCRIPTION

The work required under this section consists of the supply, installation, testing and commissioning of the lighting fixtures and associated equipment and materials.

QUALITY ASSURANCE

- A. Industry Referenced Standards: The following specifications and standards are incorporated into and become part of this specification by reference. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements and errata) on the date of invitation for bids, shall apply. In text, such specifications and standards are referenced to be basic designation only.

International Electrotechnical Commission (IEC)

The National Fire Protection Association:
National Electrical Code
Underwriter's Laboratories, Inc.

- A. Polyvinyl Chloride (PVC) Conduit shall be schedule 40 heavy wall rated for 90 C conductors and UL listed for aboveground and underground uses in accordance with PEC article 5.6.3. Conduit shall conform to NEMA TC-2 and UL -651 standards.
- B. Fittings such as couplings, elbows, offsets, conduit adapters, etc. shall be fabricated from same material as conduit.

PART 3 EXECUTION

3.1 APPLICATION

- A. Unless otherwise indicated all types of conduit shall be Intermediate metal conduit to be installed for exposed interior wiring, in concrete slabs, in exterior walls, for exposed exterior wiring, and as shown on drawings except as may be specifically accepted elsewhere in the specifications.
- B. Rigid PVC conduit shall be used for underground work only as indicated in the drawings. The conduit shall be concrete encased under paved areas and other location as noted on the drawings. PVC conduit shall also be used in corrosive areas as defined on the drawings, and concealed in floors and walls whenever possible.
- C. All 20 mm and 25 mm diameter conduit sizes if embedded in concrete shall be Rigid PVC conduit and remaining type and sizes of conduit shall be rigid steel conduit or unless otherwise indicated in the drawing.
- D. Flexible liquidtight PVC jacketed steel conduit shall be used for connections to motors and equipment subject to vibration and in wet or damp locations.
- E. Pendant mounted lighting fixtures shall be supported using rigid steel conduit without exception.
- F. Minimum size conduit shall be 15 mm unless otherwise noted.

3.2 INSTALLATION

- A. Exposed conduit shall be run parallel or perpendicular to building walls and shall be kept as inconspicuous as possible.
- B. Conduits shall be concealed in walls and floors, wherever possible. In areas where there are dropped ceilings, conduits shall be installed above ceiling.
- C. Conduits and cable trays may be exposed in mechanical equipment rooms.
- D. Concealed conduit shall be run in straight lines with long sweep bends and offsets.
- E. Conduit entries through building walls below grade shall be made watertight by means of manufactured fittings. Fittings shall provide sleeve through wall having neoprene

ring gasket which can be compressed for positive seal between entering conduit and fitting body.

- F. Underground conduits entering areas below grade shall be arranged to drain water that may enter conduit system. Where possible conduits shall pitch away from building to exterior manholes. Junction boxes at conduit entries within building shall be provided with drain holes.
- G. Where conduits penetrate fire walls or partitions, pack openings with mineral fiber or approved insulation to maintain integrity of fire barriers.
- H. Conduit connections to pull boxes, safety switches, etc. shall be made by use of double steel locknuts. The conduit system, including pullboxes, shall form a continuously conductive grounding system.
- I. Conduits shall be protected immediately after installation by means of installing flat, noncorrosive, metallic discs and steel bushings at each end. Discs shall not be removed until necessary for pulling cable. Prior to pulling of cables, steel bushings and metallic discs shall be removed and phenolic insulating bushings shall be installed on end of each conduit of 25 mm size and over.
- J. No horizontal runs of conduits may be installed in masonry walls, except by specific permission of the Owner's representative.
- K. Conduit shall be substantially supported by pipe straps, or suitable clamps or hangers. Attached to structure of building to provide substantial and rigid installation. Joint use of hangers with heating and plumbing lines will not be permitted.
- L. Expansion joints shall be provided in conduit systems that cross building expansion joints or for raceways exceeding 30 meters. Bonding straps shall be used to provide continuous ground around expansion joint.
- M. For 20 mm and 25 mm diameter size Rigid PVC conduit embedded in concrete, provide special fitting such as adapter for joining or connecting between PVC and rigid steel conduit. Adapter fitting shall be embedded in concrete and there will be no exposed part of PVC conduit.

3.3 CONDUIT IN SLABS

- A. Conduits in structural slabs shall be placed between upper and lower layers of reinforcing steel and shall be spaced at least 200 mm apart. 20 mm conduits may be used in 110 mm and thicker slabs. 25 mm conduits may be used in 130 mm and thicker slabs. Maximum conduit size shall be 40 mm in structural concrete slabs. Conduits running parallel to slab supports such as columns, beams and walls shall not be installed less than 300 mm from such elements. Conduits shall have a minimum of 40 mm of concrete all around.

WIRES AND CABLES FOR 0-600 V CIRCUITS and POWER CABLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide building wires, power cables, control cables, flexible cords, splices, taps, and termination's as required for electrical work covered by the Contract Documents.

PART 2 PRODUCTS

2.1 BUILDING WIRES FOR 600 VOLTS AND LESS

- A. General
 - 1. Conductors shall be new and shall show the name and trademark of the manufacturer and shall be tagged showing acceptance by Underwriter's Laboratories. Conductors shall be identified in accordance with Philippine Electrical Code color coding. Conductors shall be 600 volt insulated and shall be 3.5 mm² or larger unless otherwise noted. Sizes larger than 3.5 mm² are noted on the drawings.
 - 5. Conductors shall be stranded copper.
 - 6. Conductors used in fluorescent fixture channels shall be rated 90°C.
 - 7. Conductors for power circuits shall be type THHN/THWN.
 - 8. Equipment grounding conductors shall be green or have the ends taped with green tape and shall be type TW.
 - 6. Conductors for wiring in high ambient areas shall be stranded flexible tinned copper. Silicone rubber insulated with heat and moisture resistant glass braid jacket, rated 200°C intermittent operating temperature, 180°C continuous.
- B. Insulation Types shall be as follows:
 - 1. Type THHN conductor insulation shall be polyvinyl chloride plastic. Rating shall be 90°C in wet or dry locations.
- C. Approved Product Manufacturers or approved equal.
 - 1. Insulated copper, annealed conductors:

2.2 FLEXIBLE CORDS

- A. Flexible cords shall be furnished for pendent connections to lighting fixtures and connections to portable equipment.

2.3 CONTROL CABLE

- A. Multiple conductor control cables shall be rated 600 Volts, shall have outer jacket as specified, and be suitable for installation in open, air, ducts, conduit, or direct burial.
- B. Conductors: Stranded soft copper or number shown.
- C. Insulation: As specified below with stranded IPCEA Color Coding.

2.4 POWER CABLE

- A. Power cables shall be rated as specified, 133% shall have outer jacket as specified, and be suitable for installation in open or direct burial.
- B. Conductors: Copper
- C. Insulation: XLPE Insulation, Extruded Semi-Conductive Conductor
- D. Temperature: 90 degrees C up to 250 degrees C short circuit condition

PART 3 EXECUTION

3.1 CONDUCTOR INSTALLATION

- A. Interiors of conduit shall be clean and dry before pulling wire. If dirt or moisture has entered conduits contractor shall swab them clean.
- B. Care shall be exercised while installing wire in conduits so as not to injure conductor insulation. Use only UL listed wire pulling lubricants for pulling-in conductors.
- C. Free ends and loops of wire at boxes and enclosures shall be pushed back in box and protected by blank covers or other means until the interior painting or decorating work is completed.

3.2 CONDUCTOR IDENTIFICATION

- A. The conductors of branch circuits for power and lighting shall be color coded for identification purposes in accordance with Article 5.3 of the Philippine Electrical Code. Refer to Section 16055 of these specifications.
- B. Power feeders for 600 volts and below shall be color coded by using permanent-colored, non - aging insulating tape.

- C. Branch circuits shall be connected as numbered on drawings. Test and permanently tag by circuit number each circuit wire, except neutrals, in panel gutter before connecting to panels, using numbered tapes.
- D. Terminal strips shall be lettered or numbered, and numbered or lettered tapes shall be attached to conductors connected through terminal strips.

3.3 SPLICES, TAPS AND TERMINATIONS

- A. Splices and taps of conductors 5.5 mm² and smaller shall be made using electrical spring connectors with vinyl insulating caps.
- B. Splices and taps of conductors larger than 5.5 mm² shall all be made by split-bolt type connectors. Finished splice or tap shall be insulated with one layer of vinyl backed mastic followed by two half-lapped layers of electrical tape or premolded caps or heat shrinkable tubing.
- C. Feeder conductors shall be terminated with pressure bolt type lugs.
- D. Conductors for other than feeders shall be terminated using pressure bolt type terminals. Where connections are to be made under screw heads only, install insulated crimp type spade lugs on stranded wire ends before connections are made.
- E. Connectors shall contain only one wire unless listed for multiple conductors.
- F. Feeder cables shall be continuous without splices.

3.4 TESTING

- A. Continuity shall be checked by means of a DC test device using a bell or buzzer. Circuit and phase identification tags shall comply with 3.2 above.
- B. Lighting circuit shall be identified and shall pass operational tests to see that the circuits perform functions for which they are designed.
- C. Cable connections must pass a visual inspection for workmanship and conformance with standard practice.
- D. Conductors and leads shall be tested for continuity. Feeder and branch circuits shall be given a megger test using 1000 volt motor driven megger.
 - 1. Megger tests shall be made between one conductor and ground with the other conductors grounded. Each conductor shall be tested in the same manner. Megger readings for cables connected at both ends shall be recorded.
 - 2. Each feeder conductor shall be meggered with the cable connected to the open breaker at the equipment. Connections at the other end of each of these cables shall be as follows:

WIRING DEVICES

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Device plates and decorative box covers.
- D. Access floor box.

1.2 RELATED SECTIONS

- A. Section 16130 - Boxes.

1.3 REFERENCES

- A. Philippine Electrical Code
- B. NECA - Standard of Installation.
- C. NEMA WD 1 - General Requirements for Wiring Devices.
- D. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- E. NFPA 70 - National Electrical Code.
- F. PEC - Philippine Electrical Code

1.4 SUBMITTALS

- A. Product Data: Submit three (3) manufacturer's sample or catalog information showing each dimensions, colors, configuration and etc. Final selection shall be made by the Architect.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 or PEC.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.
- B. Body and Handle: Ivory plastic with toggle handle.
- C. Ratings:
 - 1. Voltage: 300 volts, AC.
 - 2. Current: 15 amperes.
- D. Ratings: Match branch circuit and load characteristics.

2.2 RECEPTACLES

- A. Description: NEMA WD 1, Heavy-duty general use receptacle.
- B. Device Body: Ivory plastic.
- C. Configuration: NEMA WD 6, type as specified and indicated.
- D. Convenience Receptacle: Type as indicated.
- E. General purpose receptacle are 20 ampere 250 volt 3 pin grounding type.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

- A. Decorative Cover Plate: Ivory, smooth plastic, modern plate.
- B. Jumbo Cover Plate: Ivory, smooth plastic, modern plate.
- C. Weatherproof Cover Plate: Gasketed cast metal with gasketed device cover. Weatherproof accessories are to be of non-corroding metal or polycarbonate enclosure with a IP56 rating.

DIGITAL KILOWATT-HOUR METER

- A. Manufacturers or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 INSTALLATION

Install in accordance with NECA "Standard of Installation."

- B. Install switches with OFF position down.
- C. Install receptacles with grounding pole .
- D. Install decorative plates on switch and receptacle in finished areas.
- E. Connect wiring devices by wrapping conductor around screw terminal.
Use jumbo size plates for outlets installed in masonry walls.

Connect the grounding terminal of each device to the equipment grounding conductor of the circuit and connect to the metallic outlet box grounding lug with a pig-tail conductor. The connection shall be made with a conductor pig-tail such that removal of the device will not interrupt the ground continuity of the downstream devices.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install wall switch 1.2 m above finished floor.
- B. Install convenience receptacle 300 mm above finished floor.
- C. Install convenience receptacle 150 mm above counter or backsplash of counter.

3.4 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.