Table of Contents

Click on heading to be taken to that section

3  Building Automation Systems

28  Building Energy Efficiency Analysis

30  Cable Splicing and Termination Qualifications

33  Emergency Generator Systems

34  Exterior Lighting and Installation
39  IES Roadway Luminaire Classifications Summary
40  Pedestrian Poles and Fixture Datasheets
57  Roadway / Parking Poles and Fixture Datasheets
68  Bollard Fixture Datasheets
70  Appendix A – Exterior Lighting Installation

74  General Overhead Electrical Distribution Systems

77  High Density Polyethylene (HDPE) Piping Installations

80  Interconnection of Facilities to Utility Infrastructure

81  Medium Voltage Power Systems

93  Thermal Systems (Chilled Water and Hot Water)
95  Appendix A - CHW & HHW Supply Temperature Reset Schedules

98  Underground Piping Systems
102  Insulation Thickness Table

103  Utility Manhole Covers
107  Utility Manhole Cover Standards Diagram
108  Utility Manhole Cover Marking Standards

109  Utility Metering
Design Standard

Building Automation Systems

Detailed specifications follow.

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Refer to the Construction Documents for Sequences of Operations for HVAC Controls, for requirements that relate to this Section.

C. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Agent. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Section 01 91 13, General Commissioning, for detailed commissioning requirements.

1.02 WORK INCLUDED

A. Provide a temperature control/energy management system and control function for the entire building. The system shall include a Direct Digital Control (DDC) System that shall communicate & be integrated to the Johnson Controls or Siemens front end Building Automation System (BAS) at the TAMU Utilities & Energy Services through an owner furnished Ethernet network.

B. The BAS system must be compatible with the existing Johnson Controls or Siemens campus system. Systems or building components to be monitored and/or controlled by the central campus systems include, but are not limited to, the following: temperature control, fire alarm, outside building lighting, and the start and stop of major equipment. Provide metering of primary building utilities which include electrical, chilled water, heating hot water, domestic cold water, domestic hot water, steam, irrigation water utilizing a WAGES and electrical metering system / Square D ION metering software with indication and totalization capabilities

C. The bidding and Contract Requirements and General Requirements apply to this work.
D. Furnish and install all components but not limited to all temperature, pressure, and flow sensors, transmitters, relays, switches, wire, and all DDC panels. Also furnish all controls, operators, power supplies, control valves, air and water flow measuring stations, transducers and wiring to connect components. Submit for approval, appropriate product data cut-sheets for all material/components intended for use prior to beginning work. Where BAS is used in specifications and drawings, it is understood to be same as DDC. In addition, provide a complete installation of the Laboratory Control System (LCS) completely integrated into the campus (building) DDC System, Refer to Specification 23 09 13.

E. The Contractor shall provide Direct Digital Control (DDC) panels complete with all microprocessors, software, terminal strips, transducers, relays, and regulated power supply with battery backup at the mechanical room field equipment controllers and supervisory engines.

F. The Contractor shall furnish a HVAC Terminal Equipment Controller (TEC), electronic damper actuator(s), and electronic HW valve and actuator for installation on each VAV terminal unit and fan coil unit, as applicable, by the terminal equipment manufacturer. These DDC devices shall be delivered to the manufacturer's factory in sufficient time for the terminal equipment manufacturer to meet their scheduled delivery obligations.

G. The Contractor shall furnish all DDC lab control system components, including TECs, Lab Supply Air Terminal Units with reheat coils (duct mounted), General Exhaust Air Terminals, Fume Hood Exhaust Terminals, and all other associated controls components per Specification 23 09 13. Installation of all air terminals shall be by the mechanical contractor.

H. The terminal equipment manufacturer shall provide for each VAV box an inlet flow sensor suitable for interfacing with a pressure transducer, and for VAV boxes and all other terminal equipment (fan coil units, etc.) a 24 vac, 40 va transformer, any necessary pilot control relays, and factory mount and connect these devices and the DDC controller as required for proper operation as required under this Section. The cost of factory mounting shall be included in the cost of the terminal equipment. All wiring and terminations related to the lab control system components shall be provided by the BAS contractor.

I. The BAS Contractor shall provide for each TEC, a 24 vac, 40 va power source, and mount and connect these devices and the DDC controller as required for proper operation as required under this Section. All other wiring and terminations related to the TEC shall be provided by the BAS contractor.

J. Room temperature, CO₂ sensors and humidity sensors and mounting plates shall be provided and installed by the BAS Contractor.
K. Temperature controls and non-DDC accessories that are standard catalog products as manufactured by Siemens Building Technologies, Inc. or Johnson Controls, Inc., will be acceptable. Industrial instrumentation supplied shall be standard catalog products of Rosemount, Honeywell, Bristol, Foxboro, Leeds and Northrup, Taylor or Brown. All coordination and execution of work pertaining to the installation, service, and guarantee, under this Section of the specifications, shall be the sole responsibility of the BAS Contractor.

L. All controls to be installed, calibrated and adjusted by trained instrument technicians in the full-time employ of the BAS Subcontractor & low voltage electrical subcontractor.

M. Submit engineering/wiring drawings and receive approval prior to beginning work. These drawings shall be submitted in a timely manner to provide sufficient time to review drawings so as not to hold up the project.

N. The DDC field panels will be located in mechanical rooms as shown on the drawings. All sensor and start/stop wiring will be brought back to the panel responsible for controlling/monitoring the mechanical/electrical equipment for which the sensor, start/stop wiring is directly related. The location of these panels may not be shown on the drawings. The DDC panels in the mechanical room shall be provided with a UPS to allow operation of the panels during switchover to emergency power. The UPS shall provide a minimum of 500 va, be similar to an Invensys Powerware 120, and be installed in a NEMA 1 hinged, lockable cabinet.

O. Division 26 shall provide power to a duplex receptacle inside each panel. Power shall be provided from a breakered, 20 amp dedicated circuit on emergency power having an insulated ground wire from the power panel ground buss wired to the duplex receptacle.

P. The BAS Control System will perform all Sequence of Operations as required by the Design Engineer. Furnish and install a network communications trunk (N.C.T.) between DDC panels, and a separate LAN communications network between each terminal unit controller (or group of controllers) back to the DDC panel associated with the AHU which serves the terminal units. Trunks shall be connected to the panels with CAT-6 conductors and required components (switches). In addition, the N.C.T. trunk shall be extended from the nearest Panel to an Owner-provided, network drop(s) location.

Q. The Owner shall provide the dedicated network connection between the drop(s) location and the Campus Energy Management System.

R. Provide graphics for all new work compatible with existing campus front end system.
S. All exposed wiring shall be in conduit (1/2” minimum), as per Division 26 Sections. Concealed wiring shall be plenum rated. All active Ethernet switches, hubs, and routers shall be Contractor-provided and installed. The conduit/wiring system required for the Energy Management System shall be a complete, separate, independent system. Conduit sharing with other unrelated electrical systems is not permitted.

T. A Square D Model #PM870 WAGES utility metering panel will be provided by Division 26, complete with all microprocessors, software, programming, point data base, trends, terminal strips, and regulated power supply with battery backup. The WAGES panel will require sensor wiring from the panel to temperature sensors located in the primary supply and return piping on the Chilled Water, Heating Hot Water, and Domestic Hot Water, to be included as part of the BAS Contractor’s responsibilities. Provide all wiring from the flow meters to the WAGES panel. This WAGES panel will require a dedicated 110 volt, 20 amp, single phase standby electric circuit source installed by Division 26. This WAGES panel will require a category 6 Ethernet cable installed by Division 27. A meeting between the TAMU UES and the BAS contractor will be held as early as possible, prior to installation, to review the installation and finalize panel and wiring locations. The WAGES system will require start-up by the square D vendor.

U. Integration of the WAGES system to the UES Metering Software shall include loading of the TAMU WAGES program into each WAGES panel, connecting to the UES meter software, as well as five Graphic screens that represent each commodity that is being metered in the WAGES system. Electric Meters by the Square D, Schneider Electric Vendor will include connecting to the UES meter software, logging of meter data as required by UES, as well as many Graphic screens required to represent the electrical system and the meters that are included in the project.

V. The BAS contractor will be responsible for the connection from the Energy Management System to the campus (University). The Contractor will be responsible for programming the DDC panels with operational sequences and set-points as specified.

W. Refer to Division 23 00 10 for additional commissioning requirements.

1.03 RELATED WORK

A. All work of this Division shall be coordinated and provided by the single Building Automation System (BAS) Contractor (Also known as DDC Contractor).

B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.
C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.

D. If the BAS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

E. Section 01 91 13, Commissioning

1.04 SUBMITTALS

A. General.
   1. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance, prior to installation.
   2. All product data in the submittal shall reference the paragraph number in the specification for the corresponding equipment.
   3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BAS work.
   4. Owner & A/E Submittal Review
      a. Two weeks after submittal has been issued the Contractor, Owner and A/E will have a meeting to review and discuss A/E and Owner’s comments. The submittal will be returned approximately one week after the controls meeting.

B. Product Data: For each control device specified.

C. Shop Drawings:
   1. Schematic flow diagrams & graphic display.
   2. Power, signal, and control wiring diagrams.
   3. Details of control panel faces.
   4. Damper schedule.
   5. Valve schedule.
   6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
   7. Control System Software: Schematic diagrams, written descriptions, and points list.
   8. Sequences of operation.
   10. Samples of Graphic Display screen types and associated menus.
   11. Field quality-control test reports.
   12. Operation and maintenance data.
1.05 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals:
   1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner’s Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BAS provided:
      a. Table of contents.
      b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
      c. Manufacturer’s product data sheets or catalog pages for all products including software.
      d. Archive copy of all site-specific databases and sequences.
      e. BAS network diagrams.
      f. Interfaces to all third-party products and work by other trades.
   2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.06 ENERGY MANAGEMENT SYSTEM WIRING

A. All wiring and conduit shall be installed in accordance with related Specification Section Division 26, Electrical.

B. The conduit/wiring system required for the BAS specification Input/Output summary:
   1. Digital Input (D.I.) wiring (Class 2) may be run in a common conduit with Digital Output (D.O.) wiring (Class 1) where local codes permit.
   2. Analog Input (A.I.), Analog Output (A.O.), Digital Input (D.I.), and Network Communications Trunk (N.C.T.) wiring may be run in a common conduit.
   3. Digital Output (D.O.) wiring run in a common conduit with Analog Input (A.I.), Analog Output (A.O.), or Network Communications Trunk (N.C.T.) is not permitted under any circumstances.
   4. AC line power to DDC panel shall be #12 THHN.
   5. Digital Output (D.O.) wiring shall be #14 THHN.
   6. Digital Input (D.I.), Analog Input 4-20 mA (A.I.), and Analog Output (A.O.) wiring shall be #20 TSP (twisted shielded stranded pair with drain wire).
   7. Analog Input/Thermistor/or voltage types (A.I.) wiring shall be #20 TSP (twisted shielded stranded pair with drain wire).
   8. Network Communications Trunk (N.C.T.) between DDC panels and TEC’s shall be 2 individual minimum #24 awg TSP (twisted, shielded stranded pair) cables, not to exceed 12.5 pf capacitance per foot, wire-to-wire, and
not to exceed 6 twists per foot. TEC controller LAN networks shall be 1 #24 awg TSP of the same type.

C. Wiring between DDC Panels:
   1. Furnish, install and terminate individual CAT-6 cable assemblies to interconnect each mechanical room in a star configuration. Data is passed through the switch before continuing to its destination to other main building panels and to the front end. Each cable shall originate and terminate within one designated DDC panel in each mechanical room. Additionally, furnish, install and terminate individual Cat-6 cable assemblies to connect each DDC panel within the mechanical room(s) with others in that same room, as engineered by the BAS Contractor.
   2. All cable runs between mechanical rooms and /or DDC panels shall be no longer than allowed as specified in Division 27. Where runs are required that will be longer than Division 27, furnish and install an additional enclosure near the midpoint (coordinate location wit architect), to be used as a network junction box, complete with 120VAC emergency power source. Terminate and label the cables within this junction box as directed for each DDC panel.
   3. Furnish, install and make connections of all interlock, power for sensors (if required), line and low-voltage wiring external and internal to DDC panels. All wiring shall be clearly and permanently labeled as outlined below.

D. Field devices requiring a 4-20 mA DC input signal shall be non-ground referenced.

E. All wiring in mechanical rooms, electrical rooms, inaccessible areas, or located in areas exposed to occupant view shall be run in conduit. Plenum rated wiring shall be acceptable for installation in concealed, accessible locations. Conduit fill limit shall not exceed 40% in any portion of the conduit system.

F. In order to facilitate maintenance, where multiple sensors or devices are connected to a common raceway or conduit, each sensor or device shall be individually connected to a common (non-sensor or device) junction box, which shall then be attached to the common conduit. Under no circumstances shall sensor or device wiring or tubing be routed through any other sensor or device's specific enclosure or junction box.

G. All wiring shall be labeled at both ends and at any spliced joint in between. Wire and tubing shall be tagged using a system similar to the Panduit P1 Self Laminating System that utilizes a thermal transfer (or equivalent) printer with a minimum font size of Arial 10. In addition to tagging at field device end and at spliced joints, a tag shall be placed 6 inches after entering each DDC panel. Identification and tag information shall be included in engineering/wiring submittal which must be submitted for Owner approval prior to beginning work. Tag information shall coincide with equipment/point information as written in the specification input/output summary.
1.07 SYSTEM VERIFICATION--PROCEDURE TO BE FOLLOWED

A. Provide minimum 2 week written notice for all inspections.

B. The system verification also includes the Laboratory Control System.

C. Upon completion of all external sensor mounting, terminations, and wiring into and out of the DDC panels (and WAGES panel), the Owner shall inspect and approve this work. The BAS Subcontractor shall make his Representative(s) available and coordinate with the Owner during this inspection process. At the successful conclusion of this inspection, contractor shall provide a written report stating all work is complete. BAS Subcontractor, General Contractor and Owner’s Rep shall sign. This should be filed with Project Commissioning/Startup documents.

D. Upon such approval being achieved, the BAS Contractor shall make terminations within the DDC panels and WAGES panel.

E. Following completion of the work and the DDC panel and WAGES Panel tie-in, a performance test shall be conducted by the Owner in the presence of the BAS Contractor and his appropriate Subcontractors.

F. The BAS Contractor shall be present for the testing of proper operation of each and every physical system point to which the Contractor has provided devices, wiring, in order to verify the equipment and installation provided by them (their portion of the work), i.e., when the Owner commands a point, the Contractor verifies in the field that the commanded point operates properly. At the successful conclusion of this inspection, contractor shall provide a written report stating all work is complete, calibrated and functioning properly per the specified sequences of operation. An electronic and paper copy of which will be provided to UES for signature by the BAS Subcontractor, General Contractor and Owner’s Representative. This should be filed with Project Commissioning/Startup documents. A representative of the BAS Contractor that can revise control sequences shall be available on site as necessary to make changes during the system verification.

G. Owner’s Representative shall attend initial inspection and verification of completed punch list for items in paragraphs 1.5C and 1.5F of this Section. Further inspections required due to incomplete/incorrect work shall be at Contractor’s expense.

H. Upon conclusion of final checkout and acceptance, the Contractor's responsibility reverts to warranty of materials and installation herein specified. System shall be warranted for a period of two (2) years.
I. The Contractor shall coordinate and include the Commissioning Agent as required for the above activities. Commissioning agent will coordinate and witness functional performance test procedures. Refer to 01 91 13 for additional details.

1.08 COORDINATION OF EFFORT

A. It is the responsibility of the Contractor to schedule and coordinate with the installer of all furnished equipment.

B. It is the Contractor’s responsibility to schedule the accomplishment of these activities to allow for nominal system checkout, performance tests and balancing within the contract performance period.

1.09 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.10 SYSTEM GRAPHICS

A. Provide a cover page for the project to include graphic links including, but not limited to:
   1. Air Handling Equipment
   2. Chilled and Heating Water Pumps
   3. Domestic Water Pumps
   4. Fans
   5. Outside Air Handling Equipment
   6. Supply Air Floor Plan
   7. Exhaust Air Floor Plan
   8. Schedules
   9. Other items as indicated on the construction documents

B. Floor plans shall show the following:
   1. Show room numbers or list of group of rooms within the colored areas
   2. Colored areas indicate different graphic links such as 1st floor North, etc.
   3. Links to other floors along with chilled and heating water system links.
   4. Links to sequence of operations
   5. Links to any operations schedules

C. Floor Plan of supply shall show the following:
   1. Indicate room numbers on plan
   2. Indicate different AHU coverage with different colored cloud
   3. Indicate VAV box locations along with ductwork
   4. Indicate room temperatures for each zone
D. Typical VAV box shall show the following:
   1. AHU serving VAV box
   2. Supply CFM and damper position
   3. Reheat valve position
   4. Box status, heat or cool
   5. Fan proof
   6. Room temperature and set point
   7. Occupancy sensor state (if available)

E. Exhaust fan floor plan layout shall show the following:
   1. Indicate room numbers on plan
   2. Indicate with different colored bubble or cloud the boundaries of each exhaust fan.
   3. Link to each exhaust fan that is shown on that floor

F. Schematic of outside air units shall show the following:
   1. Schematic indicating what other AHU’s the outside air handler serves
   2. Indicate flows to each AHU

G. Air Handling Unit (and PTOA) shall show the following:
   1. Provide feedback on devices, but not limited to items such as temperatures, fan speed, static pressure set point and actual, valve position, filter status, airflow measuring station CFM, etc.
   2. Graphics to be a true representation of the actual field equipment.

H. Chilled and Heating Water systems shall show the following:
   1. Pumps along with their speed and proof of status
   2. Flow meters
   3. Temperature and pressure sensors and their values
   4. Building control valve
   5. Where pumps are lead / lag set up, indicate run time in hours for each pump

I. Other
   1. Refer to construction documents for other systems that require graphics.
   2. Graphics shall include feedback on all devices including set point and actual values.

PART 2 - PRODUCTS

2.01 GENERAL DESCRIPTION

A. The Building Automation System (BAS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed
for use on the Internet, or intranets using off the shelf, industry standard
technology compatible with other Owner provided networks.

B. The Building Automation System shall consist of the following:
   1. Standalone Network Automation Engine(s).
   2. Field Equipment Controller(s).
   3. Input/Output Module(s).
   4. Local Display Device(s).
   5. Portable Operator’s Terminal(s).
   6. Distributed User Interface(s).
   7. Network processing, data storage and communications equipment.
   8. Other components required for a complete and working BAS.

C. The system shall be modular in nature, and shall permit expansion of both
capacity and functionality through the addition of sensors, actuators, controllers
and operator devices. In existing installation, re-use existing controls
equipment (Small Animal Hospital).

D. System architectural design shall eliminate dependence upon any single device
for control execution:
   1. The failure of any single component or network connection shall not
      interrupt the execution of control strategies at other operational devices.
   2. The System shall maintain all settings and overrides through a system
      reboot.

E. System architectural design shall eliminate dependence upon any single device
for alarm reporting and control execution.

F. Acceptable Manufacturers:
   1. Johnson Controls, Metasys
   2. Siemens Building Technologies

G. Integration with Existing Johnson Controls or Siemens BAS:
   1. The BAS Contractor for this new project shall provide the following:
      a. The BAS contractor shall provide any and all necessary connectivity
         licenses within the cost of the bid. Licenses shall allow specified
         BAS point information to be broadcast out of the BAS expansion to
         the existing Johnson Controls or Siemens BAS.

   2.02 ACCEPTABLE CONTRACTORS

A. Mechanical contractor shall not serve as BAS contractor. Acceptable BAS
contractors, provided they comply with these specifications, are:
   1. Siemens Building Technologies, Inc. (branch office)
   2. Johnson Controls, Inc. (branch office)
   3. No exceptions
2.03 FIELD DEVICES

A. Temperature Sensors: Platinum Resistance Temperature Detector, 0°F to 400°F range, 100 ohms at 0°C, 316 stainless steel sheath, single element, ¼ inch diameter sheath. For water sensing provide 316 stainless steel thermowells. Use 304 stainless steel extension fitting to extend assemblies through insulating materials. Provide spring-loaded sensors to ensure good surface contact in thermowells. Provide matched sensor/transmitter assemblies, NIST certified to be accurate to within ±0.1 degrees F from 20 degrees F to 70 degrees F for chilled water monitoring, accuracy of + / - 0.5 degrees F from 30 degrees F to 250 degrees F for condenser water, hot water, or domestic water monitoring, and accuracy of + / - 0.5 degrees F from 20 degrees F to 120 degrees F for all other temperature monitoring. Install on chilled water lines such that condensation does not collect in connection head. Duct temperature sensors shall be averaging type. Water sensors shall be provided with a separable stainless steel well. Outside air wall mounted sensors shall be provided with a sun shield. Accuracy of transmitter shall be unaffected by wiring distances up to 700 feet. Siemens Building Technologies, Johnson Controls, Minco, or Hy-Cal only. Immersion sensors for piping shall be Dwyer Series TTE explosion-proof RTD temperature transmitter with fully configurable ranges and display options or equal by Rosemount.

B. Room Sensors:
   1. Each room temperature sensor shall come complete with a terminal jack and override switch integral to the sensor assembly. The terminal jack shall be used to connect the portable operator's terminal to control and monitor all hardware and software point associated with the terminal unit.
   2. The Humidity Sensor shall provide a 0 to 100% range corresponding to an isolated 4 to 20 Ma output. Accuracy of ±2% RH, with maximum drift of 1% per year.
   3. An override switch will initiate override of the night setback or unoccupied mode to normal (day) operation when activated by the occupant. The switch function may be locked out, canceled or limited as to time or temperature in software by an authorized operator or a central or remote operator's terminal.
   4. Space temperature sensors may be Thermistor or 4-20 mA output RTD. The room sensor shall be firmly attached to the wall using approved construction techniques. Double-sided adhesive tape in lieu of screws is not acceptable.
   5. The room sensor shall be accurate to within ±.5°F and have a setpoint adjustment range of 45°F to 85°F.
   6. Room carbon dioxide shall provide a range from 0 to 2,000 ppm CO₂, and be accurate to within ±100 ppm. The CO₂ sensor shall experience less than 1% drift per year for the first two years of operation and negligible drift thereafter, no calibration of the CO₂ sensor is necessary.
7. Room sensors shall be full featured cover in all areas.

C. Water Flow Sensors: Water flow sensors shall be furnished by BAS, Rosemount series 8705 Magnetic flowmeter flow tubes. Each sensor shall be sized specifically for the pipe in which it is to be installed. Sensor shall have ±0.5% accuracy from 1 to 30 feet/second, with Class 150 carbon steel flanges, exterior painted with polyurethane, grounding electrode, Teflon (PTFE) lining, and Type 316L stainless steel electrodes. Contractor shall furnish Rosemount Model 8712 C remote mounted magnetic flowmeter transmitters, with 115Vac/1ph/60hz power supply, NEMA 4X enclosure, 4 – 20 ma output, battery-backup totalizer, and local operator interface.

D. Temperature Transmitters: Temperature transmitters shall be designed for 4-20 mA DC output for Platinum RTD millivolt input sensor (as specified above). Accuracy shall be the same as specified for the temperature sensors. Stability shall be ±0.2% of calibrated span for 6 months. Transmitter shall be a part of the temperature sensor assembly and shall be in a moisture-proof housing with a moisture-proof seal between the sensor and transmitter. Immersion sensors for piping shall be Dwyer Series TTE explosion-proof RTD temperature transmitter with fully configurable ranges and display options or equal by Rosemount.

E. Humidity Transmitter Space: Sensor shall provide a 0 to 100 percent range corresponding to an isolated 4-20 mA or 0-10 VDC output. Accuracy of + / - 2 percent RH, with maximum drift of 1 percent per year. Sensor shall be equipped with LCD display. Siemens model number QFA3000 or Johnson Controls number HC-7603.

F. CO₂ Duct-Stat Indoor AQ Sensor: C02 sensor shall be Siemens model number QPA63 or Johnson Controls model number CD-P00-00. The unit shall be self-contained for wall mounting application. The unit shall have a fast response and shall have 0-1 percent range corresponding to an isolated 4-20 mA or 0-10 VDC output. Visual alarm is not to be provided. The monitor shall utilize the photo acoustic sensor with VOC sampling capability.

G. Electric Room Thermostats: Provide line voltage room thermostats with cover. Set point must be adjustable from approximately 50 to 100 Deg. F. Minimum rating is 6 amps at 120 VAC. Provide removable setting knob. Housings shall not contain thermometers.

H. Duct Relative Humidity Sensor: Duct relative humidity sensors used in the calculation of enthalpy shall be Siemens QFM Series Duct Relative Humidity or similar. The sensor shall have an accuracy of +/- 2% RH. Provide unit with housings suitable for return air plenum installations. Filter material shall be Teflon. The unit shall be operating range of 0 to 100% RH and have a 4 to 20 mA or 0 to 10 Vdc linear output.
I. **Flow Transmitters:** Flow transmitters shall provide a 4-20 mA DC signal output proportional to flow. Accuracy of ±0.25% of calibrated span. Temperature Limits: -40°F to +220°F. Stability of ±0.25% of upper range limit for 6 months. Range of transmitter shall match flow conditions. Flow transmitter shall be Rosemont only.

J. **Pressure Transmitters:** Transmitters for water pressure shall provide a 4-20 mA DC signal output directly proportional to pressure. Device shall be constructed with corrosive resistant stainless steel wetted parts and have a die-cast aluminum enclosure specifically designed for NEMA4/IP65 service. Accuracy of ±0.5% of calibrated span. Span not over 200% of sensed pressure. Stability ±0.5% of upper range limit for 6 months. Stainless steel diaphragm, viton O-rings. Temperature limits: -20°F to 220°F. Rosemount, Setra, or Bristol, only.

K. **Fan proof-of-flow switches** shall be UL listed adjustable setpoint and differential pressure type. Switches shall be piped to fan inlet and outlet. For fractional horsepower and non-ducted fans, relays or auxiliary contacts may be used. Maximum pressure rating shall be at least 10 inch w.c. All pressure tubing on roof shall be stainless steel. Hawkeye or equivalent.

L. **Pump proof-of-flow switches** shall be UL listed adjustable differential pressure or flow type as specified in the sequence of operation or data point summary. Devices shall be 150 psi rated except chilled water flow switches shall be provided with totally sealed vapor tight switch enclosure on 150 psi body. Differential pressure switches shall have valved manifold for servicing. Hawkeye or equivalent.

M. **Current Status Switch:** Provide a high performance miniature split-core current status switch with adjustable set point (where indicated). The current status switch shall have an operating range of between 1.25 – 50 amps and be able to detect belt loss and mechanical failure. Shall be Veris Hawkeye H908 or equal.

N. **Air flow and static pressure analog sensors** shall be ±0.5% accuracy, range suitable for the low velocity pressures to be encountered, be selected for approximately 50% over-range, and have an electronic 4 to 20 mA analog output. These differential pressure sensors shall be connected to the air flow measuring station with valved lines for testing and calibration, and shall have adjustments for zero and span. Rosemount, Dresser Industries/Ashcroft XLDP or Setra C-264, only.
O. Electric Low Limit Duct Thermostat: Snap-acting, two pole, single throw, manual reset switch which trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint, requiring minimum 15 feet length of bulb. Provide one thermostat for every 20 sq ft of coil surface.

P. Air Flow Control Dampers:
   1. Rectangular
      a. Frame: 5 inches x 1 inch x minimum 0.125 inch 6063-T5 extruded aluminum hat-shaped channel, mounting flanges on both sides of frame, reinforced at corners.
      b. Blades:
         1) Airfoil-shaped, single-piece.
         2) All proportional (modulating and mixing) control dampers shall be opposed blade type and all two-position dampers shall be parallel-blade types.
         3) Heavy duty 6063-T5 extruded aluminum.
         4) Maximum 6 inches (152 mm).
      c. Bearings: Molded synthetic sleeve, turning in hole in frame.
      d. Seals:
         1) Blade: Extruded type for ultra-low leakage from -0 to 2 00 degrees F Mechanically attached to blade edge.
         2) Jamb: Flexible metal compression type.
      e. Linkage: Concealed in frame.
      f. Axles: Minimum 1/2 inch diameter plated steel, hex-shaped, mechanically attached to blade.
      g. Finish:
         1) Mill aluminum for dampers in exhaust airstreams.
      h. Performance Data:
         1) Closed Position: Maximum pressure of 13 inches w.g. at a 12 inch blade length.
         2) Open Position: Maximum air velocity of 6,000 feet per minute.
         3) Leakage: Maximum 5.2 cubic feet per minute per square foot at 4 inches w.g for size 48 x 48 inches.
         4) Pressure Drop: Maximum 0.03 inch w.g. at 1,500 feet per minute across 24 inch x 24 inch damper.
      i. Similar to Ruskin CD-50
   2. Round
      a. Frame: Minimum 12 gage x 8 inches deep galvanized steel, 18 inches diameter and above. Flange: Minimum 12 gage x 1-1/2 inches.
      b. Blade: Single skin, minimum 16 gage or Double skin, minimum 18 gage. Provide blade stiffeners as required.
d. Axle: Minimum 1/2 inch diameter continuous plated steel rod to 24 inches diameter, 3/4 inch diameter above 24 inches diameter.

e. Bearings: Flange stainless steel pressed into frame.

f. Blade Seals: Provide seals as required to meet minimum leakage indicated. Mechanically attach blade seals to blade.

g. Finish: Mill galvanized.

h. Maximum Static Pressure: 4.0 inches w.g.

i. Performance Data for Damper Diameter of 48 inches, AMCA 500:
   1) Maximum System Velocity: 2,500 feet per minute.
   2) Leakage with Sponge Seals:
      a) Percent of Maximum Flow: 1.40.
      b) Total Leakage: 35 cubic feet per minute.

j. Similar to Ruskin CDRS82

Q. Air Flow Measurement Station:
   1. Industrial Thermal Dispersion Technology Type, Similar to Ebtron, Inc. Model GT. Each measuring device shall consist of one or more multi-point measuring probes and a single microprocessor-based transmitter.
   2. Each unit shall operate on 24 VAC.
   3. Each sensing point shall independently determine the airflow rate and temperature, and shall equally weight and average by the transmitter prior to output. Pitot tube arrays are not acceptable.
   4. A single manufacturer shall provide probe and transmitter.
   5. The operating range shall be from 0 - 5000 fpm with accuracy of ±2% over the entire operating airflow range and be verified against standards that are traceable to NIST.
   6. The transmitter shall be capable of communicating with the host controls using 0-10VDC and 4-20ma, RS-485 and BACnet.
   7. Sensors shall be UL listed.
   8. Manufacturer shall have review and approve placement in field, and provide written report to engineer indicating airflow measuring stations are installed in accordance with manufacturer’s installation requirements.

2.04 SUPERVISORY CONTROLLERS

A. The Supervisory Controller shall be a fully user-programmable, supervisory controller. The Supervisory Controller shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Supervisory Controllers.

B. Processor – The supervisory controllers shall be microprocessor-based with a minimum word size of 32 bits. It shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. Supervisory Controller size and capability shall be sufficient to fully meet the requirements of this Specification.
C. Memory – Each Supervisory Controller shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

D. Hardware Real Time Clock – The Supervisory Controller shall include an integrated, hardware-based, real-time clock.

E. The Supervisory Controller shall include troubleshooting LED indicators to identify the following conditions:
1. Power - On/Off
2. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
3. Ethernet Connection Speed – 10 Mbps/100 Mbps/1000 Mbps
4. FC Bus – Normal Communications/No Field Communications
5. Peer Communication – Data Traffic between Supervisory Control Devices
6. Run – Running/in Startup/Shutting Down/Software Not Running
7. Bat Fault – Battery Defective, Data Protection Battery Not Installed
8. 24 VAC – 24 VAC Present/Loss Of 24VAC
9. Fault – General Fault

F. Communications Ports – The Supervisory Controller shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator’s terminals.
1. Minimum (1) USB port
2. Minimum (1) URS-232 serial data communication port
3. Minimum (1) RS-485 port
4. One (1) Ethernet port

2.05 APPLICATION CONTROLLERS

A. Based on the Building Automation System selected for the project, the following products are acceptable. If the project has selected Siemens as the Building Automation System (BAS) then the acceptable application controllers must be the Siemens product, if the project has selected the Johnson Metasys System as the BAS, then the acceptable application controllers must be the Johnson Metasys product. In all cases the acceptable application controllers must use BACnet™ as the native communication protocol between controllers, control panel, and front-end software.

B. Acceptable Products:
1. Siemens Apogee: PXC and programmable TEC line of controllers.
2. Johnson Metasys: Field Equipment Controllers

2.06 GENERAL - APPLICATION CONTROLLERS

A. Definition: An Application Controller, for this specification, could be an AAC (Advanced Application Controller), an ASC (Application Specific Controller), or
and Terminal Equipment Controller (TEC). These would be used on Primary Equipment and Terminal Equipment, respectively.

B. Each Application Controller must be capable of standalone direct digital operation utilizing its own processor, non-volatile flash memory, input/output, minimum 8 bit A to D conversion, and include voltage transient and lightning protection devices. Firmware revisions to the module must be able to be made from the local workstation, portable operator terminals or from remote locations over modems or LANs.

C. The Application Controllers for Primary Equipment shall be expandable to the specified I/O point requirements. Each controller shall accommodate multiple I/O Expander Modules via a designated expansion I/O bus port. The controller, in conjunction with the expansion modules, shall act as one application controller.

D. All point data, algorithms and application software within the controllers shall be custom programmable.

E. Each Application Controller shall execute application programs, calculations, and commands via a microcomputer resident in the controller. All operating parameters for application programs residing in each controller shall be stored in read/write-able nonvolatile flash memory within the controller and will be able to upload/download to/from the Operator Workstation.

F. Each Application Controller shall be configured on the workstation/server software as a BACnet™ device. All of the points shall be configured as BACnet objects. Each controller shall include self-test diagnostics which allow the controller to automatically relay to the system supervisory engine(s) any malfunctions or alarm conditions that exceed desired parameters as determined by programming input.

G. Each Application Controller should be capable of scheduling, either by using an on-board real-time clock or by receiving the time from the system supervisory engine(s).

H. Each Application Controller shall contain both software and firmware to perform full DDC PID control loops.

I. Each Application Controller shall contain a port for the interface of maintenance personnel's portable computer. All network interrogation shall be possible through this port.

J. If being installed outdoors, the Application Controllers shall be capable of being mounted directly in or on the equipment located outdoors. The Application
Controllers shall be capable of proper operation in an ambient temperature environment of -20 degrees F to + 150 degrees F.

K. Input-Output Processing:
1. Digital outputs shall be relays or triacs, 24VAC or VDC minimum. Each output shall be configurable as normally open or normally closed.
2. Universal inputs shall be capable of, 0-20mA, dry contact, and 0-5VDC, 2-10VDC or 0-10VDC.
3. Analog output shall be electronic, voltage mode 0-10VDC, 2-10VDC or current mode 4-20mA.
4. Enhanced Zone Sensor Input shall provide one thermistor input, one local set point adjustment, one timed local override switch, and an occupancy indicator.
5. All programming sequences shall be stored in non-volatile memory. All programming tools shall be provided as part of the system. Provide documentation of all programming including configuration files.

L. Each Application Controller shall execute application programs, calculations, and commands via a microcomputer resident in the Application Controller. All operating parameters for application programs residing in each Application Controller shall be stored in read/write-able nonvolatile flash memory within the controller. Firmware revisions, application programs and program modifications to the controller shall be capable of being performed over the Wide Area Network (WAN).

M. Each Application Controller shall be able to support various types of zone temperature sensors, such as temperature sensor only, temperature sensor with built-in local override switch, with set point adjustment switch.

N. Each Application Controller for VAV application shall have a built-in air flow transducer for accurate air flow measurement in order to provide the Pressure Independent VAV operation.

O. Each Application Controller for VAV applications shall have an integral direct coupled electronic actuator. If the actuator is not integral to the controller, the controller/actuator assembly shall be factory tested and approved for the intended use. The actuator shall provide on-off/ floating point control with a minimum of 35 in-lb of torque. The assembly shall mount directly to the damper operating shaft with a universal V-Bolt clamp assembly. The actuator shall not require any limit switches, and shall be electronically protected against overload. When reaching the damper or actuator end position, the actuator shall automatically stop. The gears shall be manually disengaged with a button on the assembly cover. The position of the actuator shall be indicated by a visual pointer. The assembly shall have an anti-rotational strap.
P. Each Application Controller shall have LED indication for visual status of communication and power.

Q. Astronomical Time: Astronomical capability shall allow the system to calculate sunrise and sunset times based on geographical location, and incorporate Daylight Savings Time, for dusk-to-dawn control or dusk-to-time control. This is required in any Application Controller with I/O for the Exterior lighting circuit(s). The Application Controller may receive this value from the Global Building Controller and fail to a “safe” position (ie., lights fail on) upon a loss of communication from the Global Building Controller.

R. In the event of a loss of communication, the Application Controller shall control from a standalone algorithm which maintains the assigned space temperature until communication is restored.

S. UPS: Uninterruptible Power Supply(s) is(are) required for any Application Controller (on primary or terminal equipment) that monitors or serves emergency and/or critical equipment, locations or points.

T. All Application Controller level objects shall be exposed as BACnet Objects.

U. Primary Equipment shall be controlled using one Application Controller when possible. A single controller with adequate Input/Output and resource capacity shall be used for a single piece of equipment as opposed to using two or more smaller controllers to house the programs for one piece of equipment.

V. Each Application Controller for Primary Equipment shall contain the following as Spare I/O:
   1. Minimum of: (3) Spare Universal Inputs (or 2-DIs and 1-AI), (1) Spare AO, and (2) Spare DOs.
   2. In addition to the Minimum, the Application Controller shall have 10% Spare I/O, of each type; UI (or DI and AI), AO and DO.

2.07 CONTROL VALVES

A. Terminal Unit Control Valves:
   1. Characterized Ball, Forged brass body, Stainless Steel trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
   2. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
   3. Sizing: 5-psig maximum pressure drop at design flow rate, to close against pump shutoff head. Select control valves for a minimum Cv of 1.0 to reduce the risk of system dirt accumulating in very small orifices in characterizing-discs.
   4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
B. Butterfly Valves:
   1. 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
   3. Disc Type: Elastomer-coated ductile iron.
   4. Sizing: 1-psig maximum pressure drop at design flow rate.

2.08 VALVE AND DAMPER ACTUATORS

A. Electronic direct-coupled actuation shall be provided.

B. The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a "V" bolt design with associated "V" shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or screw type fasteners are not acceptable.

C. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.

D. For power failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are acceptable for valves larger than 4”.

E. All spring return actuators shall be capable of both clockwise and counterclockwise spring return operation.

F. Proportional actuators shall accept a 0 to 10VDC or 0 to 20mA analog control input and provide a 2 to 10VDC or 4 to 20mA operating range.

G. Actuators capable of accepting a pulse width modulating or three-point floating control signal are acceptable for specific uses only, but are generally not preferred. Typically, these uses would be fin tube radiation control valves or small (less than 1 gpm) re-heat control valves.

H. All 24VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10VA for AC or more than 8 watts for DC applications. Actuators operating on 120VAC power shall not require more than 10VA. Actuators operating on 230VAC shall not require more than 11VA.
I. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque shall have a manual crank for this purpose.

J. All modulating actuators shall have an external, built-in switch to allow reversing direction of rotation.

K. Actuators shall be provided with a conduit fitting.

L. Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.

M. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of start-up, per Start-up Report or Cx documentation.

N. Manufacturer shall be ISO9001 certified.

O. Electronic Damper Actuators:
   1. Electronic damper actuators shall be equal to Siemens EA or SQ or Johnson Controls M Series actuator.
   2. For air handling unit isolation dampers, the actuators shall be electric with spring return. The actuators shall be able to open and close in less than 30 seconds.

P. Butterfly Valve Actuators
   1. Bray model CF Series 70 or approved equal.

2.09 COMPRESSED AIR SYSTEM

A. No controls air compressor is required for this project.

PART 3 - EXECUTION

3.01 GENERAL

A. All DDC and lab-trac panels shall be connected to emergency power system.

3.02 LAMINATED SEQUENCE OF OPERATION

A. For each piece of equipment, including, but not limited to pumps, air handling units, fans, fan coil units, etc., provide a laminated sequence of operation, including control schematic, to be mounted on the wall in the mechanical rooms or at location as indicated by Owner.
3.03 INPUT/OUTPUT SUMMARY

A. The I/O Summary on the drawings is provided as a list of the minimum points required by this contract for connection to the Energy Automation system. Furnish all devices, wiring, tubing, etc., necessary to serve and transmit to the DDC panels. Any points not shown on the I/O Summary yet required to accomplish the sequence of operation shall be provided under this contract at no additional cost to the Owner.

3.04 EQUIPMENT, AIR HANDLING UNIT AND FAN START-UP AFTER POWER FAILURE

A. In case of power failure, all AHUs and fans with 7-1/2 HP and larger motor shall be energized as follows upon restoration of normal power: Fifteen seconds (adjustable) after restoration of power, motors shall be started sequentially at 15 second intervals (adjustable) through the DDC system. Initiate start-up with:
   1. EF-C4-1/2 System
   2. PTOA-C4-1 though PTOA-C4-5.
   4. AHU-A4-1, followed by AHU-A4-2, etc.
   5. All other equipment to start sequentially after air handling units are verified on.

   B. DDC to send alarm if any equipment does not start within 15 minutes and omit that item from remaining starting sequence.

3.05 INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

   B. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

   C. Contractor shall install labels and nameplates to identify control components according to Section 23 05 53, Identification for HVAC Piping and Equipment.

   D. Contractor shall install hydronic instrument wells, valves, and other accessories according to Section 23 21 13, Hydronic Piping.

   E. Contractor shall install duct volume-control dampers according to Division 23 Sections specifying air ducts.

   F. Install electronic and fiber-optic cables as applicable according to Division 27.
3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
   2. Test and adjust controls and safeties.
   3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
   4. Test each point through its full operating range to verify that safety and operating control set points are as required.
   5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
   6. Test each system for compliance with sequence of operation.
   7. Test software and hardware interlocks.

C. DDC Verification:
   1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
   2. Check instruments for proper location and accessibility.
   3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
   4. Check instrument tubing for proper fittings, slope, material, and support.
   5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
   6. Check temperature instruments and material and length of sensing elements.
   7. Check control valves. Verify that they are in correct direction.
   8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
   9. Check DDC system as follows:
      a. Verify that DDC controller power supply is from emergency power supply, if applicable.
      b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
      c. Verify that spare I/O capacity has been provided.
      d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section, Demonstration and Training.

B. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans. Refer to Section 01 91 13, General Commissioning, for contractor training requirements.

3.08 FUNCTIONAL PERFORMANCE TESTING

A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans.
Design Standard

Building Energy Efficiency Analysis

PART 1  GENERAL

1.1 The objective is to ensure the efficient use of energy at the planning and design phase of a new or renovated building project, rather than attempt to manage and pay for an inefficient design over the life of the building. Implementing this strategy can be a positive game changer when it comes to the future of energy consumption on campus as well as ensuring that Texas A&M will not be taking on undue financial exposure as a result of inefficient building design. It is much more cost effective to ensure that efficiency is designed into a building when built or renovated so the university can benefit from an ongoing annuity of reduced operating cost over the life of the building. The work required to implement this strategy will be called Energy Efficiency Analysis (EEA). The EEA will start with an initial requirement for all project managers for new or renovated buildings to perform a design review to ensure university standards will be met for design and ensure overall building operating efficiency will meet or exceed the campus standard. The recommended university building energy design standard is a requirement that the project design engineer demonstrate that the new or renovated building will meet or exceed the ASHRAE 90.1-2010 efficiency standard by 14% for new construction and 11% for existing building renovations. Achieving this target will require that cost-effective energy conservation measures be used which do not compromise building performance or occupant comfort.

1.2 Utilities & Energy Services (UES) will work directly with the project manager and through the CBE sub-council review process to ensure that the required steps have been completed for all new construction or renovation projects budgeted at $4 million and above. Each project manager shall complete the EEA and obtain written verification from UES Technical Services. An overview of the Energy Efficiency Analysis (EEA) is provided below.

PART 2  ENERGY EFFICIENCY ANALYSIS (EEA)

2.1 Buildings shall be designed to exceed the requirements of the ASHRAE 90.1-2010 energy standard by 14% for new construction and 11% for existing building renovations, and incorporate cost effective energy conservation measures that do not compromise building performance or occupant comfort. Energy modeling by the project team will be required to verify energy performance of buildings. Energy modeling shall be conducted with the latest version of Trane Trace 700, Carrier HAP, or IESVE for Engineers. The use of other energy modeling software shall only be permitted with the prior approval of the Utilities and Energy Services Department’s Manager for Technical Services. ASHRAE 90.1-2010 Appendix G shall be used for establishing the baseline building. Modeling to demonstrate EEA
compliance shall be completed during the Design Development (DD) phase of a project.

2.2 Residential projects, as defined by the State Energy Conservation Office (SECO), shall be designed to comply with International Code Council’s International Energy Conservation Code, IECC 2009.
Design Standard

Cable Splicing & Termination Qualifications

The majority of premature cable accessory failures in the electrical industry are due to poor workmanship. To ensure that TAMU has safe and reliable power to the campus, the following guidelines have been implemented to ensure only authorized personnel perform terminations on the TAMU Campus.

Splicer – A person who installs terminations, joints, and insulated separable connectors as required to install, operate, and/or maintain a medium voltage, shielded, solid dielectric, insulated conductor distribution system. At TAMU, most of the splices consist 200A loadbreak elbows, 600A deadbreak elbows, stress cones, and splicing.

Detailed specifications follow.

PART 1 SPLICING / TERMINATIONS REQUIREMENTS AT TAMU

1.1 Minimum of 2 years experience in 2.1kV to 12.5kV systems.

1.2 Must have performed at least 25 terminations over the last 2 years.

1.3 Must have completed and documented formal training (splicing school or manufacturer training).

1.4 Must complete T-body termination demonstration for TAMU Utilities Distribution Department.
   
   A. Must supply own T-Body and material to complete termination
   
   B. Must supply own 500 MCM demonstration cable

PART 2 STANDARD PROCEDURES

2.1 Prior to cable termination or splicing, contractor shall submit in writing to the Supervisor of Electrical Distribution the qualifications of personnel directly responsible for completing the work required. The following information should be provided for approval:

   A. Training certificate and/or professional license.
   
   B. Years of experience in cable termination and/or splicing.
   
   C. Number of cable terminations and/or splices performed.
   
   D. Manufacturer certifications if applicable.
E. Must be able to successfully perform a termination and/or splice under the supervision of the Supervisor for Electrical Distribution.

2.2 After successfully meeting the above requirements and receiving approval of the Supervisor for Electrical Distribution:

A. The personnel that have been approved will be added to the university’s list of approved installers for the TAMU campus.

B. The contractor may proceed on the requested work once approval is received from the Supervisor of Electrical Distribution.

C. All cable terminations and/or splicing must be tagged with the installer name and the date of the work performed. (See Figure 1 on the following page).

D. The tag must be made of brass with letters and or numbers minimum 1/8-inch-high.

E. The contractor shall submit a list of all terminations completed for the project; the list shall have manhole number, type of termination, date and the installer’s name.

F. Qualifications shall be updated every two years to remain on the authorized personnel list.

PART 3 DISTRIBUTION

3.1 After each update to the TAMU Utilities Approved Splicer List, the list and updated TAMU Utilities Electrical Distribution Guidelines shall be distributed to:

A. TAMU Utilities Manager for Electrical Distribution & Controls

B. TAMU System Facility Planning & Construction System Electrical Engineer

C. Compass SSC
FIGURE 1

FIRST & MIDDLE INITIAL

TAMU INSTALLER NUMBER

FULL LAST NAME

DATE OF INSTALLATION

AA MALDONADO

007 01-30-2009
Design Standard

Emergency Generator Systems

Detailed specifications follow.

PART 1 GENERATORS

1.1 Generator equipment shall be supplied by a single manufacturer who has been regularly engaged in the sales and service of engine-generator sets, generators, engine auxiliaries, transfer switches, and controls for a minimum of fifteen years.

1.2 A manufacturer’s representative shall provide local factory-trained services, all required stock of replacement parts, and technical assistance.

1.3 Accessibility to the generator for service and fueling is critical. Coordinate each emergency generator installation with TAMU Utilities & Energy Services.

1.4 The fuel shall be diesel and be contained by a 24-hour double wall tank.

1.5 Approved Generator Manufacturers:
   A. Caterpillar
   B. Onan
   C. Kohler
   D. Stewart & Stephenson

PART 2 LIFE SAFETY TRANSFER SWITCH

2.1 Life safety loads are to be on a separate transfer switch from the legally required and optional generator loads.

2.2 The switch shall be fed from a separate overcurrent protective device in the generator.

2.3 Approved Transfer Switch Manufacturers:
   A. Russelectric
   B. ASCO
   C. Zenith
Design Standard

Exterior Lighting and Installation

Detailed specifications follow.

Pedestrian & General Area Lighting (Primary Campus Standard)

PART 1 FIXTURE

1.1 Gardco Round Form 10 or Kim CC/CCS
1.2 Finish: Bronze Anodized Hiawatha Metal #311
1.3 Distribution Type specific for location or Type 5 open area.

PART 2 POLES

2.1 Gardco or Sterner
2.2 Finish: Bronze Anodized Hiawatha Metal #311
2.3 All pedestrian lighting applications shall have poles at least ten feet tall. Ten foot pole mounted fixtures are preferred. Fifteen foot poles are an acceptable alternative if site lighting needs require the additional height.

PART 3 LAMPS

3.1 High Performance Advanced Metal Halide Systems
3.2 For up to 140 Watt, Philips CosmoPolis CosmoWhite System

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manufacture</th>
<th>Style</th>
<th>Catalog Number Speciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10'</td>
<td>Sterner</td>
<td>Tapered</td>
<td>RTA10-4.5x3.0-0.125-10-C-LBZ#311</td>
</tr>
<tr>
<td>10'</td>
<td>Sterner</td>
<td>Straight</td>
<td>RSA10-4.5-0.125-10-C-LBZ#311</td>
</tr>
<tr>
<td>10'</td>
<td>Gardco</td>
<td>Straight</td>
<td>PRA45-HB-10-D4-BRA#311</td>
</tr>
<tr>
<td>15'</td>
<td>Sterner</td>
<td>Tapered</td>
<td>RTA15-4.5x3.2-0.125-10-C-LBZ#311</td>
</tr>
<tr>
<td>15'</td>
<td>Sterner</td>
<td>Straight</td>
<td>RSA15-4.5-0.125-10-C-LBZ#311</td>
</tr>
<tr>
<td>15'</td>
<td>Gardco</td>
<td>Straight</td>
<td>PRA45-HB-15-D4-BRA#311</td>
</tr>
</tbody>
</table>

Note: DT-Light Duty Pole – engineer to specify correct relative strength based on site wind load factors.
### Historical Pedestrian & Heritage Area Lighting (standard per noted locations)

Historic District Lighting Areas include New Main Roadway and Military Walk.

**PART 1  FIXTURE**

1.1 Lumec Sealsafe Ancestra Fixture

1.2 Roman Bronze finish of decorative cast 356 aluminum.

1.3 Hood: spun aluminum with disk to block the up light out from hood.

**PART 2  POLES**

2.1 Lumec

2.2 Shaft: 12 fluted round cast 356 aluminum tapered shaft, .250” wall thickness

2.3 Base: round fluted cast 356 Aluminum, .357” avg. wall thickness, double fuse double fuse holders, and a cast-in anchor plate

**PART 3  LAMPS**

3.1 Lamps – same as primary campus lamp requirements

---

### Pedestrian Light Fixtures

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manufacture</th>
<th>Style</th>
<th>Catalog Number Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>90W</td>
<td>Gardco</td>
<td>Form 10</td>
<td>CP17-PXX-3-90CMPE-277-BRA311-OWLET</td>
</tr>
<tr>
<td>140W</td>
<td>Gardco</td>
<td>Form 10</td>
<td>CP17-PXX-3-140CMPE-277-BRA311-OWLET</td>
</tr>
<tr>
<td>70W</td>
<td>Gardco</td>
<td>Form 10 LED</td>
<td>CP17L-PXX-5-70LA-WW-UNIV-BRA311-OWLET</td>
</tr>
<tr>
<td>90W</td>
<td>Kim</td>
<td>CC/CCS</td>
<td>FM-CCS17P5-90CMPE-3K-277-BRA311-OWLET LUCO</td>
</tr>
<tr>
<td>90W</td>
<td>Kim</td>
<td>CC/CCS RetroLED</td>
<td>CP17-90CMPE-3K-RETROKIT-OWLET LUCO</td>
</tr>
<tr>
<td>140W</td>
<td>Kim</td>
<td>CC/CCS</td>
<td>FM-CCS17P5-140CMPE-3K-277-DBA311-OWLET LUCO</td>
</tr>
<tr>
<td>140W</td>
<td>Kim</td>
<td>CC/CCS RetroLED</td>
<td>CP17-140CMPE-3K-RETROKIT-OWLET LUCO</td>
</tr>
<tr>
<td>66W</td>
<td>Kim</td>
<td>CC/CCS LED</td>
<td>FM-CCS17P5-60L3K277-277-DBA311-OWLET LUCO</td>
</tr>
<tr>
<td>90W</td>
<td>Gardco</td>
<td>Form 10 Wall</td>
<td>CW17-1-3-90CMPE-277-BRA311-OWLET</td>
</tr>
<tr>
<td>140W</td>
<td>Gardco</td>
<td>Form 10 Wall</td>
<td>CW17-1-3-140CMPE-277-BRA311-OWLET</td>
</tr>
<tr>
<td>140W</td>
<td>Kim</td>
<td>CC/CCS Wall</td>
<td>1W-CCS17A5-140CMPE-3K-277-DBA311-OWLET LUCO</td>
</tr>
</tbody>
</table>

Note: PXX can be P21 or P22 depending on mounting type specified in cut sheet below. P21 mounting sleeve inside the pole and P22 is on the outside of the pole. All fixtures to be installed will be equipped with a controller that will integrate into the existing TAMU campus lighting automation and control system.
Historical Pedestrian & Heritage Lighting (Fixture/Pole)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manufacture</th>
<th>Style</th>
<th>Catalog Number Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture</td>
<td>Lumec</td>
<td>Ancestra</td>
<td>Z47A-XXX-5-AC-XXX-SFZ4-SC1-LMS18161A</td>
</tr>
<tr>
<td>10'</td>
<td>Lumec</td>
<td>Round</td>
<td>R50-12-FS2-SCQ-LM18161A</td>
</tr>
</tbody>
</table>

Note: XXX denotes lamp type and system voltages. D1-Light Duty Pole – engineer to specify correct relative strength based on site wind load factors.

Parking & Roadway Lighting

PART 1 | FIXTURE
1.1 Fixture: Gardco Square Form 10 or Kim EKG402
1.2 Finish: Bronze Anodized Hiawatha Metal #311
1.3 Distribution Type specific for location or Type 5 open area.

PART 2 | POLES
2.1 Gardco, Sterner or Kim
2.2 Finish: Bronze Anodized Hiawatha Metal #311
2.3 Parking lighting applications shall have poles no more than 39 feet tall. Parking lighting applications for small and medium sized parking areas and the perimeter of large parking areas shall have a cutoff fixture.

PART 3 | LAMPS
3.1 Metal Halide Lamps
3.2 For 400 Watt, Advanced Metal Halide System (same as primary campus standard)

Roadway & Parking Light Poles

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manufacture</th>
<th>Style</th>
<th>Catalog Number Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>30'</td>
<td>Sterner</td>
<td>Tapered</td>
<td>RTA30-8.0x4.5-0.188-10-L-VD-LBZ#311</td>
</tr>
<tr>
<td>30'</td>
<td>Gardco</td>
<td>Tapered</td>
<td>TAMU-TRA-CB-30L-D1-BRA-311</td>
</tr>
<tr>
<td>30'</td>
<td>Kim</td>
<td>Tapered</td>
<td>LTRA30-7156</td>
</tr>
</tbody>
</table>

Note: D1- Light Duty Pole – engineer to specify correct relative strength based on site wind load factors.
Pedestrian Bollard Lighting

**PART 1  FIXTURE**

1.1 Fixture: Gardco 830 Series LED Bollard with Demand Response

1.2 The Bollard can be specified with or with lighting capability in effort to provide a standardized bollard type, but have the flexibility of installing the luminaire type in only the locations that ground lighting is needed.

### Pedestrian Bollard Lighting

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manufacture</th>
<th>Style</th>
<th>Catalog Number Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture</td>
<td>Gardco</td>
<td>LED</td>
<td>TAMU-BRM830-42-DR-NW-360-277-SC/BRA#311</td>
</tr>
<tr>
<td>Pole</td>
<td>Gardco</td>
<td>Nonlit</td>
<td>TAMU-42-NONLIT-SC/BRA#311</td>
</tr>
<tr>
<td>Fixture</td>
<td>Kim</td>
<td>Nonlit</td>
<td>VRB1-15L-3KUV-DBA311</td>
</tr>
<tr>
<td>Pole</td>
<td>Kim</td>
<td>LED</td>
<td>VRBC-BR-C</td>
</tr>
</tbody>
</table>

Note: Engineer to review bollard specifications (height/coverage/voltage) to ensure specification meets actual bollard application.
General Exterior Campus Lighting Guidelines

Examine all available lighting source technologies to determine the appropriate source for the application, lowest life cycle cost and energy requirements for any given project. High performance HID, Compact Fluorescent, Induction, and LED technologies all have appropriate applications, based on energy efficiency, lighting level requirements, color of light, maintenance, cost, and other project criteria. Any deviation from the campus standards must be approved through Utilities & Energy Services (UES).

- All fixtures must be dark-sky compliant as required by state law.
- Manufacturer specifications for fixture and poles are available from TAMU Utilities & Energy Services (UES) Electrical Distribution at 979-845-3234.

*Typical Design Lighting Level:* TAMU follows the lighting level chart below as a guide, refer to IESNA, TXDOT, and local codes requirements for additional information.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Ways</td>
<td>1.0</td>
<td>-</td>
<td>0.1</td>
<td>2.2</td>
<td>-</td>
</tr>
<tr>
<td>Parking Lots</td>
<td>-</td>
<td>1.2</td>
<td>-</td>
<td>-</td>
<td>3:1</td>
</tr>
<tr>
<td>Roadways</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major</td>
<td>-</td>
<td>0.8</td>
<td>-</td>
<td>-</td>
<td>4:1</td>
</tr>
<tr>
<td>Collector</td>
<td>-</td>
<td>0.6</td>
<td>-</td>
<td>-</td>
<td>6:1</td>
</tr>
<tr>
<td>Local</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
IES Roadway Luminaire Classifications (Types I, II, III, IV and V) Summary:

The Illuminating Engineering Society of North America (IESNA) defines roadway and area lighting fixtures by their photometric properties and distance to the half maximum candela trace and the maximum candela value.

The definitions of the IES classifications follow:

The lateral classification describes the lateral light distribution with regards to the lighted area width described as multiples of the mounting height (MH). The width of the half-maximum candela trace within the longitudinal distribution range (Short, Medium or Long) is used. The boundaries for each classification in terms of Longitudinal Roadway Lines (LRL, running along the roadway) are as follows:

- **Type I** - Half-maximum candela trace falls between 1 MH LRL on the House side and 1 MH LRL on the Street side.
- **Type II** - Half-maximum candela trace on the Street side is beyond the 1 MH LRL but not beyond the 1.75 MH LRL.
- **Type III** - Half-maximum candela trace on the Street side is beyond the 1.75 MH LRL but not beyond the 2.75 MH LRL.
- **Type IV** - Half-maximum candela trace on the Street side is beyond the 2.75 MH LRL.
- **Type V** - Has circular symmetry being essentially the same at all lateral angles around the luminaire.

Informally, there is also a Type V-S, similar to Type V, but square in shape.
Pedestrian Poles and Fixture Datasheets

Pedestrian Sterner Tapered Pole

**ORDERING EXAMPLE**

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTA20</td>
<td>6.0 x 4.5</td>
<td>0.188</td>
<td>A28</td>
<td>B</td>
<td>DF</td>
<td>BK</td>
</tr>
</tbody>
</table>

**ORDERING SEQUENCE**

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>SHAFT LENGTH (IN)</th>
<th>SHAFT DIAMETER (IN)</th>
<th>BOLT</th>
<th>FINISH</th>
<th>BK</th>
<th>BZ</th>
<th>WH</th>
<th>AL</th>
<th>Anodized</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTA10</td>
<td>10</td>
<td>0.125</td>
<td>1/2</td>
<td>Black</td>
<td>BZ</td>
<td>WH</td>
<td>AL</td>
<td>Anodized</td>
<td></td>
</tr>
<tr>
<td>RTA12.5</td>
<td>12.5</td>
<td>0.156</td>
<td>3/4</td>
<td>Black</td>
<td>BZ</td>
<td>WH</td>
<td>AL</td>
<td>Anodized</td>
<td></td>
</tr>
<tr>
<td>RTA15</td>
<td>15</td>
<td>0.188</td>
<td>1</td>
<td>Black</td>
<td>BZ</td>
<td>WH</td>
<td>AL</td>
<td>Anodized</td>
<td></td>
</tr>
<tr>
<td>RTA20</td>
<td>20</td>
<td>0.250</td>
<td>1 1/2</td>
<td>Black</td>
<td>BZ</td>
<td>WH</td>
<td>AL</td>
<td>Anodized</td>
<td></td>
</tr>
<tr>
<td>RTA25</td>
<td>25</td>
<td>0.312</td>
<td>2</td>
<td>Black</td>
<td>BZ</td>
<td>WH</td>
<td>AL</td>
<td>Anodized</td>
<td></td>
</tr>
<tr>
<td>RTA30</td>
<td>30</td>
<td>0.438</td>
<td>3</td>
<td>Black</td>
<td>BZ</td>
<td>WH</td>
<td>AL</td>
<td>Anodized</td>
<td></td>
</tr>
</tbody>
</table>

**POLE DATA**

<table>
<thead>
<tr>
<th>Pipe Cat No.</th>
<th>Diameter (In)</th>
<th>Wall Thickness (In)</th>
<th>Unit Weight (Lb)</th>
<th>Anchor Bolt Finishing</th>
<th>Base Style</th>
<th>Gross Height</th>
<th>Gross Weight</th>
<th>Gross Length</th>
<th>Gross Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.125</td>
<td>4.5 x 0.125</td>
<td>0.125</td>
<td>10</td>
<td>0.625</td>
<td>0.625</td>
<td>0.625</td>
<td>0.625</td>
<td>0.625</td>
<td>0.625</td>
</tr>
<tr>
<td>0.156</td>
<td>5.0 x 0.156</td>
<td>0.156</td>
<td>12.5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0.188</td>
<td>6.0 x 0.188</td>
<td>0.188</td>
<td>15</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>0.250</td>
<td>7.0 x 0.250</td>
<td>0.250</td>
<td>20</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>0.312</td>
<td>8.0 x 0.312</td>
<td>0.312</td>
<td>25</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>0.438</td>
<td>9.0 x 0.438</td>
<td>0.438</td>
<td>30</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
Pedestrian Sterner Straight Pole

**Ordering Example**

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSA20</td>
<td>/</td>
<td>4.5</td>
<td>/</td>
<td>0.125</td>
<td>/</td>
<td>A28</td>
</tr>
</tbody>
</table>

**Ordering Sequence**

<table>
<thead>
<tr>
<th>POE</th>
<th>GAUGE</th>
<th>DATA</th>
<th>WALL</th>
<th>THICKNESS</th>
<th>VOLT</th>
<th>BASE</th>
<th>OPTIONS</th>
<th>FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSA10</td>
<td>10</td>
<td>0.125*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DF</td>
<td>Powder Coat</td>
</tr>
<tr>
<td>RSA12.5</td>
<td>12.5</td>
<td>0.125*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DF</td>
<td>Black</td>
</tr>
<tr>
<td>RSA15</td>
<td>15</td>
<td>0.125*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DF</td>
<td>BZ</td>
</tr>
<tr>
<td>RSA17.5</td>
<td>17.5</td>
<td>0.125*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DF</td>
<td>WH</td>
</tr>
<tr>
<td>RSA20</td>
<td>20</td>
<td>0.125*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DF</td>
<td>AL</td>
</tr>
<tr>
<td>RSA25</td>
<td>25</td>
<td>0.125*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DF</td>
<td>NS</td>
</tr>
</tbody>
</table>

**Pole Data**

<table>
<thead>
<tr>
<th>POE</th>
<th>Dia.</th>
<th>Wall Thickness</th>
<th>Pole Height</th>
<th>Base Plate</th>
<th>Anchor Bolt</th>
<th>Min. Overall</th>
<th>Max. Overall</th>
<th>Anchor Depth</th>
<th>Ground Opening Diameter</th>
<th>Overall Shipping Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSA10</td>
<td>4.5&quot;</td>
<td>0.125&quot;</td>
<td>18-1-2</td>
<td>225</td>
<td>225</td>
<td>0.625 x 1/2-2</td>
<td>0.625 x 1/2-2</td>
<td>16</td>
<td>4&quot;</td>
<td>16&quot;</td>
</tr>
<tr>
<td>RSA15</td>
<td>4.5&quot;</td>
<td>0.125&quot;</td>
<td>15-1-2</td>
<td>225</td>
<td>225</td>
<td>0.625 x 1/2-2</td>
<td>0.625 x 1/2-2</td>
<td>16</td>
<td>4&quot;</td>
<td>16&quot;</td>
</tr>
<tr>
<td>RSA20</td>
<td>4.5&quot;</td>
<td>0.125&quot;</td>
<td>17-1-2</td>
<td>225</td>
<td>225</td>
<td>0.625 x 1/2-2</td>
<td>0.625 x 1/2-2</td>
<td>16</td>
<td>4&quot;</td>
<td>16&quot;</td>
</tr>
<tr>
<td>RSA25</td>
<td>4.5&quot;</td>
<td>0.125&quot;</td>
<td>19-1-2</td>
<td>225</td>
<td>225</td>
<td>0.625 x 1/2-2</td>
<td>0.625 x 1/2-2</td>
<td>16</td>
<td>4&quot;</td>
<td>16&quot;</td>
</tr>
</tbody>
</table>

*Alloy 631 steel, galvanized and painted.

---

Exterior Lighting and Installation
Pedestrian Poles and Fixture Datasheets

Page 41
Pedestrian Gardco Straight Pole

**Straight Round Aluminum - Hinged Base**

The Philips Gardco hinged base aluminum pole consists of a one-piece round extruded aluminum lighting standard welded to a cast aluminum base plate. This top plate/pole assembly is attached on-site to the lower base with removable pivot pins. This construction allows for easy installation and servicing of the attached luminaires without the need for a ladder or basket truck. The poles are finished with either Architectural Class I anodizing or electrostatically applied TGIC polyester powdercoat. All poles include anchor bolts, full base cover, hand hole, ground lug and top cap.

### Poles

**PREFIX**
- PRA45

**BASE**
- HB Hinged Base

**HEIGHT**
- 8'
- 10'
- 12'
- 15'
- 20'

**DRILLING**
- D1 1 Way
- D2 2 Way
- D2@90 2 Way at 90°
- D3 3 Way
- D3@120 3 Way at 120°
- D4 4 Way
- T2 2 3/8" OD Tenon
- T4 4" OD Tenon

**FINISH**
- BRP Bronze Paint
- BLP Black Paint
- WP White Paint
- NP Natural Aluminum Paint
- BRA Bronze Anodized 311
- BLA Black Anodized
- NA Natural Anodized
- OC Optional Color Paint
  - Specify Optional Color or RAL, ex: RAL 7024
- SC Special Color Paint
  - Specify Must supply color chip.

**OPTIONS**
- DR Duplex Receptacle
- GFCI Ground Fault Receptacle
- AHH Additional Hand Hole
- VDA Vibration Damper
- Nipples and Couplings
  - Indicate height above base and orientation to hand hole. See Pole Orientation Information on Page 4.
  - NL Nipple - External thread
  - CL Coupling - Internal thread

**Single Mount Bullhorn Brackets**
- Indicate height above base and orientation to hand hole. See Pole Orientation Information on Page 4.
  - A15BH-19 Single - 1.9" OD
  - A15BH-24 Single - 2.4" OD
  - A215BH-19 2-Tenant - 1.9" OD
  - A215BH-24 2-Tenant - 2.4" OD

**Motion Response Provisions**
- GMR Provision for Gardco HID Motion Response System
  - Minimum Pole Height is 18'. Includes a 1/2" coupling placed 180° to the hand hole, 13° above the pole base.
- MSM Motion Sensor Mounting Provision for LED Luminaires available with Motion Response
  - Minimum Pole Height is 18'. Includes a special hand hole with 1/2" coupling placed in the cover plate, 180° to the hand hole, 13° above the pole base.
**Gardco Pole Mount**

**Form 10 Round**

**CP / MP Post Top Mount**

The Gardco Round Post Top Mounted Form 10 products are cylindrical (CP) or semi-spherical (MP) cutoff luminaires providing the greatest energy efficiency when utilized with Cosmopolis or MasterColor Elite high performance ceramic metal halide electronic systems. Luminaires may also utilize other high intensity discharge lamps up to 875 watts (400 watts in the MP). Housing is a piece seamless spun aluminum and finished with either Architectural Class 1 anodizing or electromechanically applied TGIC polyester powder coat or polyurethane. Luminaires can accept one of six (6) interchangeable and rotatable precision segmented optical systems. Optional twin glow rings at post tops are available in (4) colors and are illuminated by the primary source. Flat glass lens luminaires provide full cutoff performance. Sag Lens luminaires provide cutoff performance.

**PREFIX**

<table>
<thead>
<tr>
<th>PREFIX</th>
<th>MOUNTING</th>
<th>DISTRIBUTION</th>
<th>WATTAGE</th>
<th>VOLTAGE</th>
<th>FINISH</th>
<th>OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP17</td>
<td>P21</td>
<td>Q</td>
<td>140CMPE</td>
<td>277</td>
<td>BRA 311</td>
<td></td>
</tr>
</tbody>
</table>

*Enter the order code in the alphabetical box above. Note: Gardco reserves the right to revise a configuration. Not all combinations and configurations are valid. Refer to notes below for exclusions and limitations. For questions or concerns, please consult the factory.*

**POLES**

<table>
<thead>
<tr>
<th>Type</th>
<th>Mounting</th>
<th>Illustrations</th>
<th>Data...</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-8</td>
<td>Min. O.D.</td>
<td>Max. O.D.</td>
<td>4.000</td>
</tr>
<tr>
<td>13</td>
<td>2.25&quot;</td>
<td>4.000</td>
<td>4.000</td>
</tr>
<tr>
<td>17</td>
<td>3.00&quot;</td>
<td>5.000</td>
<td>5.000</td>
</tr>
<tr>
<td>21</td>
<td>3.50&quot;</td>
<td>6.000</td>
<td>6.000</td>
</tr>
<tr>
<td>25</td>
<td>3.75&quot;</td>
<td>6.500</td>
<td>6.500</td>
</tr>
</tbody>
</table>

**TENONS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Mounting</th>
<th>Illustrations</th>
<th>Data...</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2.00&quot;</td>
<td>4.000</td>
<td>4.000</td>
</tr>
<tr>
<td>3</td>
<td>2.50&quot;</td>
<td>5.000</td>
<td>5.000</td>
</tr>
<tr>
<td>4</td>
<td>3.00&quot;</td>
<td>6.000</td>
<td>6.000</td>
</tr>
<tr>
<td>5</td>
<td>3.50&quot;</td>
<td>6.500</td>
<td>6.500</td>
</tr>
</tbody>
</table>

**DISTRIBUTION**

**WATTAGE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Mounting</th>
<th>Illustrations</th>
<th>Data...</th>
</tr>
</thead>
<tbody>
<tr>
<td>17&quot;</td>
<td>2.00&quot;</td>
<td>4.000</td>
<td>4.000</td>
</tr>
<tr>
<td>22&quot;</td>
<td>2.50&quot;</td>
<td>5.000</td>
<td>5.000</td>
</tr>
<tr>
<td>25&quot;</td>
<td>3.00&quot;</td>
<td>6.000</td>
<td>6.000</td>
</tr>
</tbody>
</table>

**Vertical Lamp**

<table>
<thead>
<tr>
<th>Type</th>
<th>Mounting</th>
<th>Illustrations</th>
<th>Data...</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A</td>
<td>Min. O.D.</td>
<td>Max. O.D.</td>
<td>4.000</td>
</tr>
<tr>
<td>3B</td>
<td>2.25&quot;</td>
<td>4.000</td>
<td>4.000</td>
</tr>
<tr>
<td>3C</td>
<td>3.00&quot;</td>
<td>6.000</td>
<td>6.000</td>
</tr>
<tr>
<td>3D</td>
<td>3.50&quot;</td>
<td>6.500</td>
<td>6.500</td>
</tr>
</tbody>
</table>

**Note:**

1. 17" luminaires only 400W and below are available with 400W "4000W" extended flat lens standard.
2. 17" and 33" luminaires require the ELEMETAL adapter kit.
3. Medium base lamp.
4. Available with fixture options only.
5. Available in CP Style only. Not available in MP Style.

16411 Cloris Barker Road, San Marcos, TX 78666
(800) 237-0758 | (512) 753-1000  FAX (512) 753-7955  site@lighting.com
© 2013 Koninklijke Philips Electronics N.V. All Rights Reserved.
Philips Garden reserves the right to change materials or modify the design of its product without notification as part of the company’s continuing product improvement program.

**Version 2.1.2014**

**Exterior Lighting and Installation**

**Pedestrian Poles and Fixture Datasheets**

Page 43
Form 10 Round LED

CP / MP Post Top Mount

The Philips Gardco post top mounted Round Form 10 LED products are cutoff luminaires featuring LED arrays. Round Form 10 LED luminaires provide performance excellence and advanced Philips Gardco thermal management technology. High performance Class 1 LED systems offer the potential for energy savings up to 50% when compared to HID systems. Housing is one-piece seamless spun aluminum and finished with either Architectural Class 1 anodizing, with hardcoat, fade resistant, electrostatically applied TGC polyester powdercoat or polyurethane. Optional twin glow rings at post tops are available in (4) colors and are illuminated by the primary source. Luminaires provide full cutoff performance.

<table>
<thead>
<tr>
<th>PREFIX</th>
<th>MOUNTING</th>
<th>DISTRIBUTION</th>
<th>LED WATTS</th>
<th>LED SELECTION</th>
<th>VOLTAGE</th>
<th>FINISH</th>
<th>OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP17L</td>
<td>P22</td>
<td>5</td>
<td>70LA</td>
<td>WW</td>
<td>UNIV</td>
<td>BRA</td>
<td></td>
</tr>
</tbody>
</table>

Enter the order code into the appropriate box above. Note: Philips Gardco reserves the right to refuse a configuration. Not all combinations and configurations are valid. Refer to notes below for exclusions and limitations. For questions or concerns, please consult the factory.

**PREFIX**

- **Available in 70LA and 85LA LED Wattages Only**
  - **CP17L** 17" Cylindrical Luminaires LED - Constant Wattage
  - **CP17L-DIM** 17" Cylindrical Luminaires LED - 0-10V Dimming
  - **MP17** 17" Semi-Spherical Luminaires LED - Constant Wattage
  - **MP17L-DIM** 17" Semi-Spherical Luminaires LED - 0-10V Dimming

- **Available in 110LA and 160LA LED Wattages Only**
  - **CP22L** 22" Cylindrical Luminaires LED - Constant Wattage
  - **CP22L-DIM** 22" Cylindrical Luminaires LED - 0-10V Dimming
  - **MP22L** 22" Semi-Spherical Luminaires LED - Constant Wattage
  - **MP22L-DIM** 22" Semi-Spherical Luminaires LED - 0-10V Dimming

Refer to Kites for existing Form 10 Round 17" and 22" HID luminaires are available. See Legacy LED Refercf Kites Submittal Data Sheet (G200-214) for Refercf Kite information.

**MOUNTING**

<table>
<thead>
<tr>
<th>See</th>
<th>Mounting Illustrations on Page 2 for more information.</th>
<th>POLES</th>
<th>TENONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRS1 MIN O.D. 2.38&quot; MAX O.D. 3.00&quot;</td>
<td>CP / MP 17 MIN O.D. 3.50&quot; MAX O.D. 3.85&quot;</td>
<td>CP / MP 22 MIN O.D. 4.62&quot; MAX O.D. 4.89&quot;</td>
<td>T3</td>
</tr>
<tr>
<td>MP17</td>
<td>P11 (2, 3)</td>
<td>P12 (1, 2)</td>
<td>Not Available</td>
</tr>
<tr>
<td>MP22</td>
<td>P13 (2, 3)</td>
<td>P14 (1, 2)</td>
<td>T3</td>
</tr>
<tr>
<td>CP22</td>
<td>P15 (2, 3)</td>
<td>P16 (1, 2)</td>
<td>T15 (2, 3)</td>
</tr>
</tbody>
</table>

**DISTRIBUTION**

- Type II
- 2 T3
- Type IV
- 4 T4
- Type V
- 3 T3
- 5 T4

**LED WATTAGE and LUMEN VALUES**

| Ordering Code | Average System Watts | LED Current (mA) | LED Selection | Luminaire Initial Absolute Lumen* | Basis of Lumen Data: Photometric tests performed in compliance with IESNA LM-79, except where otherwise indicated. Notes:

1. Wattage may vary by ±5% due to LED manufacturers forward current specification and ambient temperature. Wattage shown is average for 130V through 277V input. Actual wattage may vary by an additional ±10% due to actual input voltage.

2. Values shown are for luminaires without the HS external shield option. Tests are in process for luminaries with the HS option and WW luminaires. Contact Gardco applications@philips.com for appropriate estimates are required for design purposes.

3. LED arrays feature LEDs that provide from 100 to 110 lumens per watt when operated at 130 mA. Lumen values based on tests performed in compliance with IESNA LM-79.

4. Marked values are scaled from NW tests on the same luminaire. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>70LA</td>
<td>70</td>
<td>350</td>
<td>CW</td>
<td>6,676</td>
<td>6,676</td>
</tr>
<tr>
<td>85LA</td>
<td>85</td>
<td>350</td>
<td>NW</td>
<td>6,676</td>
<td>6,676</td>
</tr>
<tr>
<td>110LA</td>
<td>110</td>
<td>350</td>
<td>NW</td>
<td>6,676</td>
<td>6,676</td>
</tr>
<tr>
<td>160LA</td>
<td>160</td>
<td>350</td>
<td>NW</td>
<td>6,676</td>
<td>6,676</td>
</tr>
</tbody>
</table>

1611 Clevis Barker Road, San Marcos, TX 78666
(800) 237-0758 (512) 753-3000 FAX: (512) 753-7855 site+lighting.com
© 2012 Koninklijke Philips Electronics N.V. All Rights Reserved.
Philips Gardco reserves the right to change materials or modify the design of its product without notification as part of the company’s continuing product improvement program.
G200-0351012

PHILIPS

GARDCO
Kim Pole Mount

CC/CCS 17° Post Top Mounted
Curvilinear Cutoff

Specifications

17° Diameter
42 to 150 Watt

Housing: spun aluminum. (Rollformed linear reveals;
CC: three equally spaced reveals, 1/2" wide, separated by 1/16" ribs,
1/2" deep. CCS: one 1/2" groove, 1/4" deep.) Sidewalls have a maximum 1° of taper, and are free of welds or fasteners. A rollformed aluminum flange is flared into the bottom providing support for the reflector module. An internal aluminum casting provides for mounting of the electrical module and support for the housing hinge.

Lens Frame and Yoke: One-piece cast aluminum lens frame is attached to the housing by a zinc plated cold rolled steel hinge with a stainless steel pin. Closure of the housing is by a single self-centering stainless steel screw. A stainless steel self-locking stop arm is provided to hold the housing in the open position while servicing. A 3/4" thick flat tempered glass lens is fully gasketed by a one-piece extruded and vulcanized silicone gasket. Lens is retained in the frame by removable zinc plated steel clips. Lens frame is supported at four points two aluminum U-shaped arms cradled in a cast aluminum hub. Arms are welded to the lens frame, and welded to the hub along their longitudinal axis. Hub contains a field-splice compartment, a cast aluminum cover and one of the following pole attachment means: FM - Flange Mounting or PT - Pole Top Mounting. (See page 2 for complete descriptions).

Reflector Module: Specular Alzak® optical segments are rigidly mounted within a die-cast aluminum enclosure that attaches to the housing as a one-piece module. Reflectors are field replaceable in 90° increments. All sockets are factory assembled with a quick disconnect plug for the ballast module. Wire penetrations to the socket are sealed by a silicone gasket and a totally sealed optical chamber. The optical segments are positioned so that reflected light does not pass through the lamp arc tube. All reflectors are equipped with a medium base socket rated 450V.

Electrical Module: All electrical components are UL and CSA recognized, mounted on a single plate and factory assembled with a quick disconnect plug. Module attaches inside the housing using keyhole slots. All ballasts are high power factor with starting temperatures of -40°F for HPS and -20°F for PMH lamp modes.

Finish/Color: finish is Super TGIC thermoset polyester powder coat paint, 2.5 mil nominal thickness, applied over a tinplated zirconium conversion coating. 5000 hour salt spray test endurance rating. Standard colors are Black, Dark Bronze, Light Gray, Stealth Gray®, Platinum Silver, or White. Custom colors are available.

CAUTION: fixtures must be grounded in accordance with national, state and local electrical codes. Failure to do so may result in serious personal injury.

Listings and Ratings

<table>
<thead>
<tr>
<th>UL cUL 1598*</th>
<th>CE</th>
<th>IP66 Rated</th>
<th>25C Ambient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Cut Off (for Clear Lens Only)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Suitable for wet locations
* Dark Sky Legislation Compliant

Kim Lighting reserves the right to change specifications without notice.

© 2008 Kim Lighting Inc. • P.O. Box 60980, City of Industry, CA 91716-0980 • Tel: 626.359-6695 • Fax: 626.359-2983

Kim Pole Mount Table

Approval:

Date:

Page: 1 of 5

Kim Pole Mount

KIM LIGHTING

Type:

Job:

Catalog number:

Select poles from Kim Arms and Poles Selection Guide. If pole is provided by others indicate O.D. for arm fitting.
## Standard Features

### Mounting

<table>
<thead>
<tr>
<th>EPA</th>
<th>0.7</th>
<th>0.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat. No.</td>
<td>☐ FM Flush Mount</td>
<td>☐ PT Pole Tenon Mount</td>
</tr>
<tr>
<td>Pole Top Requirements</td>
<td>3(\frac{3}{8}), 4(\frac{1}{2}), 4(\frac{3}{8}), or 5(\frac{1}{2}) Dia.</td>
<td>2(\frac{1}{2}) Pipe-size Tenon (2(\frac{3}{8}) O.D. x 4(\frac{3}{8}) L)</td>
</tr>
</tbody>
</table>

### Fixture

Cat. No. designates CC/CCS fixture and light distribution. See the Kim Site/Roadway Optical Systems Catalog for detailed information on reflector design and application.

<table>
<thead>
<tr>
<th>Horizontal Lamp</th>
<th>Light Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="CC" /></td>
<td>Type I Full Cutoff</td>
</tr>
<tr>
<td><img src="image" alt="CCS" /></td>
<td>Type II Full Cutoff</td>
</tr>
<tr>
<td><img src="image" alt="CCS" /></td>
<td>Type III Full Cutoff</td>
</tr>
<tr>
<td><img src="image" alt="CCS" /></td>
<td>Type IV Forward Throw</td>
</tr>
<tr>
<td><img src="image" alt="CCS" /></td>
<td>Type V Square</td>
</tr>
<tr>
<td><img src="image" alt="CCS" /></td>
<td>Type V Full Cutoff</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>☐ CC17P1</th>
<th>☐ CC17P2</th>
<th>☐ CC17P3</th>
<th>☐ CC17P4</th>
<th>☐ CC17P5</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ CCS17P1</td>
<td>☐ CCS17P2</td>
<td>☐ CCS17P3</td>
<td>☐ CCS17P4</td>
<td>☐ CCS17P5</td>
<td>☐ CCS17P5</td>
</tr>
</tbody>
</table>
Standard Features

Electrical Module

<table>
<thead>
<tr>
<th>Electrical Module</th>
<th>Cat. Nos. for Electrical Modules available:</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPS = High Pressure Sodium</td>
<td>High Pressure Sodium</td>
</tr>
<tr>
<td>PMH = Pulse Start Metal Halide</td>
<td>70HPS200</td>
</tr>
<tr>
<td></td>
<td>70HPS240</td>
</tr>
<tr>
<td></td>
<td>70HPS277</td>
</tr>
<tr>
<td></td>
<td>70HPS347</td>
</tr>
<tr>
<td></td>
<td>70HPS480</td>
</tr>
<tr>
<td></td>
<td>Lamp: ED-17</td>
</tr>
<tr>
<td></td>
<td>Socket: Medium Base</td>
</tr>
<tr>
<td>ANSI Ballast</td>
<td>S-62</td>
</tr>
</tbody>
</table>

Pulse Start Metal Halide

| Pulse Start Metal Halide | 70PMH120 | 100PMH120 | 150PMH120 |
|                         | 70PMH208 | 100PMH208 | 150PMH208 |
|                         | 70PMH240 | 100PMH240 | 150PMH240 |
|                         | 70PMH277 | 100PMH277 | 150PMH277 |
|                         | 70PMH347 | 100PMH347 | 150PMH347 |
|                         | 70PMH480 | 100PMH480 | 150PMH480 |
|                         | Lamp: ED-17, Clear | ED-17, Clear | ED-17, Clear |
|                         | Socket: Medium Base | Medium Base | Medium Base |
| ANSI Ballast | M-98 | M-90 | M-102 |

Lamps by others.

Finish

<table>
<thead>
<tr>
<th>Finish</th>
<th>90CMPE-3K-277V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super TGIC powder coat over a tinated zincum conversion coating</td>
<td></td>
</tr>
</tbody>
</table>

Color: Black, Dark Bronze, Light Gray, Stealth Gray™, Platinum Silver, White, Custom Color

Cat. No.: BL, DBA-311, LG, SG, PS, WH, CC

*Custom colors subject to additional charges, minimum quantities and extended lead times.
Consult representative. Custom color description:__________________________

NOTE: For lamp/ballast information outside of the U.S.A. and Canada, please consult local Kim representative.

WARNING: Fixtures must be installed and grounded in accordance with national, state, and/or local electrical codes. Failure to do so may result in serious personal injury.

*CAUTION: All manufacturers of metal halide lamps recommend turning them off for 15 minutes once per week when under continuous operation. This will reduce the risk of arc tube rupture at end of life. Also, color temperature may differ between manufacturers of metal halide lamps. See lamp manufacturers' specification sheets. Lamps by others.
## Optional Features

### Photocell

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Line Volts:</th>
<th>Cat. No.</th>
<th>Line Volts:</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ A-30</td>
<td>120V</td>
<td>□ A-33</td>
<td>277V</td>
</tr>
<tr>
<td>□ A-31</td>
<td>208V</td>
<td>□ A-35</td>
<td>347V</td>
</tr>
<tr>
<td>□ A-32</td>
<td>240V</td>
<td>□ A-34</td>
<td>480V</td>
</tr>
</tbody>
</table>

The factory installed photocell inside housing with a fully gasketed sensor on the side wall.

### Convex Glass Lens

- The 3/4" thick clear convex tempered glass lens replaces standard flat glass lens. Provides increased lens presence and provides a subtle improvement in uniformity where pole spacing is extreme. Increases effectiveness of housside shielding.

### Polycarbonate Lens

- Clear UV stabilized convex polycarbonate replaces standard flat glass lens. Gasketed and integral with lens frame.

**CAUTION:** Use only when vandalism is anticipated to be high. Useful life is limited by UV discoloration from sunlight and metal halide lamps.

### Houseside Shield

- Fixtures with the standard flat glass lens are available with stumped aluminum louvers that pass streetside light and block houseside light, and a black panel added to the reflector to reduce houseside reflections. Fixtures with the optional convex glass lens are available with a formed aluminum shield that passes streetside light and blocks houseside light, and a black panel added to the reflector to reduce houseside reflections.

**NOTE:** Recommended for use with clear lamps only.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HS</td>
<td>For use with Type II, III, or IV light distributions only.</td>
<td></td>
</tr>
<tr>
<td>□ HSC</td>
<td>For fixture with optional convex glass lens or polycarbonate lens. Not for use with Type V light distributions.</td>
<td></td>
</tr>
</tbody>
</table>
## Optional Features

**Neighbor Friendly Shield**

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ NFS</td>
</tr>
<tr>
<td></td>
<td>□ No Option</td>
</tr>
</tbody>
</table>

*(Type IV only)* Stamped internal shield and blocking panels are used to direct and redirect lighting into a forward throw distribution. The amount of light directed and redirected toward the back of the luminaire is dramatically reduced to create extremely low glare behind the pole. Only available on the Type IV reflectors.

**Accent Reveal**

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ No Option</td>
</tr>
</tbody>
</table>

*(For CC series only)* Three aluminum bands riveted inside the housing reveal. Available in five standard Kim powder coat finishes. Custom colors available.

<table>
<thead>
<tr>
<th>Color</th>
<th>Black</th>
<th>Dark Bronze</th>
<th>Light Gray</th>
<th>Stealth Gray™</th>
<th>Platinum Silver</th>
<th>White</th>
<th>Custom Colors*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat. No.</td>
<td>□ BL-REV</td>
<td>□ DS-REV</td>
<td>□ LO-REV</td>
<td>□ SG-REV</td>
<td>□ PS-REV</td>
<td>□ WH-REV</td>
<td>□ CO-REV</td>
</tr>
</tbody>
</table>

*Custom colors subject to additional charges, minimum quantities and extended lead times. Consult representative. Custom color description:
Kim LED Pole Mount

CC/CCS17
17" Post Top Mounted, Curvilinear, LED

Type: 
Job: 
Catalog number:

<table>
<thead>
<tr>
<th>Mag.</th>
<th>Fixture</th>
<th>Electrical Module</th>
<th>Finish</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Select pole from Kim Arms and Poles Selection Guide. If pole is provided by others indicate O.E.D. for arm fitting.

Specifications

17" Diameter
60 Light Emitting Diodes
Total System Watts = 60W

Housing: Spun aluminum. (Rolled form linear reveals:
CC: Three equally spaced reveal, \( \frac{3}{8} \) " wide, separated by \( \frac{3}{8} " \) ribs, \( \frac{3}{4} " \) deep. CCS: One \( \frac{3}{4} " \) groove, \( \frac{3}{4} " \) deep.) Sidewalls have a maximum \( \frac{1}{16} " \) of taper, and are free of oil pits or flaws. A rolled form aluminum flange is hammered into the bottom providing support for the reflector module. An internal aluminum casting provides for mounting of the electrical module and support for the housing flange.

Lens Frame and Yoke: One-piece cast aluminum lens frame is attached to the housing by a zinc plated cold rolled steel hinge with a stainless steel pin. Closure of the housing is by a single self-retained stainless steel screw. A stainless steel self-locking stop arm is provided to hold the housing in the open position while servicing. A \( \frac{3}{4} " \) thick class flat tempered glass lens is fully galvanized by a one-piece extruded and vulcanized silicate gasket. Lens is retained in the frame by removable zinc plated steel clips. Lens frame is supported at four points two aluminum 14-gage tubular arms cradled in a cast aluminum hub. Arms are welded to the lens frame, and welded to the hub along their longitudinal axis. Hub contains a field splice compartment, a cast aluminum cover and one of the following pole attachment means: FM - Flush Mounting or PT - Pole Taper Mounting. See page 2 for complete description.

Electrical Module: All electrical components are UL and CSA recognized, mounted on a single plate and factory premounted with quick disconnect plugs. Module includes a driver, LifeShield™ temperature control device and surge protector. Electrical module attaches to housing with no tool hinges and latches, accessible by opening the lens frame only. Driver is rated for 40°F starting and has a 0-10V dimming interface for multi-level illumination options.

Optical Module: Precision, replaceable MicroEmitter™ reflectors are positioned to achieve directional control toward desired task. The entire EmitterDock™ mounting assembly fastens to the housing as a one-piece module.

Finish/Color: Finish is Super TGIC thermoset polyester powder coat paint, 2.5 mil nominal thickness. Standard colors are Black, Dark Bronze, Light Gray, Stealth Gray, Platinum Silver, or White. Custom colors are available.

Warranty: Kim Lighting warrants Curvilinear LED products ("Products") sold by Kim Lighting to be free from defects in material and workmanship for (i) a period of five (5) years for metal parts, (ii) a period of ten (10) years for exterior housing, and (iii) a period of five (5) years for LED Light Engines (MicroEmitter™ reflectors) and (iv) a period of five (5) years for LED power components (LED Driver, LifeShield™ temperature control device, surge protector), from the date of sale of such goods to the buyer as specified in Kim Lighting shipment documents for each product.

CAUTION: Fixtures must be grounded in accordance with national, state and/or local electrical codes. Failure to do so may result in serious personal injury.

Listings and Ratings

ETL to UL Standard 6750

*Suitable for wet locations. Kim Lighting reserves the right to change specifications without notice.

© 2012 KIM LIGHTING INC. • P.O. BOX 60080, CITY OF INDUSTRY, CA 91716-0080 • TEL: 626-998-5666 • FAX: 626-998-2605

Version 2.1.2014

Exterior Lighting and Installation
Pedestrian Poles and Fixture Datasheets

Page 50
# CC/CCS17

17\" Post Top Mounted, Curvilinear, LED

**Type:**  
**Job:**  
**Page:** 2 of 5

## Standard Features

<table>
<thead>
<tr>
<th>Mounting</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA:</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Cat. No.:</td>
<td>FM</td>
<td>PT</td>
</tr>
<tr>
<td>Pole Top Requirements:</td>
<td>3%, 4%, 4%1/2, or 5% Dia.</td>
<td>2% Pipe size Tennon (2% O.D. x 4%1/2 L)</td>
</tr>
</tbody>
</table>

### Fixture

Cat. No. designates CC/CCS fixture and light distribution.

**NOTE:** Curvilinear system employs Nichia’s SSL product.  
Part number: NS6X183  
(NS6L183-H3, NS6W183-H3)

### Distribution:

- Type I Full Cutoff
- Type II Full Cutoff
- Type III Full Cutoff
- Type IV Full Cutoff
- Type V Square Full Cutoff
- Type I Left Full Cutoff
- Type R Right Full Cutoff
- Type IV Forward Throw
- Type V Square
- Type R Right
- Type I Left
Standard Features

<table>
<thead>
<tr>
<th>Electrical Module</th>
<th>Cat. Nos. for Electrical Modules available:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60L</td>
</tr>
<tr>
<td>Source:</td>
<td></td>
</tr>
<tr>
<td>Color Temperature:</td>
<td></td>
</tr>
<tr>
<td>4K = 4000K</td>
<td></td>
</tr>
<tr>
<td>5K = 5000K</td>
<td></td>
</tr>
<tr>
<td>2K = 2200 - Amber</td>
<td></td>
</tr>
<tr>
<td>3K = 3000K</td>
<td></td>
</tr>
<tr>
<td>Voltage:</td>
<td></td>
</tr>
<tr>
<td>120 = 120V</td>
<td></td>
</tr>
<tr>
<td>208 = 208V</td>
<td></td>
</tr>
<tr>
<td>240 = 240V</td>
<td></td>
</tr>
<tr>
<td>127 = 277V</td>
<td></td>
</tr>
<tr>
<td>347 = 347V</td>
<td></td>
</tr>
<tr>
<td>480 = 480V</td>
<td></td>
</tr>
</tbody>
</table>

1. 3000K is also available on an "Engineered-to-Order" (ETO) basis.
2. Due to current unavailability of 347V and 480V drivers, specification of these voltages may feature an integral step-down transformer.

<table>
<thead>
<tr>
<th>Finish</th>
<th>Color:</th>
<th>Black</th>
<th>Dark Bronze</th>
<th>Light Clay</th>
<th>Stealth Clay</th>
<th>Platinum Silver</th>
<th>White</th>
<th>Custom Color</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cat. No.</td>
<td>BL</td>
<td>DBA311</td>
<td>LG</td>
<td>SG</td>
<td>PS</td>
<td>WH</td>
<td>CC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Custom colors subject to additional charges, minimum quantities and extended lead times. Consult representative. Custom color description:__________
Optional Features

Photocell
Cat. No. (See right)
☐ No Option

- Factory installed photocell inside housing with a fully gasketed sensor on the side wall.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Line Volt:</th>
<th>Cat. No.</th>
<th>Line Volt:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-30</td>
<td>120V</td>
<td>A-33</td>
<td>277V</td>
</tr>
<tr>
<td>A-31</td>
<td>208V</td>
<td>A-35</td>
<td>347V</td>
</tr>
<tr>
<td>A-32</td>
<td>240V</td>
<td>A-34</td>
<td>480V</td>
</tr>
</tbody>
</table>

Photocell Sensor

Dimming Controls

- The Curvilinear LED driver is a 0-10V dimming interface, allowing 0-100% illumination output when synchronized with a control and dimming system, provided by others. Kim Lighting is working with several control system manufacturers to develop a variety of proven turnkey solutions to meet any application's need. Kim Lighting will advise availability of complete control packages, and even two-way monitoring systems, once they have been tested and exceed Kim's high quality standards.

Convex Glass Lens
Cat. No. ☐ CGL
☐ No Option

- The 9/16” thick clear tempered glass lens replaces standard flat glass lens. Provides increased lens presence and provides a subtle improvement in uniformity where pole spacing is extreme. Increases equipment shielding.

Convex Glass Lens

Polycarbonate Lens
Cat. No. ☐ L17F
☐ No Option

- Clear UV stabilized polycarbonate replaces standard flat glass lens, gasketed and integral with lens frame.

CAUTION: Use only when vandalism is anticipated to be high. Useful life is limited by UV discoloration from sunlight.

Polycarbonate Lens

Accent Reveals
Cat. No. (See right)
☐ No Option

- For CC Series only: Three aluminum bands riveted inside the housing reveals. Available in five standard Kim powder coat finishes. Custom colors available.

Accent Reveals

Color: Black, Dark Bronze, Light Gray, Stealth Gray™, Platinum Silver, White

Custom Color: BL-REV, DS-REV, LG-REV, SG-REV, PS-REV, WH-REV, CC-REV

Custom colors subject to additional charges, minimum quantities and extended lead times. Consult representative. Custom color description:

© 2012 KIM LIGHTING INC. • PO. BOX 20390, CITY OF INDUSTRY, CA 91748-0390 • TEL: 626/566-5666 • FAX: 626/566-2805

Version 2.1.2014

Exterior Lighting and Installation
Pedestrian Poles and Fixture Datasheets
# Lumen Data

**Spectroradiometric**

<table>
<thead>
<tr>
<th>Correlated Color Temp. (CCT) (K)</th>
<th>520nm: Amber Average</th>
<th>4000K: Average</th>
<th>5300K: Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Color Rendering Index (CRI)</th>
<th>520nm: Amber Average</th>
<th>4000K: Average</th>
<th>5300K: Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power Factor</th>
<th>520nm: Amber Average</th>
<th>4000K: Average</th>
<th>5300K: Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**L70 Data (calculated)**

60,000 hours

**Electrical Drive Current**

<table>
<thead>
<tr>
<th>Volt AC</th>
<th>Amps AC</th>
<th>System Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>55</td>
<td>66</td>
</tr>
<tr>
<td>208</td>
<td>32</td>
<td>66</td>
</tr>
<tr>
<td>249</td>
<td>28</td>
<td>66</td>
</tr>
<tr>
<td>277</td>
<td>24</td>
<td>66</td>
</tr>
<tr>
<td>347</td>
<td>19</td>
<td>66</td>
</tr>
<tr>
<td>400</td>
<td>14</td>
<td>66</td>
</tr>
</tbody>
</table>

**B.U.G. Rating (Thermal) in Lumens where B = Backlight, U = Uplight, C = Claze**

<table>
<thead>
<tr>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
<th>Type IV</th>
<th>Type V</th>
<th>Type LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>B2</td>
<td>U0</td>
<td>C2</td>
<td>B1</td>
<td>U0 C1</td>
</tr>
</tbody>
</table>

**Absolute Lumens**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
<th>Type IV</th>
<th>Type V</th>
<th>Type LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>520nm Amber</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>4000K</td>
<td>3414</td>
<td>3476</td>
<td>3428</td>
<td>3483</td>
<td>3281</td>
<td></td>
</tr>
<tr>
<td>5000K</td>
<td>4161</td>
<td>4117</td>
<td>4100</td>
<td>4248</td>
<td>4001</td>
<td></td>
</tr>
</tbody>
</table>

LED performance and lumen output continues to improve at a rapid pace. Log onto www.kimlighting.com to download the most current photometric files from Kim Lighting’s OS File Library for custom optics and code compliant configurations, direct factory.

*Data is provided from 5000K LED files.*

© 2012 KIM LIGHTING INC. • 801 W. 6000 S., CITY OF INDUSTRY, CA 91745-0080 • TEL: 626/566-8685 • FAX: 626/566-2625

---

**Exterior Lighting and Installation**

Pedestrian Poles and Fixture Datasheets

**Page 54**
Gardco Wall Mount

Featuring Cosmopolis and MasterColor Elite Electronic HID Systems

The Gardco wall mounted Round Form 10 products are cylindrical (CW) or semi-spherical (MW) cutoff luminaires providing the greatest energy efficiency when utilized with Cosmopolis or MasterColor Elite high performance ceramic metal halide electronic systems. Luminaires may also utilize other high intensity discharge lamps up to 675 watts (400 watts in the MW). housings are one piece seamless spun aluminum and finished with either Architectural Class 1 anodizing or electrostatically applied TGIC polyester powder coat or polyurethane. Luminaires can accept one of four (4) interchangeable and rotatable precision segmented optical systems. Flat glass lens luminaires provide full cutoff performance. Sag lenses luminaires provide cutoff performance.

<table>
<thead>
<tr>
<th>PREFIX</th>
<th>MOUNTING</th>
<th>DISTRIBUTION</th>
<th>WATTAGE</th>
<th>VOLTAGE</th>
<th>FINISH</th>
<th>OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW17</td>
<td>1</td>
<td>3</td>
<td>140CMPE</td>
<td>277</td>
<td>BRA 311</td>
<td></td>
</tr>
</tbody>
</table>

Enter the order code into the appropriate box above. Note: Gardco reserves the right to refuse a configuration. Not all combinations and configurations are valid. Refer to notes below for exclusions and limitations. For questions or concerns, please consult the factory.

### PREFIX

| CW17   | 17° Diamater Cylindrical Luminaire |
| MW17   | 17° Diamater Semi-Spherical Luminaire |
| CW22   | 22° Diamater Cylindrical Luminaire |
| MW22   | 22° Diamater Semi-Spherical Luminaire |

1. 12" luminaires only. 400W and below are supplied with flat glass lens standard. For wattages above 400W, "FL" extended flat lens is supplied standard.
2. MW17PSMH-400W Type 4X luminaires require the E200/ST20 reduced jacket lamp.

### MOUNTING

<table>
<thead>
<tr>
<th>DISTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Single Assembly</td>
</tr>
<tr>
<td>3 Type III</td>
</tr>
<tr>
<td>4X Type</td>
</tr>
<tr>
<td>FM Type IV</td>
</tr>
</tbody>
</table>

### WATTAGE

<table>
<thead>
<tr>
<th>Pulse Start MH</th>
<th>Magnetic Ballast</th>
</tr>
</thead>
<tbody>
<tr>
<td>50MH</td>
<td>150MH</td>
</tr>
<tr>
<td>70MH</td>
<td>175MH</td>
</tr>
<tr>
<td>100MH</td>
<td>200MH</td>
</tr>
</tbody>
</table>

Cosmopolis

<table>
<thead>
<tr>
<th>Electronic System</th>
</tr>
</thead>
<tbody>
<tr>
<td>65CMPE</td>
</tr>
</tbody>
</table>

MasterColor Elite

<table>
<thead>
<tr>
<th>Electronic System</th>
</tr>
</thead>
<tbody>
<tr>
<td>140CMPE</td>
</tr>
</tbody>
</table>

### VOLTAGE

| 120 | 208 | 200-277 |
| 347 | 480 | 277 |

120/200-277 Vacuum, NHE, and PSE types only.

2. MW17PSMH-400W Type 4X luminaires require the E200/ST20 reduced jacket lamp.

3. Medium base lamp.

4. Available in CW Style only. Not available in MW Style.

5. Uses E17 + 5/37 lamps only.

6. 250 watt Pulse Start Metal Halide with a 90% Efficient Magnetic Ballast complied with California Title 20 effective 11/1/2010. Available at 250, 200, 200W only.

7. 175MH, 250MH and 400MH not available for sale in the United States.


9. 120V or 200 - 277V only. Not available with Q5, QST, Q524 or Q524-4000K options.

10. "-4K" suffix specifies a 4000K lamp and "-4C" suffix specifies a 4000K lamp.

1611 Clovis Barker Road, San Marcos, TX 78666
(800) 227-0758 (512) 753-1000 FAX: (512) 753-7855 site@lighting.com
© 2012 Koninklijke Philips Electronics N.V. All Rights Reserved.

Philips Gardco reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program.
Kim Wall Mount

CC/CCS 17° Arm Mounted Curvilinear Cutoff

Type:
Job:

Standard Features

Mounting
3Y configuration is available for round poles only.

Plan View:

EPA: 0.9 1.8 1.6 2.5 2.5 2.8
Cat. No.: □ 1A □ 2B □ 2L □ 3T □ 3Y □ 4C □ 1W

Fixture
Cat. No. designates CC/CCS fixture and light distribution.
See the Kim Site/Roadway Optical Systems Catalog for detailed information on reflector design and application.

Horizontal Lamp

Light Distribution: Type I Type II Type III Type IV Type V
Full Cutoff Full Cutoff Full Cutoff Forward Throw Full Cutoff Square Full Cutoff
Cat. No.: □ CC17A1 □ CC17A2 □ CC17A3 □ CC17A4 □ CC17A5
□ CCS17A1 □ CCS17A2 □ CCS17A3 □ CCS17A4 □ CCS17A5
Roadway/Parking Poles and Fixture Datasheets

Sterner Tapered Pole

### Ordering Example

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTA20</td>
<td>6.0 x 4.5</td>
<td>0.188</td>
<td>B</td>
<td>DF</td>
<td>BK</td>
<td></td>
</tr>
</tbody>
</table>

### Ordering Sequence

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>Powder Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTA30</td>
<td>See Pole Data Table Below</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non-Standard Finish</td>
</tr>
</tbody>
</table>

#### Pole Data

<table>
<thead>
<tr>
<th>Pole Part No.</th>
<th>Diameter (Footprint)</th>
<th>Wall Thickness</th>
<th>Pipe Height</th>
<th>Anchor Bolt Province</th>
<th>Anchor Bolt Threads</th>
<th>Base Style</th>
<th>Bolt Chair</th>
<th>Stripped Shipping Weight</th>
<th>Allowable Pole EDA (ready wind/parking wind x 1.3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTA10</td>
<td>6.5&quot; x 2.0&quot;</td>
<td>0.125&quot;</td>
<td>10' - 4'</td>
<td>R</td>
<td>0.425 x 1.5 x 1.5</td>
<td>L</td>
<td>R</td>
<td>8.35 lbs</td>
<td>10.25 lbs</td>
</tr>
<tr>
<td>RTA12.5</td>
<td>6.5&quot; x 2.0&quot;</td>
<td>0.125&quot;</td>
<td>12' - 4'</td>
<td>R</td>
<td>0.425 x 1.5 x 1.5</td>
<td>L</td>
<td>R</td>
<td>8.35 lbs</td>
<td>10.25 lbs</td>
</tr>
<tr>
<td>RTA15</td>
<td>6.5&quot; x 2.0&quot;</td>
<td>0.125&quot;</td>
<td>15' - 4'</td>
<td>R</td>
<td>0.425 x 1.5 x 1.5</td>
<td>L</td>
<td>R</td>
<td>8.35 lbs</td>
<td>10.25 lbs</td>
</tr>
<tr>
<td>RTA20</td>
<td>6.5&quot; x 2.0&quot;</td>
<td>0.125&quot;</td>
<td>20' - 4'</td>
<td>R</td>
<td>0.425 x 1.5 x 1.5</td>
<td>L</td>
<td>R</td>
<td>8.35 lbs</td>
<td>10.25 lbs</td>
</tr>
<tr>
<td>RTA25</td>
<td>6.5&quot; x 2.0&quot;</td>
<td>0.125&quot;</td>
<td>25' - 4'</td>
<td>R</td>
<td>0.425 x 1.5 x 1.5</td>
<td>L</td>
<td>R</td>
<td>8.35 lbs</td>
<td>10.25 lbs</td>
</tr>
</tbody>
</table>

Note: 1) Tapered Applies to both arm & pole mount fixtures.
2) "C" style & "R" style boxes available 25' max.
3) 4" dia. base only.
4) Tapered 25' with liner below to indicate fixture drilling.
5) See below table for dimensions & bolt information

---

Exterior Lighting and Installation

Roadway / Parking Poles and Fixture Datasheets

Version 2.1.2014
Gardco Tapered Pole

Poles

Tapered Round Aluminum - Cast Base

The Philips Gardco TRA tapered round aluminum pole consists of a one-piece design fabricated aluminum tubing circumferentially welded to a structural quality hot rolled carbon steel plate. The poles are finished with either Architectural Class 1 anodizing or electrostatically applied TGIC polyester powdercoat. All poles include anchor bolts, hand hole, ground lug and top cap.

<table>
<thead>
<tr>
<th>PREFIX</th>
<th>BASE</th>
<th>HEIGHT</th>
<th>DRILLING</th>
<th>FINISH</th>
<th>OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRA</td>
<td>CB</td>
<td>30L</td>
<td>D1</td>
<td>BRA 311</td>
<td>VDA</td>
</tr>
</tbody>
</table>

Enter the order code into the appropriate box above. Note: Gardco reserves the right to refuse a configuration. Not all combinations and configurations are valid. Refer to notes below for exclusions and limitations. For questions or concerns, please contact the factory.

<table>
<thead>
<tr>
<th>HEIGHT</th>
<th>DRILLING</th>
</tr>
</thead>
<tbody>
<tr>
<td>8'</td>
<td>D1 Way</td>
</tr>
<tr>
<td>10'</td>
<td>D2 Way</td>
</tr>
<tr>
<td>12'</td>
<td>D2@90</td>
</tr>
<tr>
<td>14'</td>
<td>D3 Way</td>
</tr>
<tr>
<td>16'</td>
<td>D3@120</td>
</tr>
<tr>
<td>20'</td>
<td>D4 Way</td>
</tr>
<tr>
<td>25' L, H'</td>
<td>1 Way</td>
</tr>
<tr>
<td>28' L, H'</td>
<td></td>
</tr>
<tr>
<td>30' L, H'</td>
<td></td>
</tr>
<tr>
<td>35' L, H'</td>
<td></td>
</tr>
<tr>
<td>39' L, H'</td>
<td></td>
</tr>
<tr>
<td>4' OD Tenon</td>
<td></td>
</tr>
</tbody>
</table>

1. Refers to relative strengths based on wind load factor. L = Light; M = Medium; H = Heavy.

### Options

- **DR**: Duplex Receptacle
- **GFCI**: Ground Fault Receptacle (GFCI)
- **VDA**: Vibration Dampener
- **Nipples and Couplings**: Indicate size (1/2", 3/4", 1", 1 1/4", 1 1/2") indicate height above base and orientation to hand hole. See Pole Orientation Information on Page 4.
- **NL**: Nipple - External thread
- **CL**: Coupling - Internal thread
- **Single Mount Bulb Arm Brackets**: Indicate height above base and orientation to hand hole. See Pole Orientation Information on Page 4.

### Motion Response Provisions

- **GMR**: Provision for Gardco HID Motion Response System
- **Minimum Pole Height is 18". Includes a 1/2" coupling placed 180° to the hand hole, 12" above the pole base.**
- **MSM**: Motion Sensor Mounting Provision for LED Luminaires available with Motion Response
- **Maximum Pole Height is 18". Includes a special hand hole with 1/2" coupling placed in the cover plate, 180° to the hand hole, 15" above the pole base.**

1611 Clavis Barker Road, San Marcos, TX 78666
(800) 227-0758 (512) 753-1000 FAX: (512) 753-7855 site@lighting.com
© 2011 Kentwicke Philips Electronics N.V. All Rights Reserved.

Philips Gardco reserves the right to change materials or modify the design of its product without notification as part of the company’s continuing product improvement program.

79415-24-0611 Version 2.1.2014

Exterior Lighting and Installation
Roadway / Parking Poles and Fixture Datasheets
Kim Tapered Pole

LTRA
Round Aluminum Tapered Pole

Type: Kim Lighting

Job:

Standard Features

NOTE: All allowable pole and fixture EPAs are derived from the AASHTO standard. Responsibility lies with the specifier for correct pole selection based on local codes and standards for the job location. (See page 4).

<table>
<thead>
<tr>
<th>Pole Height</th>
<th>Allowable Pole EPA</th>
<th>Wind Map Steady Steady Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>X</td>
<td>Y</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pole Catalog</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>85</th>
<th>90</th>
<th>100</th>
<th>110</th>
<th>120</th>
<th>130</th>
<th>140</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTRA30-6196</td>
<td>30&quot; 7/8 x 156 4&quot; 21.80</td>
<td>4&quot;</td>
<td>19.86</td>
<td>17.93</td>
<td>14.70</td>
<td>12.26</td>
<td>12.30</td>
<td>10.20</td>
<td>8.67</td>
<td>7.36</td>
<td></td>
</tr>
<tr>
<td>LTRA30-6188</td>
<td>30&quot; 7/8 x 156 4&quot; 26.32</td>
<td>4&quot;</td>
<td>23.38</td>
<td>21.64</td>
<td>17.77</td>
<td>14.83</td>
<td>12.49</td>
<td>10.56</td>
<td>9.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTRA30-6188</td>
<td>30&quot; 7/8 x 156 3&quot; 21.80</td>
<td>4&quot;</td>
<td>19.86</td>
<td>17.93</td>
<td>14.70</td>
<td>12.26</td>
<td>12.30</td>
<td>10.20</td>
<td>8.67</td>
<td>7.36</td>
<td></td>
</tr>
<tr>
<td>LTRA25-6196</td>
<td>25&quot; 7/8 x 156 4&quot; 22.70</td>
<td>4&quot;</td>
<td>20.73</td>
<td>18.60</td>
<td>15.67</td>
<td>12.24</td>
<td>10.10</td>
<td>9.12</td>
<td>8.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTRA25-6188</td>
<td>25&quot; 7/8 x 156 3&quot; 22.70</td>
<td>4&quot;</td>
<td>20.73</td>
<td>18.60</td>
<td>15.67</td>
<td>12.24</td>
<td>10.10</td>
<td>9.12</td>
<td>8.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTRA20-6196</td>
<td>20&quot; 7/8 x 156 4&quot; 22.70</td>
<td>4&quot;</td>
<td>20.73</td>
<td>18.60</td>
<td>15.67</td>
<td>12.24</td>
<td>10.10</td>
<td>9.12</td>
<td>8.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTRA20-6188</td>
<td>20&quot; 7/8 x 156 3&quot; 22.70</td>
<td>4&quot;</td>
<td>20.73</td>
<td>18.60</td>
<td>15.67</td>
<td>12.24</td>
<td>10.10</td>
<td>9.12</td>
<td>8.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTRA15-6196</td>
<td>15&quot; 7/8 x 156 4&quot; 22.70</td>
<td>4&quot;</td>
<td>20.73</td>
<td>18.60</td>
<td>15.67</td>
<td>12.24</td>
<td>10.10</td>
<td>9.12</td>
<td>8.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTRA15-6188</td>
<td>15&quot; 7/8 x 156 3&quot; 22.70</td>
<td>4&quot;</td>
<td>20.73</td>
<td>18.60</td>
<td>15.67</td>
<td>12.24</td>
<td>10.10</td>
<td>9.12</td>
<td>8.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

48" and 50" poles are 2-piece assemblies.

Anchor Base and Bolt Detail

<table>
<thead>
<tr>
<th>Pole Height</th>
<th>Y Pole Diameter</th>
<th>Bolt Circle Dia</th>
<th>Anchor Bolt Diameter</th>
<th>Anchor Bolt Projection</th>
<th>Anchor Bolt Size</th>
<th>Base Size</th>
<th>Conduit Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>20'</td>
<td>5'</td>
<td>9 1/2&quot;</td>
<td>3 1/2&quot;</td>
<td>3/4 x 30' + 4&quot;</td>
<td>9 1/2 sq.</td>
<td>4 1/2 Dia</td>
<td></td>
</tr>
<tr>
<td>16'-25'</td>
<td>6'</td>
<td>9 1/2&quot;</td>
<td>3 1/2&quot;</td>
<td>3/4 x 30' + 4&quot;</td>
<td>10 1/2 sq.</td>
<td>5 1/2 Dia</td>
<td></td>
</tr>
<tr>
<td>25' - 30'</td>
<td>7'</td>
<td>11&quot;</td>
<td>4 1/2&quot;</td>
<td>3/4 x 30' + 4&quot;</td>
<td>11 1/2 sq.</td>
<td>7 1/2 Dia</td>
<td></td>
</tr>
<tr>
<td>25' - 30'</td>
<td>8'</td>
<td>11 1/2&quot;</td>
<td>4 1/2&quot;</td>
<td>3/4 x 30' + 4&quot;</td>
<td>11 1/2 sq.</td>
<td>7 1/2 Dia</td>
<td></td>
</tr>
<tr>
<td>35' - 48'</td>
<td>10'</td>
<td>14 1/2&quot;</td>
<td>4 1/2&quot;</td>
<td>3/4 x 30' + 4&quot;</td>
<td>14 1/2 sq.</td>
<td>9 1/2 Dia</td>
<td></td>
</tr>
<tr>
<td>50'</td>
<td>10'</td>
<td>14 1/2&quot;</td>
<td>4 1/2&quot;</td>
<td>3/4 x 30' + 4&quot;</td>
<td>14 1/2 sq.</td>
<td>9 1/2 Dia</td>
<td></td>
</tr>
</tbody>
</table>

Version 2.1.2014

Exterior Lighting and Installation
Roadway / Parking Poles and Fixture Datasheets

Page 59
Gardco Roadway & Parking Light Fixture

Featuring CosmoPoIis and MasterColor Elite Electronic HID Systems

Form 10 Square

EH / H Arm Mount

The Philips Gardco arm mounted Square Form 10 products are cutoff luminaires for high intensity discharge lamps up to 1000 watts. The EH units are manufactured from mitered extruded aluminum and finished in an Architectural Class 1 anodizing. The H style luminaires are die formed aluminum with a thermostet polyester finish. Both products can accept one of seven (7) interchangeable and rotatable precision segmented optical systems.

Flat glass lens luminaires provide full cutoff performance. Sag Lens luminaires provide cutoff performance.

Prefix | Mounting | Distribution | Wattage | Voltage | Finish | Options
---|---|---|---|---|---|---
EH19 | Q | 315MCE-3K | 277 | BRA 311 | 

Enter the order code into the appropriate box above. Note: Gardco reserves the right to resurface a configuration. Not all combinations and configurations are valid. Refer to notes below for exclusions and limitations. For questions or concerns, please consult the factory.

Prefix | Mounting | Distribution | Wattage | Voltage | Finish | Options
---|---|---|---|---|---|---
EH14 | 14" Square Extruded Luminaire | Single Pole Mount | 100MH | 120 | 
EH19 | 19" Square Extruded Luminaire | Twin Pole Mount at 180° | 175PSMH | 200MH | 
H14 | 14" Square Fabricated Luminaire | Triple Pole Mount at 90° | 250PSMH | 277 | 
H19 | 19" Square Fabricated Luminaire | Triple Pole Mount at 90° | 320PSMH | 
H26 | 26" Square Fabricated Luminaire | 4-way Pole Mount | 400MH | 

1. Type 4x available in 19" luminaire only. Type 4x luminaires, 400W and below, are supplied with flat glass lens standard.
2. MH100MH 400W Type 4x and BLC luminaires require the E280/212B reduced pocket lamp.

Wattage

EH / H 14" | EH / H 19" | H 26"
---|---|---
Magnetic Ballast
100MH | 250PSMH | 375PSMH
150MH | 250PS90 | 450PSMH
175PSMH | 320PSMH | 675PSMH
200MH | 350PSMH | 1000PSMH

CosmoPoIis Electronic System
60CMPE | 90CMPE | 140CMPE

MasterColor Elite Electronic System
210MCE-3K | 315MCE-3K

Magnetic Ballast
175MH | 250MH | 1000MH
350MH | 400MH | 

High Pressure Sodium Magnetic Ballast
700PSH | 1000PSH | 1500PSH

*175W, 250W and 400W probe start MH luminaires are not available for sale in the United States.

Philips Gardco reserves the right to change materials or modify the design of its product without notification as part of the company’s continuing product improvement program.

Exterior Lighting and Installation

Version 2.1.2014
Roadway / Parking Poles and Fixture Datasheets
Form 10 Square LED

EH / H / Arm Mount

The Philips Garedco arm mounted Square Form 10 LED products are cutoff luminaires featuring LED arrays. Square Form 10 LED luminaires provide performance excellence and advanced Philips Garedco LED thermal management technology. High performance Class 1 LED systems offer the potential for energy savings up to 50% when compared to HID systems. The EH units are manufactured from mitered extruded aluminum and finished in an Architectural Class 1 anodizing. The H style luminaires are die formed aluminum with a thermostatic polyester finish. Form 10 Square LED luminaires provide full cutoff performance and feature a flat glass lens.

**PREFIX**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EH19L</td>
<td>19&quot; Square Extruded Luminaire - Constant Wattage</td>
</tr>
<tr>
<td>160LA</td>
<td>160° Wattage</td>
</tr>
<tr>
<td>WW</td>
<td>Warm White - 3000°K - 80 CRI</td>
</tr>
</tbody>
</table>

**WATTAGE AND LUMEN VALUES**

<table>
<thead>
<tr>
<th>Ordering Code</th>
<th>Average System Watts</th>
<th>LED Current (mA)</th>
<th>LED Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>70LA</td>
<td>70</td>
<td>350</td>
<td>CW 6.375, 6.705, 6.548, 6.328</td>
</tr>
<tr>
<td>85LA</td>
<td>85</td>
<td>350</td>
<td>NW 5.996, 6.144, 5.969, 5.878</td>
</tr>
<tr>
<td>110LA</td>
<td>110</td>
<td>350</td>
<td>CW 7.860, 8.114, 8.343, 8.248</td>
</tr>
<tr>
<td>160LA</td>
<td>160</td>
<td>530</td>
<td>NW 7.468, 7.697, 7.941, 7.323</td>
</tr>
<tr>
<td>NW</td>
<td>Neutral White - 4000°K - 70 CRI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WW</td>
<td>Warm White - 3000°K - 80 CRI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Basis of Lumen Data**

Pharmacology tests performed in compliance with ESMA LM-79, except where otherwise indicated. Tests were performed with 120V and 277V input voltage.

**LUMEN DEPENDENCE TESTS**

Type I, II, and IV optics are field rotatable. Type IV optics feature a luminous lens.

1. Lumen output may vary by ±3% due to LED manufacturer's forward current variation.
2. Values shown for luminaries with the HS external lens option. Tests are in process for luminaries with the HS option.
3. Tests are performed with the HS external lens option on 160° Wattage. Contact Garedco at gdl@gardco.com for design assistance.

**LENS SELECTION**

- CW: Cool White - 5700°K - 75 CRI
- NW: Neutral White - 4000°K - 70 CRI
- WW: Warm White - 3000°K - 80 CRI

**VOLTAGE**

- 120V through 277V, 50Hz or 60Hz
- 347V through 480V, 50Hz or 60Hz (High Voltage Universal)
Kim Roadway & Parking Light Fixture

EKG402
Shoebox Luminaire

Type:
Job:
Catalog number:

<table>
<thead>
<tr>
<th>EKG402</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ktg</td>
<td>Finish</td>
<td>Electrical Module</td>
<td>Finish</td>
<td>Options</td>
</tr>
</tbody>
</table>

Housing: Fabricated from a one-piece extruded aluminum side panel with infrared corner that are internally welded and sealed for weather tightness. A press-formed aluminum top cover interlocks with housing, and has a continuous seal of silicone rubber resistant to weathering, moisture, UV and ozone. Top is peaked for increased strength and efficient water runoff.

Reflector Module: Specular Alzak® optical segments are rigidly mounted within a die-cast aluminum enclosure that attaches to the housing as a one-piece module. HPS and PMT4 acades are porcelain 4KV pulse rated mogul base. All reflector modules are factory prewired with quick-disconnect plug.

Lens Frame Assembly: A ¾” thick impact resistant clear tempered glass lens enclosed by a one-piece molded high temperature gasket. Lens and gasket interlocks in an extruded aluminum frame which hinges at the pole end, and closes and tightly seals the optical chamber by four captive fasteners. Lens frame is removable without tools by means of quick disconnect hinges.

Electrical Module: All electrical components are UL and CSA recognized, mounted on a single plate and factory prewired with quick-disconnect plugs. Ballast components are mounted directly to the luminaire housing. Field wiring is provided for by prewiring all electrical components with quick-disconnect plugs. Ballast is high power factor of 90% or better and with starting temperatures of 22°F. Fixtures must be grounded in accordance with local codes or the National Electrical Code. Failure to do so may result in serious personal injury.

Support Arm: One-piece rectangular extruded aluminum with internal centering guides. Luminaire-to-pole attachment is by internal mechanical draw bolts, and includes a pole reinforcing plate with wire strain relief.

Finish: Super TCIC thermoplastic polyester powder coat paint, 2.5 mil nominal thickness, applied over a machined zincium conversion coating. 2500 hour salt spray test endurance rating. Standard colors are Black, Dark Bronze, Platinum Silver, Stealth Gray®, or White. Custom colors are available and subject to additional charges, minimum quantities and longer lead times. Consult representative.

Optional Anodized Finish: Dark Bronze Architectural Class I Anodize over satin polish.

Certification: Fixtures must be grounded in accordance with national, state and/or local electrical codes. Failure to do so may result in serious personal injury.

Listings and Ratings

UL cUL 1598 standard
IP66 Rated
25C Ambient

Suitable for wet locations.

KIM LIGHTING RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

©2010 KIM LIGHTING • P.O. BOX 66080, CITY OF INDUSTRY, CA 91716-0800 • TEL: 626/598-4686 • FAX: 626/598-2696

6108510047

Version 2.1.2014

Exterior Lighting and Installation
Roadway / Parking Poles and Fixture Datasheets

Page 62
## Standard Features

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Plan View:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>n/a</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Cat. No.: EKG402</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Electrical Module
- **HPS** = High Pressure Sodium
- **PMH** = Pulse Start Metal Halide
- **CMPE** = COSMO MASTER COLOR ELITE
- Lamp: Low Wattage 400V HPS 277
- Cat. Nos. for Electrical Modules available:
  - 315CMPE

### Finish
- Super TGIC powder coat paint over titined zirconium conversion coating.
- Optional Architectural Class 1 anodized finish is available at extra cost.
- Standard Finishes:
  - Color: Black, Dark Bronze, Stealth Gray™, Platinum Silver, White, Custom Color
  - Cat. No.: BL, DBA 311, SG, PS, WH, CC
- Optional Anodized Finish: (Available at extra cost)
  - Color: Dark Bronze Anodize
  - Cat. No.: DB-A

© 2010 KIM LIGHTING • P.O. BOX 60880, CITY OF INDUSTRY, CA 91746-6880 • TEL: 626/969-5600 • FAX: 626/969-2666

EKG402
Shoebox Luminaire
revision 2-16-10 • klm_ekg402_spec.pdf

Page 2 of 3
Optional Features

Wall Mounting
Cat. No. □ 1W
□ No Option
A modified arm containing an access hole to allow field splices within the arm. A wall embedment bracket (WEB) is provided to accept fixture mounting rods, and a trim plate shall be provided to cover the wall embedded junction box (J-box) by others. All exposed parts are finished to match the fixture. For concrete mounting only.

Poly carbonate Shield
Cat. No. □ LS
□ No Option
May ONLY be used with 400-HPS in outdoor locations where ambient air temperature during fixture operation will not exceed 85°F.
Optional Poly carbonate Shield replaces standard tempered glass lens. One-piece vacuum formed clear polycarbonate. Poly carbonate Shield is semi-pyramidal in shape for high thermal resistance, impact resistance and light transmission.
CAUTION: Use only when vandalism is anticipated to be high. Useful life is limited by discoloration caused by UV from sunlight and metal halide lamps.

Houseside Shield
Cat. No. □ HS
□ No Option
For highly reduced light on houseside. Two shielding components permanently installed at the Kim factory. One component reduces light directly from the lamp, the other component reduces reflected light. Recommended for use with clear lamps only.

Photocell Receptacle
Cat. No. □ A-25
□ No Option
A fully gasketed receptacle installed above the electrical compartment for NEMA base photocell (by others). For all multiple fixture pole mountings, with two or three fixtures, one fixture has a receptacle to operate the others. Four fixtures require two fixtures with receptacles.

Poles
See Kim Arms and Poles Selection Guide for a complete selection of square and round poles in aluminum or steel.
Kim Roadway & Parking LED Fixture

EKG402
Shoebox Luminaire
revision 2-16-10 • kim_ekg402_spec.pdf

Specifications

Housing: Fabricated from a one-piece extruded aluminum side panel with infilled corners that are internally welded and sealed for weather tightness. A press-formed aluminum top cover interlocks with housing, and has a continuous seal of silicone rubber resistant to weathering, moisture, UV and ozone. Top is peaked for increased strength and efficient water runoff.

Reflector Module: Specular Alzak® optical segments are rigidly mounted within a die-cast aluminum enclosure that attaches to the housing as a one-piece module. HPS and PMH sockets are porcelain 4KV polarity rated mogul base. All reflector modules are factory prewired with quick-disconnect plug.

Lens Frame Assembly: A 3/8" thick impact resistant clear tempered glass lens enclosed by a one-piece molded high temperature gasket. Lens and gasket interlocks in an extruded aluminum frame which hinges at the pole end, and closes and tightly seals the optical chamfer by four captive fasteners. Lens frame is removable without tools by means of quick-disconnecting hinges.

Electrical Module: All electrical components are UL and CSA recognized, mounted on a single plate and factory prewired with quick-disconnect plugs. Ballast components are mounted directly to the luminaire housing. Fast field wiring is provided for by prewiring all electrical components with quick-disconnect plugs. Ballast is high power factor of 90% or better and with starting temperatures of 20°F. Fixtures must be grounded in accordance with local codes or the National Electrical Code. Failure to do so may result in serious personal injury.

Support Arm: One-piece rectangular extruded aluminum with integral centering guides. Luminaire to pole attachment is by internal mechanical draw bolts, and includes a pole reinforcing plate with wire strain relief.

Finish: Super TGIC thermoset polyester powder coat paint, 2.5 mil nominal thickness, applied over a titanium zirconium conversion coating. 2500 hour salt spray test endurance rating. Standard colors are Black, Dark Bronze, Platinum Silver, Stealth Grey®, or White. Custom colors are available and subject to additional charges, minimum quantities and longer lead times. Consult representative.

Optional Anodized Finish: Dark Bronze Architectural Class 1 Anodize over satin polish.

Certification: Fixtures must be grounded in accordance with national, state and/or local electrical codes. Failure to do so may result in serious personal injury.

Listings and Ratings

<table>
<thead>
<tr>
<th>UL cUL 1598 standards</th>
<th>IP66 Rated</th>
<th>25C Ambient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suitable for wet locations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Kim Lighting reserves the right to change specifications without notice.

©2010 Kim Lighting • P.O. Box 60996, City of Industry, CA 91716-0999 • Tel: 626/688-6666 • Fax: 626/689-2695

Version 2.1.2014

Exterior Lighting and Installation
Roadway / Parking Poles and Fixture Datasheets
Page 65
## Standard Features

### Mounting

| Plan View: |
|---|---|---|---|---|
| SPA: | 2.1 | 4.2 | 3.5 | 4.5 |
| Cat. No.: | 1A | 2B | 2L | 3T |
| Wall Mount |

### Fixture

Cat. No. designates fixture with standard mounting arm.

<table>
<thead>
<tr>
<th>Cat. No.:</th>
<th>EKG402</th>
</tr>
</thead>
</table>

### Electrical Module

- **HPS** = High Pressure Sodium
- **PMMH** = Pulse Start Metal Halide
- **LED**

Lamp Type: Line
Watts: Type: Volts: 400 HPS 277

Cat. Nos. for Electrical Modules available:

- 120L3K277

### Finish

Super TGIC powder coat paint over tin plated zinc conversion coating.

Optional Architectural Class I anodized finish is available at extra cost.

### Standard Finishes:

| Color | Black | Dark Bronze | Sageh Gray™ | Platinum Silver | White | Custom Color
|---|---|---|---|---|---|---|
| Cat. No.: | BL | DBA 311 | SG | PS | WH | CC

*Custom colors subject to additional charges, minimum quantities and extended lead times. Consult representative. Custom color descriptions:

### Optional Anodized Finish:

<table>
<thead>
<tr>
<th>Color</th>
<th>Dark Bronze Anodize</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat. No.:</td>
<td>DB-A</td>
</tr>
</tbody>
</table>
## Optional Features

### Wall Mounting

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ 1W</td>
</tr>
<tr>
<td></td>
<td>□ No Option</td>
</tr>
</tbody>
</table>

A modified arm containing an access hole to allow field splices within the arm. A wall embedment bracket (WEB) is provided to accept fixture mounting rods, and a trim plate shall be provided to cover the wall embedded junction box (J-box by others). All exposed parts are finished to match the fixture. For concrete wall mounting only.

![Wall mount using wall embedment bracket - J-box in wall (by others)](image)

### Polycarbonate Shield

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ LS</td>
</tr>
<tr>
<td></td>
<td>□ No Option</td>
</tr>
</tbody>
</table>

May ONLY be used with 400-HPS in outdoor locations where ambient air temperature during fixture operation will not exceed 85°F.

Optional Polycarbonate Shield replaces standard tempered glass lens. One-piece vacuum-formed clear polycarbonate. Polycarbonate Shield is semi-pyramidal in shape for high thermal resistance, impact resistance and light transmission.

**CAUTION:** Use only when vandalism is anticipated to be high. Useful life is limited by discoloration caused by UV from sunlight and metal halide lamps.

![Side view and Front view of Polycarbonate Shield](image)

### Houseside Shield

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ HS</td>
</tr>
<tr>
<td></td>
<td>□ No Option</td>
</tr>
</tbody>
</table>

For highly reduced light on houseside. Two shielding components permanently installed at the Kim factory. One component reduces light directly from the lamp; the other component reduces reflected light. Recommended for use with clear lamps only.

![Houseside Shield](image)

### Photocell Receptacle

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ A-25</td>
</tr>
<tr>
<td></td>
<td>□ No Option</td>
</tr>
</tbody>
</table>

A fully gasketed receptacle installed above the electrical compartment for NEMA base photocell (by others). For all multiple-fixture pole mountings with two or three fixtures, one fixture has a receptacle to operate the others. Four fixtures require two fixtures with receptacles.

![Photocell Receptacle](image)

### Poles

See Kim Arms and Poles Selection Guide for a complete selection of square and round poles in aluminum or steel.
Bollard Fixture Datasheets

Gardco Bollard

LED BOLLARD

BRM830/831/833 Dome Top Louver
BRM834/835/837 Bevel Top Louver

Featuring Motion Response

Gardco’s dome top and bevel top LED Louver Bollards provide uniform illumination, superior spacing and solid vandal resistance. Rugged extruded and cast construction with silicone seals and gasketing assure years of trouble free service. The BRM830 and BRM834 are complete assemblies with an aluminum base. BRM831 and BRM835 head only units affix to custom architectural elements. BRM833 and BRM837 luminaires include a concrete base assembly. Gardco’s advanced stack-louver LED technology and Motion Response provide maximized light output and maximum energy savings.

<table>
<thead>
<tr>
<th>PREFIX</th>
<th>HEIGHT</th>
<th>LED CONTROL</th>
<th>LED SELECTION</th>
<th>LIGHTED COVERAGE</th>
<th>VOLTAGE</th>
<th>OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRM830</td>
<td>42</td>
<td>DR</td>
<td>CW</td>
<td>360° lighted louvers</td>
<td>120V</td>
<td>SC/BRM831</td>
</tr>
<tr>
<td>BRM831</td>
<td>42</td>
<td>DR</td>
<td>NW</td>
<td>180° lighted louvers (Provides reduced backside lighting)</td>
<td>120V</td>
<td></td>
</tr>
<tr>
<td>BRM833</td>
<td>42</td>
<td>DR</td>
<td>WW</td>
<td></td>
<td>120V</td>
<td></td>
</tr>
<tr>
<td>BRM834</td>
<td>42</td>
<td>DR</td>
<td></td>
<td></td>
<td>120V</td>
<td></td>
</tr>
<tr>
<td>BRM835</td>
<td>42</td>
<td>DR</td>
<td></td>
<td></td>
<td>120V</td>
<td></td>
</tr>
<tr>
<td>BRM837</td>
<td>42</td>
<td>DR</td>
<td></td>
<td></td>
<td>120V</td>
<td></td>
</tr>
<tr>
<td>BRM838</td>
<td>42</td>
<td>DR</td>
<td></td>
<td></td>
<td>120V</td>
<td></td>
</tr>
</tbody>
</table>

Enter the order code into the appropriate box below. Note: Gardco reserves the right to refuse a configuration. Not all combinations and configurations are valid. Refer to notes below for exclusions and limitations. For questions or concerns, please consult the factory.

LED CONTROL

- **MR** Motion Response
  LED’s stay on Low level (6 watts) when no motion is present. LEDs increase to full light output (44 watts) when motion detected.

- **CWL** Constant Wattage Full Light Output
  Full light output only (44 watts). No motion sensor included.

(Note: A variation of LED wattage (+/- 8%) may occur due to LED manufacturer’s finish calls specification and ambient temperature.)

Voltage Note:
2. 347V ballasts require and include a stepdown transformer in ballast. See available in BRM831 or BRM833.

LED SELECTION

- **CW** 6,500K, 75 CRI
- **NW** 4,300K, 75 CRI
- **WW** 3,000K, 75 CRI

Solid Colors:
- LA: Amber
- LC: Red
- LG: Green
- LB: Blue

FINISH

- BRP: Bronze Paint
- BLP: Black Paint
- WP: White Paint
- NP: Natural Aluminum Paint
- BGP: Beige Paint
- VP: Verde Green Paint
- LGP: Light Granite Paint
- DGP: Dark Granite Paint
- LSP: Light Sandstone Paint
- DSP: Dark Sandstone Paint
- RSP: Red Brick Paint

Optional Color Paint
- OC: Optional Color Paint

Special Color Paint
- SC: Special Color Paint

Surge Protection for 120V through 277V Input meeting ANSI C62.41.2
- SPR: Surge Protection for 120V through 277V Input meeting ANSI C62.41.2

Surge Protection for 240V through 480V Input meeting ANSI C62.41.2
- SPRH: Surge Protection for 240V through 480V Input meeting ANSI C62.41.2

Version 2.1.2014
Exterior Lighting and Installation
Bollard Fixture Datasheets
Specifications

**VRB-LED Models**
10 - 20 Diodes

**VRB1** - Single Function Luminaire (Aluminum Shaft)  
Maximum weight: 30 lb

---

**Domed Top Cap**: One-piece die-cast aluminum secured to bollards by concealed Allen screws in keyhole slots. For relamping access, Allen screws shall not require complete removal.

**Louvers**: Aluminum die-cast with vertical support ribs at 90° intervals. Horizontal louver blades shall have a 1¾" depth, a 65° upward pitch and provide light source cutoff above horizontal. Louver assembly shall be secured to shaft by four internal be rods.

**Lamp Enclosure**: One-piece molded glass with internal flanges and full gasketing at bottom edge.

**Fixture Head**: Allows flow-through ventilation around and above the lamp enclosure.

**Shaft**: One piece extruded aluminum, .125" wall thickness with a heavy cast aluminum twist-lock anchor base concealed within the shaft. Concealed set screws shall lock shaft onto the cast anchor base.

**Electronic Module**: All electrical components are either UL or ETL recognized, mounted on a single plate and factory prewired with quick disconnect plugs. Driver is rated for 40°F starting and has a 0-10V dimming interface for multi-level illumination options.

**Optical Module**: Each LED equipped with a directional optic for maximum beam angle projecting through low profile stacks. LED boards to be mounted to an anodized interlocking heat sink extrusion. (Type II) two 5-LED boards for a total of 10-LED. (Type III) three 5-LED boards for a total of 15-LED. (Type IV) four 5-LED boards for a total of 20-LED. Available in 3500K and 5000K color temperatures.

**Anchor Bolts**: Four ¾" x 10" - 2" zinc plated L-hoops, each with two nuts, washers and a rigid pressed board template.

**Finish**: TGIC thermoset polyester powder coat paint, 2.5 mil nominal thickness, applied over a titanized zincium conversion coating; 2500 hour salt spray test endurance rating.  
Standard colors are Black, Dark Bronze, Light Gray, Stealth Gray, Platinum Silver, or White. Custom colors are available.

**CAUTION**: Fixtures must be grounded in accordance with national, state and/or local codes. Failure to do so may result in serious personal injury.

<table>
<thead>
<tr>
<th>Listings and Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL or ETL to UL Standards 1598 &amp; 8153®</td>
</tr>
<tr>
<td>P46 Rated</td>
</tr>
</tbody>
</table>

---

© 2011 KIM LIGHTING  P.O. BOX 30080, CITY OF INDUSTRY, CA 91716-0080  • TEL. 626/819-5950  • FAX: 626/819-2665
APPENDIX A
EXTERIOR LIGHTING INSTALLATION
Exterior Lighting Installation

PART 1 JUNCTION BOX

1.1 Specification on lighting circuits
A. Junction box for every light pole exceeding 15’ or when multiple circuits are used
B. 8” between the lid and the top of conduit
C. Minimum 1’ conduit
D. G-TAP-2 gel tap splice with closure
E. #8 RHW minimum
F. 18” – 24” wire slack wrap
G. 18” wire slack for junction box lid ground
H. Red warning ribbon 6” above conduit

Example Installation of a Junction Box
PART 2 ROAD RATED JUNCTION BOX

2.1 Quazite
A. Junction Box - (PG1324BB18)
B. Lid Extra Heavy Duty w/2 bolts – (PG1324HH00)
PART 3  EXTERIOR LIGHTING POLE CONNECTION

3.1 Multiple circuits will be used when exceeding 5 light poles
3.2 Alternating circuits every other light pole
3.3 Fasten wire at the top of the pole or fixture
3.4 Ferraz Shawmut fuse holders set screw 30A, 600V - (FEB-81-81)
3.5 Ferraz Shawmut Insulator rubber boots - (FSB1)
3.6 6 ¼ amp fuses
3.7 Split bolt for ground or wire nut only
Design Standard

General Overhead Electrical Distribution

Detailed specifications follow.

PART 1 MATERIALS

1.1 All poles shall use S&C brand cutouts.
1.2 All materials shall be hot-dipped galvanized including nuts, bolts, and others.
1.3 Rebuilds (refurbished poles) are prohibited.

PART 2 GROUNDING

2.1 All poles shall be butt wrap grounded and ground-rod attached.

PART 3 PLAIN POLES

3.1 All Poles, regardless of length, shall be of Class 2 (C-2) designation.
3.2 Poles shall be used only at the discretion of the University. Overhead distribution is generally being replaced by underground lines.
3.3 All Poles shall be creosote pressure treated.

PART 4 RISER POLES

4.1 Any primary or secondary riser poll shall have no other equipment mounted onto it including transformers.
4.2 All riser poles shall have riser brackets.
4.3 Any primary or secondary riser shall have a OZ bushing.
4.4 A spare conduit for a riser pole will be installed with cap.

PART 5 DEAD END POLE

5.1 One guy-strain insulator shall be used in each respective guy.
5.2 Conductor size shall depend on anchor size.
5.3 Clearance shall be 20 feet wide and clear of all potential obstructions.
PART 6  OVERHEAD POLES WITH TRANSFORMERS

6.1  Transformer mounted poles shall not have a device arm installed. Single transformer installations may be bolt-mounted. However, any transformer bank cluster consisting of two or more transformers shall utilize an aluminum-form transformer bank rack.
STABLES ON GROUND WIRE SHALL BE 2' APART EXCEPT FOR A DISTANCE OF 8' ABOVE GROUND AND 8' FROM TOP OF POLE WHERE THEY SHALL BE 6' APART TYP.

GROUND WIRE TO HAVE MINIMUM CONDUCTIVITY OF NO 6 SOLID COPPER OR EQUIVALENT.
Design Standard

High Density Polyethylene (HDPE) Piping Installations

Texas A&M University requires the use of Extra High Molecular Weight Plus (EHMW Plus) High Density Polyethylene (HDPE) pipe due to its additional performance against abrasion, higher pressure and elevated temperatures. This pipe is manufactured with the PE4710 resin.

For chilled water and domestic cold water a minimum of SDR 17 is required. For heating water and domestic hot water a minimum of SDR 11 is required. For sanitary sewer a minimum of SDR 26 is required (SDR 17 is recommended under mall and paver areas).

The following standards and practices shall be adhered to:
Polyethylene fabricated fittings shall be manufactured from polyethylene pipe, sheet stock or molded fittings meeting the material requirements of this specification and all appropriate requirements of AWWA C-901 or AWWA C-906.

Polyethylene fittings, including custom fabrications, shall have the same internal pressure rating as the mating pipe. At the point of fusion, the wall thickness and outside diameter of the fitting shall be in accordance with AWWA C-901 or AWWA C-906 for the same pipe size.

Thermal lines shall be insulated in accordance with the Underground Piping Systems Design Standard.

Detailed specifications follow.

PART 1 JOINING

1.1 Heat Fusion

A. Pipe and fittings shall be joined by one of the following types of thermal fusion per the Manufacturer’s recommended procedures: Butt fusion, Saddle fusion or Socket fusion.

B. Upon request, the Manufacturer shall provide fusion training by authorized personnel or an authorized Representative. The Contractor shall be responsible for ensuring that personnel have received proper training per the Manufacturer’s recommended procedure. Records of training shall be maintained by the Contractor and should not exceed 12 months from date of construction.

C. Butt fusions performed between pipe ends or pipe ends and fitting outlets shall be within the following allowable wall mismatches:
   1. 2 DR difference for pipe and fitting diameters 6”IPS and smaller.
   2. 1 DR difference for above 6” through 18”.
3. No difference for diameters above 18”.

The difference in DR’s is determined from the following DR values: 7.3, 9, 11, 13.5, 17, 21, 26 and 32.5

1.2 Other Methods of Joining

A. Polyethylene pipe and fittings may be joined together or to other materials through the use of electrofusion fittings, flange adapters with back-up rings, mechanical couplings designed for connecting polyethylene pipe and fittings to itself or to another material, or MJ adapters. The Manufacturer of the joining device shall be consulted for proper installation procedures.

PART 2 MARKING

2.1 Pipe and tubing shall be permanently marked in accordance with all applicable standards per this specification. Marking shall be heat stamped indent print and shall remain legible under normal handling and installation practices.

2.2 Fittings shall be marked on the body or hub. Marking shall be in accordance with the applicable standard depending upon the fitting type. Mechanical fittings shall be marked with size, body material designation code, pressure rating and the Manufacturer's name or trademark.

PART 3 WORKMANSHIP

3.1 Pipe, tubing and fittings shall be homogenous throughout, and free of visible cracks, holes, foreign inclusions, blisters, dents or other injurious defects. The pipe, tubing and fittings shall be as uniform as commercially practicable in color, opacity, density and other physical properties.

PART 4 TESTING

4.1 The Contractor shall be responsible for field set-up and performance of the fusion equipment and the fusion procedure used by the operator. Upon request, the Contractor shall verify the fusion quality by making and testing per the Manufacturer’s recommended qualification procedure. The Contractor shall be responsible for the necessary adjustments to the set-up, equipment, operation and fusion procedure. Fusions that fail the qualification procedure shall be remade.

4.2 Hydrostatic testing shall be conducted in accordance with the Manufacturer's recommended testing procedures.

4.3 Low pressure pneumatic testing may be conducted on gravity sewer lines in accordance with ASTM F1417. Other methods of pneumatic testing are not recommended.
PART 5 THIRD PARTY CERTIFICATION

5.1 The performance requirements of the pipe and fittings shall comply with the most current version of AWWA C-901 or AWWA C-906. The Manufacturer shall be listed with NSF-61 certification and include the third party certification within the print line of the product.
Design Standard

Interconnection of Facilities to Utility Infrastructure

Detailed specifications follow.

PART 1 GENERAL

1.1 This standard defines requirements for connection of new facilities to existing utility infrastructure as well as minimum clearances required between new facilities and existing infrastructure. For the purposes of this standard, utility infrastructure includes overhead and underground electrical distribution lines and underground chilled water, heating hot water, domestic hot water, domestic cold water and sanitary sewer lines owned and operated by Texas A&M University.

PART 2 CONNECTIONS TO EXISTING INFRASTRUCTURE

2.1 All new buildings to be constructed on the Texas A&M University Campus shall connect to existing utility infrastructure. Any exceptions to this requirement must be approved in writing by the Utilities & Energy Services Department at Texas A&M before completion of the schematic design phase of the project.

2.2 The project is responsible for bearing all costs associated with the design and installation of utility infrastructure connections.

2.3 Design and installation shall comply with the requirements of all applicable Utilities and Energy Services Design Standards. The complete set of design standards can be found at the following link:  https://utilities.tamu.edu/design-standards/

PART 3 MINIMUM CLEARANCE REQUIREMENTS

3.1 No structures or facilities are to be built or placed underneath or on top of existing utility lines or easements.

3.2 The project is required to maintain a minimum clearance of 8 feet from the closest point of any existing underground utility infrastructure.

3.3 The project is required to maintain a minimum clearance of 15 feet from the closest point of any overhead electrical distribution lines and transformers.

3.4 The project shall bear all costs associated with utility infrastructure modifications required to maintain minimum clearances defined above.

3.5 Assistance in locating existing utility infrastructure on a proposed project site can be obtained from the Technical Services group at Utilities and Energy Services at 979-862-4604.
Design Standard

Medium Voltage Power Systems

Detailed specifications follow.

PART 1 MEDIUM-VOLTAGE CABLE

1.1 Shielded MV105 Cable

A. Provide medium-voltage shielded power cables that are NTRL-listed as Type MV105 for use in raceways, trays, underground ductbanks, manholes, vaults, and within switchgear and equipment of sufficient interior dimensions to allow for the proper bending & and termination of shielded cables.

B. Comply with the NEC®, IEEE C2™, ICEA S-93-639 / NEMA WC-74, and UL 1072.

C. Select voltage ratings for power cables and terminations based on the operating voltage of the medium-voltage distribution system as follows:

<table>
<thead>
<tr>
<th>Distribution System Operating Voltage</th>
<th>Power Cable Nominal Voltage Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,160 volts</td>
<td>5kV</td>
</tr>
<tr>
<td>5,000 volts to 15,000 volts</td>
<td>15kV</td>
</tr>
<tr>
<td>25,000 volts</td>
<td>25kV</td>
</tr>
<tr>
<td>35,000 volts</td>
<td>35kV</td>
</tr>
</tbody>
</table>

D. Specification

1. Conductor: Single uncoated annealed copper conductor with Class B stranding
2. Strand Screen: Extruded semi-conducting ethylene-propylene rubber (EPR).
3. Insulation: 133% EPR 140 mils thick for 5kV & 220 mils for 15kV.
4. Insulation Screen: Extruded semi-conducting EPR.
5. Shielding: Copper tape 5 mils thick helically applied with a minimum of 12.5% overlap.
6. Jacket: Chlorosulfonated polyethylene (Hypalon), 80 mils thick.
7. Continuous Operating Temperature: 90°C

**Note:** Operating temperature is limited to 90°C because PVC power ducts are listed for 90°C conductors.

8. Emergency Temperature Rating: 105°C
9. Short-Circuit Rating: 250°C
10. Conductor Sizes (for 15kV only): AWG Nos. 1, 1/0, 4/0, & 500kcmil.
1.2 Non-shielded MV105 Power Cable

A. Use non-shielded medium-voltage power cables only for short jumpers within switchgear or transformer enclosures where it is not feasible to install shielded cables due to inadequate space for bending or terminating shielded cables.

B. Use non-shielded medium-voltage transformer cable with 133% EPR / 140 mils thick for 5kV and 133% EPR / 220 mils thick for 15kV insulation, chlorosulfonated polyethylene (Hypalon) jacket.

C. Conductor AWG Sizes (for 15kV only): 1, 1/0, 4/0, & 500kcmil.

D. Obtain approval from the Owner for each installation of non-shielded medium-voltage cable

E. Acceptable Manufacturers:
   1. General Cable Prysium
   2. Okonite
   3. Southwire

1.3 Medium-Voltage Cable Terminations

A. Terminating materials must be compatible with the cable supplied.

B. Submit proof of the acceptability by the cable manufacturer of any splicing or terminating materials.

C. Separable Insulated Connectors: Specify pre-molded EPDM-type, submersible, fully shielded, separable insulated connectors for use with MV105 power cable as specified above. Connector system components shall comply with IEEE Std 386™, Separable Insulated Connector Systems for Power Distribution Systems Above 600V

D. Match voltage-class ratings of cable at 5kV, 15kV, or 25kV voltage-class. Provide 200A-rated load break elbow connectors for outdoor terminations at medium-voltage transformers and switchgear with switch-ways rated at 200A continuous, and 600A-rated dead break elbow connectors for terminations at medium-voltage switchgear with switch-ways rated at 600A continuous.

E. Indoor Terminators: Silicone rubber, cold shrink, tubular or skirted.

F. Outdoor Terminator: Silicone rubber, cold shrink, skirted.

G. Acceptable Manufacturers:
   1. Elastimold
   2. RTE
   3. 3M
1.4 Medium-Voltage Cable Testing

A. Upon completion of the installation, the Owner shall secure and pay for the services of a qualified, independent testing firm to conduct a test of all medium-voltage cable, including terminations, as part of the electrical acceptance test project phase.

B. The testing firm shall perform a high-potential proof test using a non-destructible DC testing device such as a “Kenotron” Westinghouse “High-Pot Tester”, or approved equal, capable of generating approximately 100,000 VDC under normal leakage conditions of acceptable cable.

C. All cables shall be tested in place with all splices and pothead terminations made up but not connected to switchgear or any other equipment, load device, or dead-end seal. Cables with dead-end seals shall be temporarily opened and then re-sealed.

D. In case of failure during the test, the Contractor shall locate the faulty splice, termination, or cable section and notify the Owner before making any repairs.

E. The testing firm shall submit to the Project A/E five copies of all test reports for review by the Engineer-of-Record. Should the test reports indicate, in the opinion of the Owner, that the condition of the new cable is unsatisfactory, the Contractor shall make all repairs and/or replacements to the satisfaction of and no additional cost to the Owner.

F. Additional tests using the same testing firm shall also be made at the Contractor’s expense on all repaired sections.

G. The Owner will not accept any cable installations until satisfactory certified proof test reports are obtained.

PART 2 RACEWAY SYSTEMS FOR MEDIUM-VOLTAGE CABLES

2.1 Design Guidance

A. Perform calculations to determine pulling tensions and sidewall pressures for all duct or conduit runs of medium-voltage power cable.

B. Design raceway systems so that the calculated pulling tensions and sidewall pressures will not exceed the cable manufacturer’s recommendations.

C. Lacking manufacturer’s recommendations use the following maximum values:

1. Cable tension:
   a. 0.008 lb./cmil for up to 3 conductors, not to exceed 10,000 pounds.
   b. 0.0064 lb./cmil for more than 3 conductors, not to exceed 10,000 pounds.
   c. 1000 lbs. per basket grip

2. Sidewall pressure: 500 lbs./ft
D. The maximum length of raceways between cable pulling points shall be the lesser of 400 feet or a maximum of 90° in total horizontal bends between cable pulling points.

2.2 Above ground Installations

A. Within the perimeter of buildings, install aboveground medium-voltage cables in rigid metal conduit.

B. In areas protected with fire sprinklers, terminate conduits entering equipment enclosures from above with water sealing fittings.

C. Install voltage markers on all conduits containing medium-voltage cables.

PART 3 INDOOR MEDIUM-VOLTAGE SWITCHGEAR

3.1 Design Criteria

A. For facility-level medium-voltage switchgear lineups and unit substation switchgear, provide metal-enclosed interrupter switchgear conforming to IEEE C37.20.3, Standard for Metal-Enclosed Switchgear, with current-limiting E-rated power fuses conforming to IEEE C37.46, Standard Specifications for Power Fuses and Fuse Disconnecting Switches.

B. For facility-level medium-voltage switchgear applications that either exceed the current capacity of fused equipment or require complex or high-speed switching operations, use metal-clad switchgear with vacuum circuit breakers conforming to:

1. IEEE C37.20.2, Standard for Metal-Clad and Station-Type Cubicle Switchgear
2. IEEE C37.04, Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
3. ANSI C37.06, Standard for Switchgear – AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities
4. IEEE C37.09, Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

C. Provide 5kV medium-voltage switchgear having the following minimum ratings:

1. 60Hz one-minute withstand voltage at mean sea level: 22kV; this rating may be obtained through insulation coordination with surge arresters.
2. BIL at mean sea level: 75kV; this rating may be obtained through insulation coordination with surge arresters.
D. Provide 15kV-class medium-voltage switchgear with the following minimum ratings:

1. 60Hz one-minute withstand voltage: 42kV at mean sea level; this rating may be obtained through insulation coordination with surge arresters.

2. BIL at mean sea level: 95kV; this rating may be obtained through insulation coordination with surge arresters.

3. Short-circuit rating: Provide equipment with a short-circuit rating greater than the available short-circuit current and not less than 25kA RMS symmetrical.


PART 4 OUTDOOR MEDIUM-VOLTAGE SWITCHGEAR

4.1 Pad Mount Switches

A. Description

1. For purposes of this Section, “padmount switches” are understood to consist of a single self-supporting enclosure containing interrupter switches.

2. Padmount switches are restricted to outdoor use. A padmount switch may include power fuses and accessory compartments.

3. Padmount switches shall be manufactured in accordance with IEEE C37.74.

B. Application

1. Padmount switches are typically used for sectionalizing applications in the medium-voltage distribution system.

   **Note:** Within the limitations of their current-carrying capability, interrupting duty and available configurations, padmount switches typically offer the lowest-cost switching solution.

2. Because of the relatively limited short-circuit capacity of padmount switchgear, available fault current at the proposed switch location must be carefully considered.
C. Installation
1. Install padmount switches atop or immediately adjacent to manholes.
2. Route cables to padmount switches through manholes.
3. Design a foundation for a padmount switch.

D. Clearances
1. Design installations of padmount switches to permit maintenance access.
   Design the installation of padmount switches to ensure 10 feet of clear working space in front of the switch enclosure doors for the full width of the enclosure.

   **Note:** In areas where vehicle parking may be possible, bollards, curbs or other structures should be installed to keep vehicles out of the working space. The sides of switches without doors or auxiliary compartments containing electrical control or instrumentation devices do not need working space greater than 30 inches for personnel access. For switches with side-mounted accessories such as fuse storage compartments or crank-type switch operators, this access space is to be measured from the outer face of the accessory or the end of the crank handle.

2. Auxiliary compartments with electrical control or instrumentation devices must be provided with working space in conformance with NESC Rule 125

PART 5 METAL-ENCLOSED INTERRUPTER SWITCHGEAR

5.1 Description

A. For purposes of this Section, “metal-enclosed interrupter switchgear” is understood to be equipment consisting of interrupter switches housed in individual steel compartments. Switching devices are fixed (not draw out). Busses are typically exposed when the compartment door is open. The switchgear may include fuses, sensing and metering devices and control equipment, but not power circuit breakers.

B. Metal-enclosed interrupter switchgear is available with enclosures suitable for indoor or outdoor installation.

C. Metal-enclosed interrupter switchgear shall be manufactured in accordance with IEEE C37.20.3.

5.2 Application

A. Metal-enclosed interrupter switchgear differs from padmount switches in its higher continuous current and interrupting rating, and wider availability of custom features. Metal-enclosed interrupter switchgear is commonly used as the primary disconnecting means for unit substations.
B. For application of metal-enclosed interrupter switchgear, consultation with the equipment vendors is recommended.

C. Manufacturers’ ratings do not take into consideration the effect of solar radiation on metal-enclosed interrupter switchgear installed outdoors. Use IEEE Standard C37.24 to calculate the derating of the continuous current rating of switchgear exposed to the sun.

**PART 6 METAL-CLAD SWITCHGEAR**

**6.1 Description**

A. For purposes of this Section, “metal-clad switchgear” is understood to be equipment consisting of individual steel compartments with draw-out switching devices. Switching devices may be load-break interrupter switches or power circuit breakers. The switchgear may include fuses, sensing and metering devices and control equipment.

B. Metal-clad switchgear is available with enclosures suitable for indoor or outdoor installation.

C. Metal-clad switchgear shall be manufactured in accordance with IEEE C37.20.2.

**6.2 Equipment**

A. Specify Powell Power/Vac vacuum metal-clad circuit breaker elements for use on 15kV-class systems.

B. Note that the requirement for GE Power/VAC equipment is not intended to unreasonably limit the market for the supply of switchgear equipment. The limitation extends only to the interrupter devices (the vacuum bottles) and the removable circuit breaker mechanism (the breaker “truck”). The switchgear control systems, buswork, and enclosures may be assembled by a qualified fabricator other than General Electric.

**6.3 Application**

A. Metal-clad offers the most flexible means of control and protection for power systems. Sophisticated protective relay schemes are readily applied to metal-clad switchgear. Of the three available types of switchgear, metal-clad is the most expensive.

B. For application of metal-enclosed interrupter switchgear, consultation with the equipment vendors is recommended.

C. Specify outdoor installations of metal-clad switchgear with walk-in aisle-type enclosures.

D. Provide ventilation (and air conditioning if required) as necessary to ensure that interior temperatures do not exceed 95°F.
E. Manufacturers’ continuous current ratings do not take into consideration the effect of solar radiation on metal-clad switchgear installed outdoors. Use IEEE Standard C37.24 to calculate the derating of the continuous current rating of switchgear exposed to the sun.

**PART 7 MEDIUM-VOLTAGE TRANSFORMERS**

7.1 Specify dry-type units for locations inside the building and mineral oil-filled pad mounted-type units for locations outdoors.

7.2 Indoor Dry-Type Medium-Voltage Transformers

A. Use dry-type transformers conforming to IEEE Std C57.12.01, *Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those With Solid Cast and/or Resin-Encapsulated Windings*, where liquid containment is not practical. Use dry-type transformers having an 80°C winding temperature rise over a 30°C average, 40°C maximum ambient. Use cast epoxy resin transformers to serve critical loads or where the transformer is in a dirty environment. Use vacuum pressure impregnated or cast epoxy resin transformers to serve non-critical loads and where the transformer is in a clean environment. Specify copper windings only.

B. Install medium-voltage dry-type transformers indoors only.

C. Install indoor transformers in vaults or rooms with a fire-resistance rating of not less than 1 hour.

D. Doors in transformer vaults or rooms shall be fire-rated and swing outward in the direction of egress.
   1. Equip doors with panic hardware.
   2. Fire rating of doors shall match fire rating of room or vault.
   3. Provide door opening adequate for moving largest equipment in the room or vault.

E. Locate transformers a minimum of 36 inches from building walls.

F. Provide ionization type smoke detectors and automatic sprinkler protection for indoor medium-voltage transformer vaults or rooms. Connect ionization-type smoke detectors to the building fire alarm system.

G. Provide automatic sprinkler protection system with a discharge density of not less than 0.20 gpm/sq. ft. over floor area of the transformer vaults, rooms, or spaces.

H. Provide mechanical cooling or ventilation powered from a reliable source to maintain transformer vaults or rooms within temperature limits appropriate for transformer operation.

I. Provide power ventilation system from an emergency or standby power source if available.
J. Specify primary overcurrent protection devices to provide through-fault protection of transformer in accordance with IEEE Std 242™.

K. Select distribution-class, gapless-type metal-oxide surge arresters for connection to the primary side of the transformer to provide additional protection against abnormally high voltage transients. Specify the maximum continuous operating voltage (MCOV) of the arrester according to its voltage-class rating. Apply arresters in accordance with IEEE Std C62.22, IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems or as recommended by the arrester manufacturer.

7.3 Outdoor Oil-Filled Pad Mounted Medium-Voltage Transformers

A. Install oil-filled medium-voltage transformers outdoors only.

B. Provide outdoor, pad-mounted, mineral oil-insulated, self-cooled medium-voltage transformers with integral dead-front loop-feed primary and live-front radial secondary cable terminating compartments. Windings shall be copper; aluminum windings are not acceptable.

C. Transformers shall be designed, constructed, and tested in conformance with IEEE C57.12.22™, Requirements for Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers (High Voltage, 16340 Volts and Below; 2500 KVA and Smaller).

D. Transformers shall be designed to operate at a 65 ºC average winding temperature rise over a 30 ºC average, 40 ºC maximum ambient temperature.

E. Furnish each transformer with the following accessories:
   1. Oil-immersed, load-break, bayonet fuse-holders with expulsion style fuses.
   2. Oil-submersible protector with current-limiting fuses rated for 50kAIC. Current-limiting fuses shall be placed in series with expulsion style fuses.
   3. Distribution-class, metal-oxide varistor elbow (MOVE) type surge arresters
   4. Two 2-1/2% above and two 2-1/2% below rated-voltage, full-current-rated for changing under no load. Include externally-mounted handle for tap-changer.

F. Acceptable Manufacturers
   1. ABB
   2. Cooper
   3. Square D
   4. GE
G. Installation

1. Design a concrete foundation for the transformer. If required, provide an oil-containment system integral to the foundation in accordance with EPA regulations.

2. Install in accordance with the NEC® and the Factory Mutual Insurance Company Loss Prevention Data Sheet 5-412.

H. Transformer Capacity

1. Base transformer capacity on load calculations per the requirements in NEC® and this Chapter and loading guidance in the following IEEE standards as applicable:


   d. IEEE C57.96, Guide for Loading Dry-Type Distribution and Power Transformers.

   **Note:** The IEEE C57-91-1995 Guide combines the data previously issued in the IEEE Guides C57.91-1981, C57.92-1981, and C57.115-1991 (redesignated as Std. 756). It also updates the data and presents equations that approximate the empirical data previously presented in tabular form. The designer may apply either method.

I. Determining Transformer Capacity

1. Use the following loading factors to determine transformer capacity:

   a. Average 24-hour ambient temperature

      1) Use the highest historical average (mean) daily temperature recorded at the University campus or at a location nearest the campus for which accurate data are available, such as the nearest airport or city. This data may be obtained from the National Weather Service at http://www.nws.noaa.gov or other source with similar reliable and/or official data. Refer to the appropriate sections in the ANSI/IEEE standards referenced above for further guidance concerning the determination of ambient temperature for use in the selection of the “Peak Load Per Unit” or peak load factor presented in the series of tables in both publications.
According to Weather.com, the highest 24-hour average temperature for College Station, TX (zip code 77843) is 30°C and occurred on August 4 and 5.


d. Transformers serving facilities having a significant daily load cycle may be operated with the peak load above the transformer nameplate rating as long as normal transformer life expectancy is maintained; refer to the IEEE transformer-loading guides listed above.

2. For single-ended services, the calculated load using the NEC® plus future load growth shall not exceed the calculated transformer self-cooled peak loading capability.

3. Example 1 – For building or facility located on a campus in College Station with a significant daily load cycle: 685kVA calculated load per the NEC® plus 137kVA future load growth of 20% = 822kVA. Select a pad-mounted transformer with a standard base rating equal to or greater than 822kVA / 1.68* = 489kVA, or 500kVA, and a 2-hour peak loading capability of approximately 500kVA X 1.68* = 840kVA based on Table 6 in IEEE C57.91-1981

   a. *The peak load factor (per unit) assuming an ambient temperature of 30°C.
   b. Base the secondary service conductors on the 822kVA calculated load.

4. For double-ended services, the calculated closed-tie load using the NEC® plus future load growth shall not exceed the calculated forced-air cooled peak loading capability of either transformer.

PART 8 ADDITIONAL REQUIREMENTS

8.1 All underground distribution medium voltage electrical switchgear shall be manufactured by Trayer Engineering Corporation. Typically, a new construction project will require a 4 or 5-way 15kV Vacuum Load Interrupter or Vacuum Fault Interrupters with visible disconnects.
8.2 Only the use of new copper wound, loop fed transformers are permitted for use in the 12.5kV TAMU electrical distribution (aluminum wound transformers are not acceptable for use).

8.3 Only use drain wire type cable with the following specifications:
   A. Description conductor: annealed bare copper
   B. Compact class b extruded strand shield
   C. Extruded black conducting stress control layer over conductor
   D. Insulation ethelene propylene rubber (epr) insulation colored to composite with black conducting shield layers.
   E. Composite insulation shield and jacket six corrugated copper drain wires embedded in an extruded black conducting black chlorinated polyethylene (cpe-130) composite insulation shield and jacket trade name: unishield 15kv 133% .220mil mv105.

8.4 Above ground, medium voltage electrical switches used in conjunction with the underground distribution and manhole system, shall be S&C. Switches supplied in switchgear linups shall be supplied by the switchgear manufacturer.

8.5 Medium-Voltage Relays: Manufactured by Schweitzer

8.6 System Configuration: Campus express feeders may not be tapped for distribution to campus buildings.
Design Standard

Thermal Systems (Chilled Water and Hot Water Systems)

Detailed specifications follow.

PART 1  CHW AND HHW SUPPLY TEMPERATURE RESET

1.1 The Utilities & Energy Services Department (UES) at Texas A&M University is actively identifying and implementing strategies to reduce the energy consumption and cost associated with campus heating and cooling requirements while ensuring customer needs are consistently met. Chilled water (CHW) and heating hot water (HHW) supply temperature reset schedules have been in effect on the campus for many years, with supply temperature adjusted based on outside air temperature. The supply temperature for chilled water ranges from 42 to 46 Degrees F and the supply temperature for heating hot water ranges from 180 to 130 Degrees F. The supply temperature reset schedule charts for both CHW and HHW are attached as Appendix A.

PART 2  HVAC COIL DESIGN DELTA T

2.1 All CHW cooling coils in facility air handling units (AHUs) and fan coil units (FCUs) shall have a minimum of 14 Degrees F design delta T based on a CHW supply temperature of 42 Degrees F, during peak cooling periods, except for spaces with high internal heat loads, such as server rooms. In spaces with high internal heat load, the system should be designed to meet maximum cooling requirements with a CHW supply temperature of 46 Degrees F.

2.2 For HHW, the minimum AHU and FCU design delta T shall be 30 Degrees F based on a design HHW Supply Temperature, during peak heating periods, of 170 Degrees F. The minimum coil design delta T's specified above are contingent upon maintaining proper coil flow tolerance per 2008 ASHRAE Handbook, pg 12.18, Fig. 34. Coil design delta T (for both CHW and HHW) can be higher than indicated above, but this design requirement must be achieved, unless a modification to this design guideline is approved in advance as indicated at the end of this guideline. Coils shall be designed in accordance with the latest version of ARI Standard 410.

2.3 AHUs having greater than 50 percent outside air supply shall have an energy recovery system incorporated into the design, unless it is proven to not be justifiable based on a life cycle cost analysis. Energy recovery systems shall be designed to operate at a minimum of 70% efficiency and be connected to the Siemens BAS to allow for effective monitoring of the system operation. Pre-filters shall be provided on all energy recovery systems to prevent fouling of the heat transfer element.

2.4 A requirement for testing, balancing and commissioning of both water and air flow shall be included in the specifications for all HVAC systems installed in new buildings and with any significant HVAC system replacement or retrofit.
PART 3  CHW AND HHW DISTRIBUTION SYSTEMS

3.1  CHW and HHW distribution pumps in the buildings shall be equipped with variable speed drives, with pump speed modulated to maintain sufficient differential pressure at desired flow through all HVAC coils in the building. Variable speed drives shall be connected to the Siemens BAS for effective monitoring and control under all flow conditions. The Siemens BAS shall also monitor the status of CHW and HHW control valves and any valve which hasn't opened a minimum of 20% at least once during any 168 hour (one week) period shall be programmed by the BAS to automatically open fully (during unoccupied periods) for a period of 15 minutes, in order to flush the thermal piping and minimize the potential for microbial growth.

3.2  All AHU and FCU fan motors and CHW and HHW pump motors installed in new buildings and with major system replacement or retrofit shall be specified to meet minimum efficiency requirements of National Electrical Manufacturers Association (NEMA) Standards Publication MG1-2006 (or any later edition) Premium Energy Efficiency Motor Standard, if a Premium Energy Efficiency Motor is available in the required size and rating. All new motors shall be sized to operate with a load factor of between 65 and 100 percent.

3.3  Three-way bypass control valves shall not be installed in any new CHW or HHW system. When HVAC systems in existing buildings are upgraded to include direct digital control (DDC), all existing three-way bypass control valves shall be removed and the DDC control system shall be programmed to provide flushing as previously described. Two-way characterized ball-style control valves shall be used for CHW and HHW flow control, rated to handle pressure drop that exceeds the highest differential pressure that the distribution pump(s) can generate, in order to avoid valve seat deterioration and leak-by. Control valve actuators shall have shut-off ratings that exceed the highest potential branch circuit differential pressure to ensure positive valve closure. Electric valve and damper actuators shall be specified for all HVAC systems that have DDC capability.

Notes:

1. See the UES Design Standard titled “Building Automation Systems” for additional requirements.

2. Any deviation from this design standard needs to be reviewed and approved by Utilities & Energy Services (UES).
APPENDIX A
CHW & HHW SUPPLY TEMPERATURE RESET SCHEDULES
Chilled Water Supply Reset Schedule

Note: CHW supply temperature range is 43 to 46°F with reset based on outside air temperature. Actual loop temperature may vary +/- 1°F from target.
Note: HHW supply temperature range is 130 to 180°F with reset based on outside air temperature. Actual loop temperature may vary +/- 5°F from target.
Design Standard

Underground Piping Systems

Uninsulated underground thermal piping systems experience significant energy losses to the soil over the course of their operating life. To minimize the heat gain/loss of these piping systems, Texas A&M University has chosen a mineral powder insulation system, similar to Gilsulate 500, as the Campus standard for insulating underground thermal lines. In addition to its insulating properties, this type of insulation system: 1) Is hydrophobic, 2) Has a high electrical resistivity preventing galvanic action between metal pipe and the soil, 3) Has good load bearing properties and 4) Is “green” since it’s made from minerals. All HHW thermal lines and CHW lines 12 inch and below are required to be insulated.

Work Includes:

An underground piping insulation system must be provided to enclose and provide thermal and waterproofing protection for piping specified and shown on Plans, including but not limited to the following:

- Piping insulation including expansion units.
- Miscellaneous materials incidental to complete installation of insulated underground sections.
- Supervision of installation as specified.

Detailed specifications follow.

PART 1 GENERAL

1.1 Insulating material which adheres to or becomes joined in any manner to piping during cycle of operation shall not be used.

1.2 Contractors are solely responsible to complete work for entire run of piping between points specified and shown on plans.

1.3 Adequate space and clearance with insulated underground piping system shall be provided to allow free movement of piping and avoid stress or abrasions to piping. No wood, masonry, metal, or any other abrasive pipe supports or guides, shall be left in contact with piping.

1.4 Provide fittings and accessories necessary and incidental to type of system selected.

1.5 Store materials and equipment on work site on wood platforms or members; stack and pile in substantial and safe manner so products will not easily dislodge while in storage.
1.6 Replace or repair wet or damaged insulation as directed by Engineer or product installation requirements.

1.7 Complete hydrostatic tests for all new lines. Perform hydrostatic leak test at 1.5 times maximum operating pressure to ensure piping system is free from leaks before application of field applied insulation and closures. UEM technical staff must be notified in advance of planned hydrostatic test and be present to witness the test. See pipe manufacturer's recommendations for testing procedures.

1.8 All parts of system to be intact, undamaged, and free from leaks before backfilling with insulation material. Upon completion of backfilling of insulation material, work must be approved by construction inspector and UEM representative before final backfilling is performed. Piping or insulation installation that is deemed to be inadequate or incorrect by Engineer, construction inspector, or UEM representative must be corrected to meet specifications prior to backfilling.

PART 2 EXCAVATION, FILLING & BACKFILLING

2.1 Final grading for setting pipe units to be performed immediately prior to setting units or concrete supporting pad in trenches; backfilling around completed insulated system to be under direction of supervisor for installation of insulated underground system.

2.2 Restore all finished grades and improvements as detailed.

PART 3 TYPE OF CONSTRUCTION

3.1 The system for insulating pipes shall keep water and moisture from pipes.

3.2 Type of material and construction: The insulation shall be a dry, free flowing granular product formulated from selected inert, inorganic materials. It shall be non-toxic, non-flammable, and completely free of asbestos. It shall require no mixing prior to installation, and no curing. It shall be completely compatible with all materials typically used for piping in the service temperature range of +35°F to +230°F. It shall be of sufficient density so any stones or rocks inadvertently falling on insulation will not penetrate or migrate into or through insulation during placement and back-filling operations.

3.3 The insulation shall be composed of granular particles that cohesively bond with each other to form a closed cell compacted mass that effectively isolates pipe surfaces from air, water, moisture and chemicals. The granules shall be surface treated to render it hydrophobic. The compacted insulation shall be capable of withstanding up to 12,000 psf (58,000 kg/M^2) at the manufacturer’s recommended density.

3.4 The insulation shall have a thermal coefficient of heat conductivity (K factor) of no more than 0.60 BTU/hr. /ft^2/°F/in. at manufacturer’s recommended use density and a mean temperature of 175°F and 0.65 at a mean temperature of 300°F by the guarded hot plate method of ASTM C-277. If an insulation with higher thermal conductivity is proposed, bidding shall be based on the equivalent amount of insulation required to minimize heat loss/gain to that which would result with the thermal conductivities
specified in the proceeding sentence. See Figure No. 1 for required insulation envelope dimensions.

3.5 Electrical resistivity of the insulation shall be greater than $10^{12}$ Ohm-cm.

3.6 The insulation shall be mineral powder with characteristics as described above similar to GILSULATE 500 as manufactured by American Thermal Products Inc.

3.7 The system shall be installed according to the published recommendations of the insulation manufacturer. The installer shall consult with and arrange for field assistance from the manufacturer’s representative prior to placement of the insulation system. Pipes, anchors-guides and expansion shall be in compliance with the recommendations of the insulation manufacturer or as shown on plans and specifications. Backfilling operations shall be performed according to Section, EXCAVATION, FILLING, AND BACKFILLING.

PART 4 PLACING MATERIALS

4.1 Insulation materials used must be capable of being placed and consolidated to prescribed density prior to any backfilling operation. Use of backfill to provide compaction of the material is not acceptable.

4.2 Installation Sequence: (Refer to Insulation Manufacturer’s Installation Sequence and notes.)

4.3 Excavate trench as near as possible to the required width of piping and insulation and pile backfill all on one side. Install pipes with required guides, supports, and anchors as shown on drawings and specifications. Perform pressure testing.

4.4 Grade and compact trench under pipes leaving required space for specified thickness of insulation. Clean any dirt or debris off pipes.

4.5 Precut gypsum board with attached spacers on the exterior may be driven into place. Horizontal spacers are used to determine envelope width. Leave forming in place. Forms are held away from pipes by temporary spacers which must be removed as insulation is installed and consolidated. Side forms must not extend above the finished consolidated insulation level of the envelope.

4.6 Provide compact sand or clean backfill behind the forms to pipe height.

4.7 All standing water shall be removed prior to placing insulation.

4.8 To minimize dust, empty the bags near pipes with as little “free fall” as possible. Fill trench to mid pipe height and consolidate. Remove spacers and temporary supports as work progresses.

4.9 Add additional layers of insulation and consolidate to specified thickness and density. A rod type concrete vibrator with a 1½ - 2” diameter head is the best and quickest means of consolidating insulation. Insert the head of the vibrator and pull along slowly.
4.10 Walk on the consolidated insulation envelope to insure use density, footprints of approximately 1” deep or less are expected. Insulation coverage shall be according to insulation manufacturer recommendations or as shown on Plans.

4.11 Additional 2” of insulation is required over pipes in areas passing under streets or parking.

4.12 Complete compaction of sand backfill behind forms. Place a layer of flattened empty bags on top of the insulation envelope. Walk on top of the bags and hand place 6” clean backfill on top of empty bags to protect against damage in case of storms. Complete backfilling to grade level as specified under Section, EXCAVATION, FILLING, & BACKFILLING as soon as possible. Provide a minimum of 12” earth backfill.

PART 5 GUARANTEE

5.1 Contractor shall guarantee installation of insulating system for a period of one (1) year from date of acceptance by Owner against deterioration of insulating value, compaction or water leakage under normal operation conditions. Contractor, however, shall not be responsible for damage or failure of system due to damage caused by other parties.
### Insulation Thickness Table

#### Design of the Insulation Envelope

**Pipe Coverage Selection**

#### Figure No. 1

![Diagram of insulation envelope](image)

#### TABLE 1

<table>
<thead>
<tr>
<th>Norm. Pipe Size</th>
<th>Outside Dis.</th>
<th>Pipe Area Sq. In.</th>
<th>Chilled Water</th>
<th>Domestic &amp; Heating Hot Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A  B  C</td>
<td>A  B  C</td>
</tr>
<tr>
<td>1</td>
<td>1.315</td>
<td>1.36</td>
<td>3  6  4</td>
<td>3  6  4</td>
</tr>
<tr>
<td>2</td>
<td>2.375</td>
<td>4.43</td>
<td>3  6  4</td>
<td>3  6  4</td>
</tr>
<tr>
<td>3</td>
<td>3.500</td>
<td>9.62</td>
<td>3  6  5</td>
<td>3  6  5</td>
</tr>
<tr>
<td>4</td>
<td>4.500</td>
<td>15.90</td>
<td>4  6  5</td>
<td>4  6  5</td>
</tr>
<tr>
<td>5</td>
<td>5.563</td>
<td>24.31</td>
<td>4  6  5</td>
<td>4  6  5</td>
</tr>
<tr>
<td>6</td>
<td>6.625</td>
<td>34.47</td>
<td>4  6  5</td>
<td>4  6  5</td>
</tr>
<tr>
<td>8</td>
<td>8.625</td>
<td>58.43</td>
<td>4  6  5</td>
<td>5  6  6</td>
</tr>
<tr>
<td>10</td>
<td>10.750</td>
<td>90.76</td>
<td>4  6  6</td>
<td>5  6  6</td>
</tr>
<tr>
<td>12</td>
<td>12.750</td>
<td>127.68</td>
<td>4  6  6</td>
<td>6  6  7</td>
</tr>
<tr>
<td>14</td>
<td>14.000</td>
<td>153.94</td>
<td>/ / /</td>
<td>6  6  7</td>
</tr>
</tbody>
</table>

Based on thermal conductivities (K factors) of Gilsulate 500xr insulation.  
If a product with higher K factors is proposed, insulation thicknesses shall be increased to provide a resistance to heat flow equivalent to the Gilsulate insulation shown in Figure 1.

Add 2 inches to C Dimension under streets. Parking lots and railroads tracks.
Design Standard

Utility Manhole Covers

Texas A&M University in College Station has standardized utility manhole covers to be used for all underground utility access on campus. All new utility manhole cover installations must use a fiber reinforced polymer cover manufactured by McGard Special Products (see attached specification sheet).

Detailed specifications follow.

Reinforced Polymer Manhole Covers

Part 1  General

1.1 Reinforced polymer manhole covers can be ordered in a variety of sizes, will all have built-in locking devices with an internal release and have a number of other benefits over conventional cast iron or steel covers:

A. Polymer covers are approximately ¼ the weight of an equivalent size cast cover
B. Standard thickness is used for pedestrian and non-vehicular application
C. Available in DOT-rated thickness to be used for vehicular traffic on roadways and drives
D. Top surface is slip resistant
E. Does not retain heat as readily as conventional cast covers
F. Available with venting if needed for specific application
G. Locking device will be used with a unique key for Texas A&M University in College Station
H. Locking device must be ordered with internal release mechanism to allow for personnel egress
I. Available in standard sizes and also in a variety of round, square, and rectangular sizes
J. Custom sizes with custom locking mechanism available depending upon specific requirement
K. “UTILITIES” to be cast into center of all manholes together with utility commodity name (ELECTRICAL, THERMAALS, SANITARY, STORM) where applicable – see attached drawing
L. No commodity name to be shown on access covers for utility tunnels
M. All covers to be ordered with locking device and internal release

N. Use McGard Registration Code No. 9500540 to order cover locking device unique to TAMU

O. TAMU Utilities & Energy Services will maintain and control inventory of unique cover keys

FiberShield Manhole and Lock Specification

PART 1 GENERAL

1.1 The FiberShield is a lightweight manhole cover with H-20 & AASHTO HS-25 load rating. The FiberShield weighs approximately ¼ of an equivalent size cast iron cover. A special operating key is required to unlock/remove the FiberShield from the frame.

1.2 The FiberShield is designed as a direct replacement for existing cast iron covers. The cover is rated to handle arterial traffic flow. The cover has a self-contained locking system. The locking system provides cover to frame retention and security from unauthorized entry.

PART 2 DESIGN CRITERIA

1.1 Base Cover

A. The FiberShield Manhole cover is manufactured from Fiber Reinforced Polymer.

B. The FiberShield is available in multiple colors and custom logos.

C. The FiberShield is manufactured with an “anti-slip” top surface.

D. The FiberShield utilizes an optional rubber gasket around the perimeter to provide dampening and reduce wear.

E. The FiberShield is available in two load ratings – 80,000 lb & 50,000 lb.

F. The FiberShield has maximum deflection of 0.75 inches @AASHTO H-20 wheel loading of 16,000 lb.

G. The FiberShield has been successfully subjected to accelerated fatigue testing @ 29,000 lb and 20,000 cycles. Full details available upon request.

H. The FiberShield has been successfully static and dynamic load tested at both 160°F and -60°F.

I. The FiberShield is available in most common sizes from 24” to 32”. Custom sizes available upon request.

J. The FiberShield has a self-contained locking system mounted on the underside. The locking system prevents the FiberShield from lifting out of the frame.
1.2 Locking System

A. The locking system is manufactured from a combination of molded plastic and fabricated stainless steel components.

B. The locking system consists of security drive bolt, two spring loaded pistons, skid runners, latch plate mechanism, piston actuation cable, and two plastic protective caps.

C. The security drive bolt uses a proprietary key drive system.

D. The security drive bolt is protected with a molded nylon protective cap.

E. The security drive bolt is manufactured from heat treated stainless steel to maximize strength, durability, and resist strong arm tools. The drive bolt actuates the latch mechanism.

F. The latch mechanism is manufactured from heat treated stainless steel for maximum strength and durability. The latch mechanism actuates both spring loaded pistons. The master side is connected directly to the latch mechanism. The slave side is driven via a nylon coated stainless steel braided cable.

G. The spring loaded pistons are manufactured from 304 stainless steel tubing. The springs are manufactured from 302 stainless steel.

H. The skid runners are manufactured from PVC tube. The skid runners are attached to the underside of the cover via molded nylon feet.

I. The skid runners allow the FiberShield to be removed from the manhole cover frame and dragged along the pavement without damaging the lock mechanism.

J. The locking system components can be easily replaced with common tools in the event they become damaged or worn.

K. The locking system has drain slots located near the security drive bolt to allow water and debris to pass thru.

1.3 Operating Key

A. The multi-purpose (MP) T-Key is used to unlock and lock the cover.

B. The MP T-Key is manufactured from alloy steel components which are covered with powder coat paint or zinc plating for corrosion protection.

C. The MP T-Key has a screwdriver storage location in the handle. The screwdriver is used for removing the plastic protective cap and cleaning debris from the security bolt counterbore.

D. The MP T-Key has a security key mounted on the lower end of the long shaft. The security key is manufactured from heat treated alloy steel and zinc plated for corrosion protection.
E. The MP T-Key has a swivel joint on the top of the long shaft. The swivel joint has two features – a threaded stud and a straight stud. The threaded stud is used to remove the FiberShield from the frame. The straight stud is used to disengage the latch mechanism (lock the FiberShield).

F. The MP T-Key has an extra key storage post located on the handle. The extra key storage post is used to store an extra key on the handle.

PART 3 FIBERSHIELD OPERATION

The FiberShield is operated with the following sequence of operations (starting with the FiberShield in the frame in the locked position).

3.1 FiberShield Removal

A. Remove the small screwdriver in the T-Key handle to pierce and remove the protective cap from the security drive bolt and cover lift hole.

B. Insert T-Key drive pattern into security drive bolt.

C. ¼ turn CCW until “audible click.” The pistons are retracted and held in the retracted position via a latch mechanism.

D. Flip T-Key over and screw cover removal stud into the FiberShield lift hole (where it mates with a female thread).

E. Lift and remove cover. Drag cover to a safe location.

F. Leave T-Key attached to the cover. The T-Key acts as safety device insuring the pistons aren’t accidently activated.

3.2 FiberShield Replacement

A. Drag FiberShield to the open frame and insert.

B. Unscrew the T-Key from the FiberShield lift hole.

C. Rotate and exchange the cover removal stud for the cover locking stud.

D. Insert the cover locking stud into the FiberShield lift hole.

E. Using your foot push the T-Key handle to disengage the latching mechanism.

F. Replace the plastic protective cap on the security bolt and lift hole.
Utility Manhole Cover Standards Diagram

<table>
<thead>
<tr>
<th>Cover Diameter</th>
<th>Cover Thickness</th>
<th>Average Frame Clear Opening</th>
<th>Fully Retracted Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>24&quot;</td>
<td>1 1/8&quot;</td>
<td>22&quot;</td>
<td>21&quot;</td>
</tr>
<tr>
<td>26&quot;</td>
<td>1 1/6&quot;</td>
<td>24&quot;</td>
<td>23&quot;</td>
</tr>
<tr>
<td>28&quot;</td>
<td>1 1/6&quot;</td>
<td>26&quot;</td>
<td>25&quot;</td>
</tr>
<tr>
<td>30&quot;</td>
<td>1 1/2&quot;</td>
<td>28&quot;</td>
<td>27&quot;</td>
</tr>
<tr>
<td>32&quot;</td>
<td>1 1/2&quot;</td>
<td>30&quot;</td>
<td>29&quot;</td>
</tr>
</tbody>
</table>

Overall Design Criteria

The FibreShield is designed as a direct replacement for existing cast iron covers. The cover is rated to handle arterial traffic flow. The cover has a self contained locking system. The locking system provides cover to frame retention and security from unauthorized entry.

See Specification Sheet for more details.
Manhole Cover Marking Standards

EXAMPLE TUNNELS

COVER LOGO INFORMATION
CENTER INSERT (18” x 6”)
UPPER INSERT (10” x 2”)

- UTILITIES
- McGARD
- ELECTRICAL
- UTILITIES
- McGARD
- THERMALS
- UTILITIES
- McGARD
- SANITARY
- UTILITIES
- McGARD
- UPPER INSERT
- CENTER INSERT
- McGARD
- STORM
- UTILITIES
- McGARD
Design Standard

Utility Metering

This section specifies the requirements for furnishing and installing metering and other infrastructure associated with the measuring and reporting of utilities consumption. This provides metering of utilities with indication and totalization capabilities.

Detailed specifications follow.

PART 1  GENERAL

1.1 Wages – In the event that a building will receive Heating Hot Water (HHW) and Chilled Water (CHW) from the University thermal system, the building shall be required to have a common data collection point. This data collection point shall be the type manufactured by Schneider Electric (Square D) under the product umbrella “WAGES Metering Box for Electrical and Piped Utilities” - Model A8 or A16 Wages. Each WAGES A8 or A16 Box shall contain an Ethernet Gateway connected to the Momentum processor to provide communications with the network. The gateway device shall be installed per manufacture’s specifications.

1.2 Electrical – The meter shall be the type manufactured by Square D under the product umbrella “Power Logic Series PM-8 or ION-8600A with Ethernet Breakout Package”. PM-8 meters require an Ethernet Gateway (PM8ECC or EGX-300) and Display (PM-8 is PM-8 Faceplate + PM-8RDA Adapter kit). All meter installations must have fused voltage references, meter power source, and all CT’s must be connected through Shorting Blocks appropriate to the installations. CT’s shall be of the appropriate size for the service, and rated at XXX:5 amps. Meter must be installed per the manufactures specifications.

1.3 Chilled Water, Heating Hot Water, Domestic Hot Water Supply & Return, and Domestic Cold Water – The meter shall be exactly like the type manufactured by Rosemount under the product umbrella “Rosemount Magnetic Flow Meter” [Model: 8705TSxxxxC1W0N0Q4D1 (xxx is flowtube sized in inches)]. All meters should be equipped with a Rosemount Remote Transmitter [Model 8712ESR1A1N0M4D1]. Meter must be installed per the manufacture’s specifications and approval from the campus must be obtained before sizing the flow meter to ensure it is within allowable flow ranges.

1.4 Steam – The meter shall be the type manufactured by Rosemount under the product umbrella 3051SFP Integral Orifice Flow meter. Meter must be installed per the manufactures specifications and must be field verified by campus personnel. Approval from the campus must be obtained before sizing the flow meter to ensure it is within allowable flow ranges.
PART 2 DETAILS

2.1 PowerLogic “WAGES”: utility monitoring 8 to 16-Channel Analog Input unit, wired and tested, comprised of the following:

A. **NEMA 12 enclosure**: (1) For Momentum Processors, wired and tested, with cables and associated connector sets

B. **Communications Gateway**: (1) To provide communications between RS-485 Device and TCP/IP network.

C. **Base unit**: (2) I/O Base Analog 8-CH Diff Input: wired, tested, w/ required cables TSX Momentum170AAI03000 Analog Input base - 8 Ch. "Isolated" Input Module Bases

D. **Communications Adapter**: (1) TSX Momentum172JNN21032 Modbus (RS232/485) Option Adapter, Time of Day Clock with Battery Backup

E. **Process Adapters (Top Hats)**: (2) TSX Momentum171CCC76010 M1 CPU / Processor Adapters; 512K RAM; RS232 and I/O Bus Ports

F. **24 VDC Power Supply**: (1) IDEC PS5R-E24 100W 120VAC to 24 VDC Power Supply

G. **120V Duplex Power Outlet**: To provide power source for Laptops and Test equipment.

H. **Processor Battery**: 2/3AA Battery, TADIRAN, High Energy Lithium, 3.6 Volts

2.2 Flow meters for Chilled water, Heating Hot water, Domestic Hot water, and/or Domestic Cold water – as required:

A. **Rosemount Remote Mount Flowmeter** – (2-parts):

B. **Rosemount Transmitter**: Rosemount Remote Transmitter for 2 inch pipe or surface mounting; 115 V ac power Supply Voltage; Factory Mutual Class I, Division 2 Approval for nonflammable fluids; High Accuracy Calibration (3 to 30 ft/s) for matched flow tube and transmitter system; with Local Operator Interface included.

C. **Rosemount Flowtube**: Common specifications for Rosemount Magnetic Flowtubes: PTFE Teflon lining, two standard 316L Stainless Steel measurement electrodes, Carbon Steel Flange to ASME B16.5 Class 150, Electrode Access in Sealed Welded Housing, Factory Mutual Certification for Ordinary Locations, High Accuracy Calibration (0.25% of rate from 3 to 30 ft/s) with Matched Flowtube and Transmitter and Calibration Data Sheet.

D. **Transmitter wire**: 2-pair twisted/individual shield 18 AWG wire, and 1 single 22 AWG wire, overall PVC jacket, plenum rated - BELDEN 1474A
2.3 **Sensor wire:** 2-wire, 18AWG Plenum-rated, shielded, sensor wire

2.4 **Chill water (CHW) Temperature Sensors:** Dwyer: programmable 1000 Ohm Platinum Sensor & Transmitter Assembly with LCD display [P/N: TTE-1XX-W-LCD (XX is length of probe in inches: ex. 04 = 4”)]; and must be installed in Thermowells in pipe [P/N: W1011-10B-XX (XX is length of probe in inches: ex. 04 = 4”)].

2.5 **Heating Hot water (HHW) Temperature Sensors:** Dwyer: programmable 1000 Ohm Platinum Sensor & Transmitter Assembly with LCD display [P/N: TTE-1XX-W-LCD (XX is length of probe in inches: ex. 04 = 4”)]; and must be installed in Thermowells in pipe [P/N: W1011-10B-XX (XX is length of probe in inches: ex. 04 = 4”)].

2.6 **Pressure Sensors:** Setra 256: range 0 - 100 psig, ±0.13% Full Scale, 1/4"-18 NPT pressure port, 4-20 ma output, Cast Aluminum case with two 1/2” conduit ports, removable cover and connectors {P/N: 2561100PG2M11].

2.7 **Steam Metering:** Rosemount 3051SFP Integral Orifice Flowmeter [P/N: 3051SFP2S015A3SXXXXD52DA1A5WDQC7Q4E5 (XXXX=0748 for 0.748 Bore Size, 1022=1022)]. The primary steam pressure is 65 PSI for all meters (state Max flow when ordering).

2.8 **Documentation:** Related documents from manufacturers for all operating systems/parts are to be provided to UES.

**Notes:**

1. Installation and wiring by Schneider-Electric technicians per warranty requirements
2. IP Addresses and network connections facilitated by UES
3. The type of 4-20ma input signals are dependent on specific building application
4. The scaling for raw temps, flow, and pressure signals, as well as, compensated signals from flow computers, BTU-totalizers, or other devices are dependent on specific building application
5. PLC-base program is for base TAMU program only and PLC-configured line- items are for specific building parameters
6. 120VAC power source to be connected to dedicated UPS supply source
7. Loop power for analog signals shall be from the enclosure
8. All cabinet penetrations must enter from the bottom of the watertight NEMA 12 enclosure
9. 3/4” EMT conduit or better with watertight/sealed connections at all penetration points