
SECTION 26 09 23
LIGHTING CONTROL DEVICES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Occupancy sensors.
- B. Time switches.
- C. Lighting contactors.
- D. Accessories.
- E. Emergency Bypass Relays.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
- E. Section 26 51 00 - Interior Lighting.
- F. Section 26 56 00 - Exterior Lighting.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts 2020.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2008 (Reaffirmed 2020).
- F. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices 2017.
- G. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).
- H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 916 - Energy Management Equipment Current Edition, Including All Revisions.
- J. UL 917 - Clock-Operated Switches Current Edition, Including All Revisions.
- K. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules Current Edition, Including All Revisions.
- L. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.

3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 2. Controls Vendor shall submit final layout drawings for review and approval as part of the shop drawing submittals. Note that the Vendor may have to modify their layout from that designed as necessary to meet vendor specific requirements or limitations. There shall be no additional costs for these modifications.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Include detailed information on device programming and setup.
- G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com.
 - 2. Lutron Electronics Company, Inc: www.lutron.com.
 - 3. Sensor Switch Inc: www.sensorswitch.com.
 - 4. WattStopper: www.wattstopper.com.
 - 5. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect large and small motion occupancy using a combination of both passive infrared and ultrasonic technologies.
 - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 - 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 - 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 - 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 - 8. Sensitivity: Field adjustable.
 - 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 - 10. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
 - 11. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
 - 12. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with local HVAC system equipment.
 - 13. Where wired sensors are indicated, wireless sensors are not acceptable without prior approval of Architect.

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- C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - c. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - d. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- D. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - e. Finish: White unless otherwise indicated.
 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. High Bay Sensors: Capable of detecting motion within high bay areas shown at a mounting height suitable for the area, with a field of view of 360 degrees. Review drawings including architectural for elevations and obstructions.
- E. Directional Occupancy Sensors:
1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
 - a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - b. Provide field selectable setting for disabling LED motion detector visual indicator.
 - c. Finish: White unless otherwise indicated.
 2. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
- F. Power Packs for Low Voltage Occupancy Sensors:
1. Basis of Design: Acuity Controls nPP16 Power/Relay Pack; Provide 0-10V dimming option where required; Provide UL924 Emergency Operation where required for operation of lighting fixtures consistent with the intent of the drawings.
 2. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
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3. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
4. Input Supply Voltage: Dual rated for 120/277 V ac.
5. Load Rating: As required to control the load indicated on drawings.

2.3 TIME SWITCHES

- A. Manufacturers:
 1. Intermatic, Inc: www.intermatic.com.
 2. Tork, a division of NSI Industries LLC: www.tork.com.
- B. Digital Electronic Time Switches:
 1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
 2. Program Capability:
 - a. 24-Hour Time Switches: Single channel, with same schedule for each day of the week and skip-a-day feature to omit selected days.
 - b. 7-Day Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days.
 - c. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
 3. Schedule Capacity: Not less than 16 programmable on/off operations.
 4. Provide automatic daylight savings time and leap year compensation.
 5. Provide power outage backup to retain programming and maintain clock.
 6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 7. Input Supply Voltage: As indicated on the drawings.
 8. Output Switch Configuration: As required to control the load indicated on drawings.
 9. Output Switch Contact Ratings: As required to control the load indicated on drawings.
 10. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

2.4 LIGHTING CONTACTORS

- A. Manufacturers:
 1. ABB/GE: www.geindustrial.com.
 2. Eaton Corporation: www.eaton.com.
 3. General Electric Company: www.geindustrial.com.
 4. Schneider Electric; Square D Products: www.schneider-electric.us.
 5. Siemens Industry, Inc; _____: www.usa.siemens.com.
- B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; combination or noncombination type as indicated; ratings, configurations and features as indicated on the drawings.
- C. Combination Contactors: NEMA ICS 2, Class A combination controllers with magnetic contactor(s) and externally operable disconnect.
 1. Disconnects: Circuit breaker type.

- a. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
 - b. Provide auxiliary interlock for disconnection of external control power sources where applicable.
- D. Short Circuit Current Rating:
 - 1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- E. Enclosures:
 - 1. Comply with NEMA ICS 6.
 - 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - 3. Finish: Manufacturer's standard unless otherwise indicated.

2.5 ACCESSORIES

- A. Auxiliary Contacts:
 - 1. Comply with NEMA ICS 5.
 - 2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.
- B. Pilot Devices:
 - 1. Comply with NEMA ICS 5; heavy-duty type.
 - 2. Nominal Size: 30 mm.
 - 3. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
 - 4. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
 - 5. Indicating Lights: Push-to-test type unless otherwise indicated.
 - 6. Provide LED lamp source for indicating lights and illuminated devices.
- C. Control and Timing Relays:
 - 1. Comply with NEMA ICS 5.
 - 2. Provide number and type of relays indicated or required to perform necessary functions.

2.6 EMERGENCY BYPASS RELAYS

- A. Emergency Shunt Relay:
 - 1. Description: Normally closed, electrically held relay, arranged for wiring in parallel with automatic switching contacts; complying with UL 924.
 - 2. Coil Rating: 120V or 277V to match circuit rating.
- B. Emergency Bypass Relay Control Device: Capable of bypassing the local manual and/or automatic lighting controls (e.g., wall switch, occupancy sensor, BAS control, etc.) when normal power has been lost and an emergency source (e.g., generator) is available to power a 20A lighting circuit.
 - 1. Description: Normally closed, electrically held relay, arranged for wiring in parallel with automatic switching contacts, test switch, normal and emergency power indicator lights; complying with UL 924 and UL 1008.

2. Enclosure: 9"x6"x3.5" galvanized steel case.
3. Coil Rating: 20A, 120/277V, 60 Hz.
4. Installation: UL listed for installation indoor or damp locations.
5. Warranty: 5 years.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.
- H. Occupancy sensors are shown on the drawings. Sensor manufacturer shall verify locations and quantities needed for adequate cover of space. Provide type and quantities needed by space with product submittals.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
 - B. Deploy "remote" devices such as room controllers, local network devices and other "back-of-house" devices in a common location throughout the project area. Example: install all room controllers (relay packs, etc.) concealed above accessible ceilings within the room being controlled, just inside the doorway of the room; install all networking equipment above the ceiling adjacent to the room controller when deployed. Locations of devices shall be similar in each room where possible, and coordinated in the field with the Owner at the time of installation.
 1. Where directed, provide label on ceiling grid noting equipment located above if deployment is uncommon or special deployments are required for a specific area or space.
 - C. Provide labeling of all line-voltage conductor branch circuitry at the lighting control equipment terminals. Label shall indicate panelboard and circuit number serving device.
 - D. Contractor and system programmer shall coordinate all room naming and numbering conventions with the Owner prior to final system programming and turnover. Architectural construction documents shall not be assumed correct for final naming and room number conventions.
 - E. All digital interface cabling shall be deployed incorporating a color-specific outer cable jacket. All cables shall remain the same color throughout the building, regardless of location or installation parameters. Coordinate jacket color system with the Owner. Cable color shall not replicate IT Data/Comm or BAS
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cable colors within the same facility.

- F. All digital interfacing and control cabling shall be installed as indicated. All cable shall be plenum rated regardless of installation methods:
1. Above accessible suspended ceilings: Cables shall be installed on J-hooks, cable tray, or other dedicated support structure. Cables shall not be directly fastened to the outside of raceways or other building structures.
 2. Above concealed, non-accessible ceilings: Cables shall be installed in raceways.
 3. Within open ceiling structures: Cables shall be installed in raceways or dedicated cable tray systems where deployed. Open support structures shall be avoided unless approved by the Owner.
 4. Inside wall cavities: Cables shall be installed in raceways from device box to above ceiling. Install above ceiling as indicated for ceiling types.
 5. Exposed: Cables shall be installed in raceways.
- G. All ceiling mounted occupancy sensors must be located at the manufacturer's minimum specified distance from all supply air registers to avoid detector false triggering. Ultrasonic technologies will not be permitted to be "programmed-off" where installation is not per manufacturer's recommendations. Detector relocations will be required if the spacing is not adequate based on field conditions. All costs to relocate the detectors will be incurred by the installing contractor. Deploy "corner" mounted sensors mounted to ceiling or wall with physically adjustable housings for "aiming" where possible to avoid potential conflicts with the ceiling mounted air supply diffusers.
- H. The network management interface device, or other lighting control network devices, for digital networked systems shall NOT be located within telecom rooms. These devices shall be located within an electrical room, or other space as directed by the Owner. These devices shall be located no more than 72" above finished floor. Do not locate at any location requiring a ladder for access.
- I. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.
1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
 2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
 3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- J. Install lighting control devices in accordance with manufacturer's instructions.
- K. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- L. Install lighting control devices plumb and level, and held securely in place.
- M. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
- N. Provide required supports in accordance with Section 26 05 29.
- O. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- P. Identify lighting control devices in accordance with Section 26 05 53.
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Q. Occupancy Sensor Locations:

1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

R. Combination Enclosed Lighting Contactors:

1. Except where indicated to be mounted adjacent to the equipment they supply, mount lighting contactors such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

S. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.**T. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.****U. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 05 33.16 for mounting of lighting control device system components.****V. Emergency Bypass Relay Control Device Installation: Where indicated on the drawings, install emergency bypass relay control device on the wall and connect both normal and emergency power circuits. Install in accordance with manufacturer's recommendations.****3.4 FIELD QUALITY CONTROL**

- A. Inspect each lighting control device for damage and defects.
- B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- C. Test time switches to verify proper operation.
- D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 COMMISSIONING

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- A. Control System Programming, Startup, and Commissioning: The following shall be conveyed to the installer for required system programming, startup, and commissioning actions.
1. Contractor shall provide the lighting controls on-site field services tech with accurate documentation of equipment locations as deployed within the facility for on-site programming and system startup. Construction floor plans shall be used to convey this information. Each deployed device location shall include the device model and serial number on the plan. Use of the device "box" labels shall be permitted to be used. Contractor shall review this approach with the Owner prior to implementing the documentation.
 2. All CAT5E cabling shall be tested prior to the system startup and corrective actions performed (repair/replacement) prior to the startup activities to minimize on-site delays during startup. Contractor shall provide testing reports seven (7) days prior to the startup date.
 3. All building-wide networked systems requiring integration with the Owner's Building Automation System (BAS) shall be coordinated with the Owner's automation network administration supervisor. Networked lighting control systems will require specific network settings within the software to provide error free communications with the BAS system. All IP address requests shall be made as early as possible in the construction timeline to avoid delays in system setup, programming, and integration with the BAS system.
 4. All building-wide networked systems startup and commissioning shall require the Owner's representative to be on-site for all startup and commissioning functions. Calendar events shall be coordinated and prioritized based on the Owner's availability.
 5. Contractor shall provide final networked systems program and/or databases to UGI upon final acceptance of the system.
- B. Provide additional occupancy sensors - 10% quantity based on total project sensor quantities. Sensor will only be provided to rectify operational issues, and not for post project spare stock.

3.8 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

END OF SECTION 26 09 23