

11300
15C/rrp
1 JUL 96

From: Commander, Naval Facilities Engineering Command (Code 15C)
To: Distribution

Subj: OCCUPANT SENSORS, INTERIM TECHNICAL GUIDANCE (ITG)

Ref: (a) OPNAVINST 4100.5D, Energy Management
(b) NAVFAC Guide Specification NFGS-16510, Interior Lighting

Encl: (1) NAVFAC Energy Criteria Team Application Guide for Occupant Sensors, dtd
1 Jul 96

1. Purpose. To provide best available current interim technical guidance concerning the use of occupant sensors for control of lighting systems within buildings. Although these devices have been in use to turn lights on and off for a number of years, many reports of improper installation and misapplication have been received. The occupant sensor application guide in enclosure (1) will assist lighting system designers in selecting the correct sensor technology and the correct sensor location to assure a successful, energy efficient installation. Please note that these same devices have also been used to control heating, ventilation, and air conditioning (HVAC) systems; however, this application guide will not specifically address control of HVAC systems.

2. Background. Reference (a) requires energy efficiency be taken into account in the design and acquisition of new facilities and that energy-efficient improvements be included in repair projects. Reference (a) also requires reducing energy consumption by 30 percent in existing buildings and a 10 percent reduction of energy usage in new buildings compared to those designed in FY 85. Many lighting retrofit projects have been done at Navy facilities and many more are planned. The new lighting systems have become very efficient, particularly the combination of electronic ballasts and T-8 fluorescent lamps. Until new lamps and ballasts are developed, the only way to achieve greater energy reduction is to turn lights off when the rooms or areas are unoccupied. Devices used to detect the presence of personnel are called occupant (or occupancy) sensors. These sensors and the high-efficiency lighting systems described above are specified in reference (b). Occupant sensors have been used in Defense Department projects, as well as in commercial buildings, for many years, but not without some problems. The problems related to occupant sensors include:

- a. incorrect sensor technology for the application,
- b. improper location for effective personnel detection, and
- c. failure to set turn-off time to appropriate value.

1 JUL 96

Subj: OCCUPANT SENSORS, INTERIM TECHNICAL GUIDANCE (ITG)

3. Technical Guidance. Until the occupant sensor application guidance included in enclosure (1) is incorporated into the appropriate criteria, follow the recommendations of enclosure (1) to ensure effective and energy efficient control of lighting systems.

4. Action. Navy engineers and architects in charge of facilities designs shall ensure that new construction and major renovation projects include as many energy conserving ideas as possible, including occupant sensors for locations such as offices, restrooms, and equipment rooms.

NAVFAC Criteria Office shall include the information in enclosure (1) in the next revision of MIL-HDBK-1004/4, Electrical Utilization Systems. Atlantic Division, Naval Facilities Engineering Command shall revise and update NFGS-16510, Interior Lighting as appropriate to include the latest technical data on occupant sensors.

5. Cancellation. None.

6. Points of Contact. For additional information concerning energy efficient design criteria, including the proper application of occupant sensors, the following points of contact are provided:

NAVFAC Criteria Office	Richard R. Paradis, P.E.	DSN 262-4447/757-322-4447
NAVFAC Energy Criteria Team	Earl Becker	DSN 521-1365/805-982-1365
LANTDIV (Preparing Activity for NFGS-16510)	W. David Phelps	DSN 262-4312/757-322-4312

P. N. BOLTON
By direction

Distribution:
CINCUSACOM
CINCLANTFLT
CINCPACFLT
COMSUBLANT
COMSUBPAC
COMNAVSURFLANT
COMNAVSURFPAC
COMNAVAIRLANT

1 JUL 96

Subj: OCCUPANT SENSORS, INTERIM TECHNICAL GUIDANCE (ITG)

COMNAV AIRPAC
COMNAV AIRSYSCOM
COMNAV SEASYS
COMNAV SEASYS (60APM, 20, 21)
LANTNAVFACENGC (03, 04, 404, 16)
SOUTHNAVFACENGC (07, 074, 076, 16)
NORTHNAVFACENGC (04, 0413, 4032, 16)
SOUTHWESTNAVFACENGC (04, 404, 406, 16)
PACNAVFACENGC (04, 404, 406, 16)
ENGFLDACT WEST (09F, 09F41, T1E, T2A, 16)
ENGFLDACT CHESAPEAKE (04, 404, 406)
ENGFLDACT MIDWEST (40, 420)
ENGFLDACT NORTHWEST (04A, 04B)
ENGFLDACT MED (N4)
PWC GUAM (400, 423)
PWC GREAT LAKES (420, 422)
PWC JACKSONVILLE (400, 420)
PWC NORFOLK (400, 424)
PWC PEARL HARBOR (400, 420)
PWC PENSACOLA (400)
PWC SAN DIEGO (400)
PWC SAN FRANCISCO (400)
PWC WASHINGTON (400, 413)
PWC YOKOSUKA (400)
OICC NAVHOSP PORTSMOUTH
OICC GUAM
OICC MIDPAC PEARL HARBOR
OICC PACNAVFACENGC DET YOKOSUKA JA
OICC TRIDENT KINGS BAY GA

Copy to:

COMNAVFACENGC (13, 15)
COMNAVBASE SAN DIEGO
COMNAVBASE SAN FRANCISCO
COMNAVBASE PEARL HARBOR
COMNAVBASE NORFOLK
COMNAVMARIANAS GQ
COMNAVFORJAPAN YOKOSUKA JA
CNET PENSACOLA

1 JUL 96

Subj: OCCUPANT SENSORS, INTERIM TECHNICAL GUIDANCE (ITG)

COMNAVFACENGCOM (135)

CESO (158)

CMC (LFF-1)

ACOE CEMP-ET

Blind copy to:

15C/rrp

15C(RF)/ssf

c:/netdata/word/cm/paradis/jul96/occitg1.doc

NAVFAC ENERGY CRITERIA TEAM APPLICATION GUIDE FOR OCCUPANT SENSORS

1.00 Introduction - Occupant (or occupancy) sensors have been used to turn lights on and off for a number of years, yet many problems still exist over their misapplication and improper installation. Remember that occupant sensors (O.S.) are viable energy savers only where human occupancy is intermittent. Do not employ O.S. in an area where people are expected to be moving about continuously throughout the day. Classrooms, offices, restrooms, warehouses, hangars, and equipment and storage rooms are examples of areas where O.S. will save energy by turning off lights when no human presence is detected. This application guide will address the available technologies and selection factors for occupant sensors in an abbreviated form. More detailed occupant sensor application guidance is included in the references listed at the end of this guide.

1.01 Sensor Technologies - The two primary technologies used to detect occupancy are ultrasonic and passive infrared (PIR) employed singly or with each other in a dual-technology sensor.

a) Ultrasonic Technology - Emits ultrasonic radiation (high-frequency sound) to sense occupants in an area. Frequency range of operation is between 20 and 28 kHz. They are most sensitive to motion toward and away from sensor. An ultrasonic sensor is volumetric, meaning it floods an area within its coverage pattern. This allows it to detect persons behind partitions and other obstructions. Any moving object within its coverage area will disturb the sound wave pattern, creating a Doppler shift and altering the signal returning to the sensor. False activation may also occur from vibration, air movement, high sound levels, and audible sounds having ultrasonic components. Ultrasonic sensors have sensitivity adjustments to minimize environmental effects. Reducing sensitivity will also reduce the coverage area. If ultrasonic sensors are mounted close to each other, they must operate at different frequencies to avoid interfering with each other.

b) Infrared Technology - An infrared O.S. is sensitive to body heat and works best when the person is moving across the sensor pattern. PIR sensors have different lenses available to generate specific patterns of coverage: fan shaped pattern for smaller areas (private offices), 360 degree pattern for large areas (open plan offices), and long narrow pattern for areas such as hallways. Lenses may also be field modified to block out part of its sensor's view area to avoid a heat generating device or an area that must remain lighted continuously. Because it is sensitive to body heat, the infrared O.S. is also sensitive to any rapid fluctuations in temperature within its field of view. Be sure no rapidly changing heat sources are in the area where the infrared O.S. is to be used. Solar heating of glass and metal surfaces can cause sensor activation. The sensor can be blinded by the sun shining directly on it. To be effective, PIR sensors should be used in areas with no obstructions to occupant movement, since it is a line-of-sight device. Small animals won't usually activate PIR sensors, although a bird flying close to one could turn it on.

c) Dual-Technology Sensors - Combines infrared and ultrasonic technologies into a single housing. Dual-technology sensors are good for areas where a single technology O.S. has difficulty of detecting human movement and where one or the other technology is prone to false activation.

d) New Technology - Although ultrasonic and PIR technologies remain predominant for occupant sensing, a new passive dual technology sensor has recently entered the market. This device combines PIR with an active listening system. After the PIR detects someone entering the area, the microphonics take over. This sensor's applications include office spaces with cubicles and large restrooms. Microwave motion sensors exist for security system applications. Do not use microwave sensors for occupant detection since microwaves pass through most building materials and will detect movement beyond the desired coverage area.

1.02 Mounting Methods - Sensors are designed for two principal mounting methods: wall switch replacement and ceiling mount.

a) Light Switch Replacement - Direct replacement of a wall switch with a PIR O.S. will likely only be acceptable in smaller rooms where no partitions obstruct the sensor's view of the movement of the room's occupants. These wall switch replacement units can control only the lighting fixtures connected to the switch. To avoid false activation, manual turn-on, automatic turn-off is recommended. In private offices, this would also preclude activation by someone just dropping off mail, plans, etc. Manual turn-on is also beneficial where available daylight allows electrical lighting system to remain off for several hours at a time.

b) Ceiling Mount - Available in infrared, ultrasonic, and dual-technology. Use for large area coverage and rooms with partitions and other obstructions. Ceiling mounted O.S. connect to lighting system through transformers and relays to operate a large number of lighting fixtures.

1.03 Proper O.S. Location - Improper location is the most significant factor in O.S. misapplication. Locate sensor so that it will not detect movement outside the desired coverage area through an open doorway. In many cases, wall switch replacement O.S. are ineffective because the existing wall switch location is behind a partition or on the wrong side of a wall, limiting motion detection to a very small part of the desired coverage area.

1.04 Compatibility - Be sure O.S. is designed to control the type of lighting system you have chosen for new projects or for the existing lighting system in a renovation project. Not all sensors will work with fluorescent loads having standard or electronic ballasts or with compact fluorescent lamps. Use O.S. with rapid start fluorescent ballasts, particularly with short "off" times (five minutes). Do not use O.S. with instant start fluorescent ballasts, unless "off" time is very long (30 minutes, minimum), since lamp life will be shortened. Before specifying O.S. with High Intensity Discharge (HID) lighting, check with O.S. manufacturer and HID lamp and ballast manufacturer for application data.

1.05 Time Delay - Ensure the O.S. has an adequate adjustable time delay (30 seconds to 30 minutes, minimum) for the application. Initially set delay to long “on” period, then adjust time delay setting based on occupant movement patterns. Do not use the “instant off” feature in any installation. Fluorescent lighting should have a minimum five minute “on” time to avoid adversely affecting the expected life of the lamps and ballasts.

1.06 Sensor Specifications - Include the following information when specifying O.S.:

- a) Sensor Type: passive infrared, ultrasonic, dual-technology, other
- b) Mounting: ceiling, wall switch replacement, recessed, surface, other
- c) Coverage Pattern: wide angle, narrow, 360 degree, other
- d) Lens Type: standard, dense, long range, other (for PIR only)
- e) Special Environment: high humidity, high or low temperature, other
- f) Quality/Safety: specify Underwriters Laboratories (UL) listing
- g) Time Delay: 30 seconds to 30 minutes, adjustable
- h) Input Voltage: 120V, 277V, other
- i) Adjustable Frequency: for multiple ultrasonic O.S. in same area only
- j) Manual Override and Manual on-off

1.07 Information on Project Drawings - For projects with many sensors and many different sized coverage area, include occupant sensor schedule and coverage patterns on drawings. Schedule should include sensor type, description, coverage, and applicable notes. Coverage patterns should be drawn to scale.

1.08 National Electrical Code (NEC) Requirements - The 1996 NEC has specific requirements related to the installation of occupant sensors. Section 110-16 states that illumination in electrical equipment rooms “shall not be controlled by automatic means only.” Be sure to include manual overrides for O.S. installed in electrical rooms. Section 210-70 permits the control of lighting outlets by O.S. in dwellings as long as there is manual override capability or separate wall switch. See NEC Handbook for details.

1.09 Occupant Sensor Etiquette - Issue memo to personnel and post signs for visitors indicating the presence of O.S. and reminding everyone that lights off does not necessarily mean that the office is closed or that someone is not at work that day.

1.10 Daylighting Option - Occupant sensing may be coupled with daylighting sensors to provide further energy conservation. Where fluorescent lighting is used, be sure that appropriate dimming ballasts are specified for correct light output adjustment by daylighting sensors.

REFERENCES

1. E SOURCE Electronic Encyclopedia, Chapter 11, Lighting Controls, E SOURCE, Inc., Boulder, CO, 303-440-8500 email: esource@esource.com
2. The Architect's Guide to Energy Conserving Products and Systems, National Institute of Building Sciences (NIBS) Construction Criteria Base (CCB), Washington, DC, 202-289-7800 email: nibs@nibs.org
3. Lighting Handbook, Eighth Edition, Chapter 31, Lighting Controls, Illuminating Engineering Society of North America, New York, NY, 212-248-5000
4. National Electrical Code Handbook, Seventh Edition, National Fire Protection Association, Quincy, MA, 800-344-3555

prepared by: Richard R. Paradis, P.E. 757-322-4447, DSN 262-4447, Internet:
paradis@efdlant.navfac.navy.mil