CMH lamps; wattage is limited by the lamp size. PAR30IR and PAR38IR lamps could be used but are not recommended because of the breadth of lamp wattages and types available with which a fixture could be re-lamped at a future time. Standard incandescent and halogen sources are not recommended.

EL12 Light-Emitting Diodes (Climate Zones: all)

To achieve the LPD recommendations in Chapter 3, light-emitting diodes (LEDs) may be used for accent lighting. LEDs are solid-state semiconductor devices that can produce a wide range of saturated colored light and can be manipulated with color mixing or phosphors to produce white light.

White light LED sources should be carefully evaluated for use in the lighting of retail merchandise, as color rendering and color temperature capabilities can vary widely by manufacturer. Products are now available that allow the adjustment of the intensity and the white color temperature, providing dynamic flexibility to the retail environment. They are not particularly efficient at this time, with efficacy similar to that of halogen lamps, although the technology is rapidly improving.

LEDs are not well suited for the ambient lighting requirements of most spaces, but they can be used effectively for casework and display integrated lighting. Effective accent and wall-washing strategies can be achieved using LEDs, but intensity, color, and efficacy must be reviewed thoroughly. Single-color LEDs are well suited to create interesting visual effects, as they produce color more efficiently than filtering other white light sources with relatively low energy consumption.

Careful consideration should also be given to maintenance issues. LED lamp life can offer advantages over other sources but does vary by color. In many cases, the LED cannot be replaced as a single lamp, like an incandescent source, for example; often the entire control board will have to be removed and replaced.

EL13 Occupancy Sensors (Climate Zones: all)

Use occupancy sensors in all non-sales areas. The greatest energy savings are achieved with manual on/automatic off occupancy sensors if daylight is present. This avoids unnecessary operation when electric lights are not needed and greatly reduces the frequency of switching. In non-daylighted areas, ceiling-mounted occupancy sensors are preferred. In every application it should not be possible for the occupant to override the automatic OFF setting, even if set for manual ON. Unless otherwise recommended, factory-set occupancy sensors should be set for medium to high sensitivity and a 15-minute time delay (the optimum time to achieve energy savings without excessive loss of lamp life). Review manufacturer's data for proper placement and coverage.

The two primary types of occupancy sensors are *infrared* and *ultrasonic*. Infrared sensors can only see in a line-of-sight and should not be used in rooms where the user cannot see the sensor (e.g., storage areas with multiple aisles, restrooms with stalls). Ultrasonic sensors can be disrupted by high airflow and should not be used near air duct outlets.

EL14 Lighting Circuits and Automatic Controls (Climate Zones: all)

Put all general, all accent, and all display case lighting on separate circuits and switches (use multiple circuits and switches as required). Use automatic time scheduling (time switches) to turn on accent and display case lighting no more than 20 minutes prior to normal scheduled hours and to turn off accent and display case lighting no more than 20 minutes after normal scheduled hours.

It is also recommended, if track lighting is to be used, that the track be included with a current-limiting device. If installed, the limiting device can limit future additions of track heads and limit the amount of "assumed" power required for the LPD calculation.

EL15 Electric Lighting Controls in Daylight Zones (Climate Zones: all)

Factory setting of calibrations should be specified when feasible to avoid field labor. Lighting calibration and Cx should be performed after furniture installation but prior to occupancy to ensure user acceptance. Refer to DL1 through DL 10.

EL16 Exit Signs (Climate Zones: all)

Use LED exit signs or other sources that consume no more than 5 W per face. The selected exit sign and source should provide the proper luminance to meet all building and fire code requirements.

EL17 Light Fixture Distribution (Climate Zones: all)

Extensive use of totally indirect luminaires or recessed direct-indirect (coffer-type) fixtures may not achieve desired light levels while meeting the LPD goal from Chapter 3. Such fixtures can create inherent brightness/contrast problems and are not recommended.

EL18 Overhead Glare Control (Climate Zones: all)

Specify luminaires properly shielded for customer comfort. Avoid T-5 lamps in open-bottomed fixtures. Avoid highly specular louvers, cones, or reflectors visible to occupants from any angle. Use efficient fixtures and proper distribution. Use more fixtures of lower wattage rather than the reverse.

Sample Design Layouts for Retail Buildings

The 1.3 W/ft^2 recommendation for lighting power (shown in each Recommendation Table in Chapter 3) represents an average LPD for the entire building. Individual spaces may have higher power densities if they are offset by lower power densities in other areas. The example design described below is one way (but not the only way) that this watts-per-square-foot limit can be met.

EL19 General Lighting in Merchandise Sales Areas (Climate Zones: all)

The general lighting (fixture type G1 in Figure 5-23) at 1.5 W/ft^2 provides the base level of lighting for the merchandise. The spill light from the merchandise will provide adequate lighting for the circulation paths. Also included in the base allowances is decorative/focus lighting at the sales transaction counter—this may be provided by pendants over (fixture type P1 in Figure 5-23) and wall lighting behind (fixture type A2 in Figure 5-23) the counter.

General lighting can be provided by a number of different types fixtures.

- Direct fixtures, open, lensed or parabolic, designed as shown in Figure 5-23, will provide the highest footcandles for the space and will provide some positive shadowing on the product. However, if the displays are expected to change sometime after the installation, the fixtures may be misaligned to the displays. Consider an alternative layout with the fixtures running perpendicular to the displays.
- Indirect fixtures, pendant and recessed indirect, designed similarly to those shown in Figure 5-23, will not be display dependant but may look better running perpendicular to the display aisles. Indirect fixtures tend to provide a flat lighting effect and can draw the customers' attention away from the display.

EL20 Accent Lighting in Merchandise Sales Areas (Climate Zones: all)

Follow recommendation EL2 for accent lighting LPD above the base power allowance. Use accent lighting (fixture type A1 in Figure 5-23) to highlight key merchandise locations or vignettes to "feature display" light levels (three to ten times the general merchandise lighting level in the area of the display). The use of accent lighting to highlight ALL merchandise does not create the proper contrast ratios.