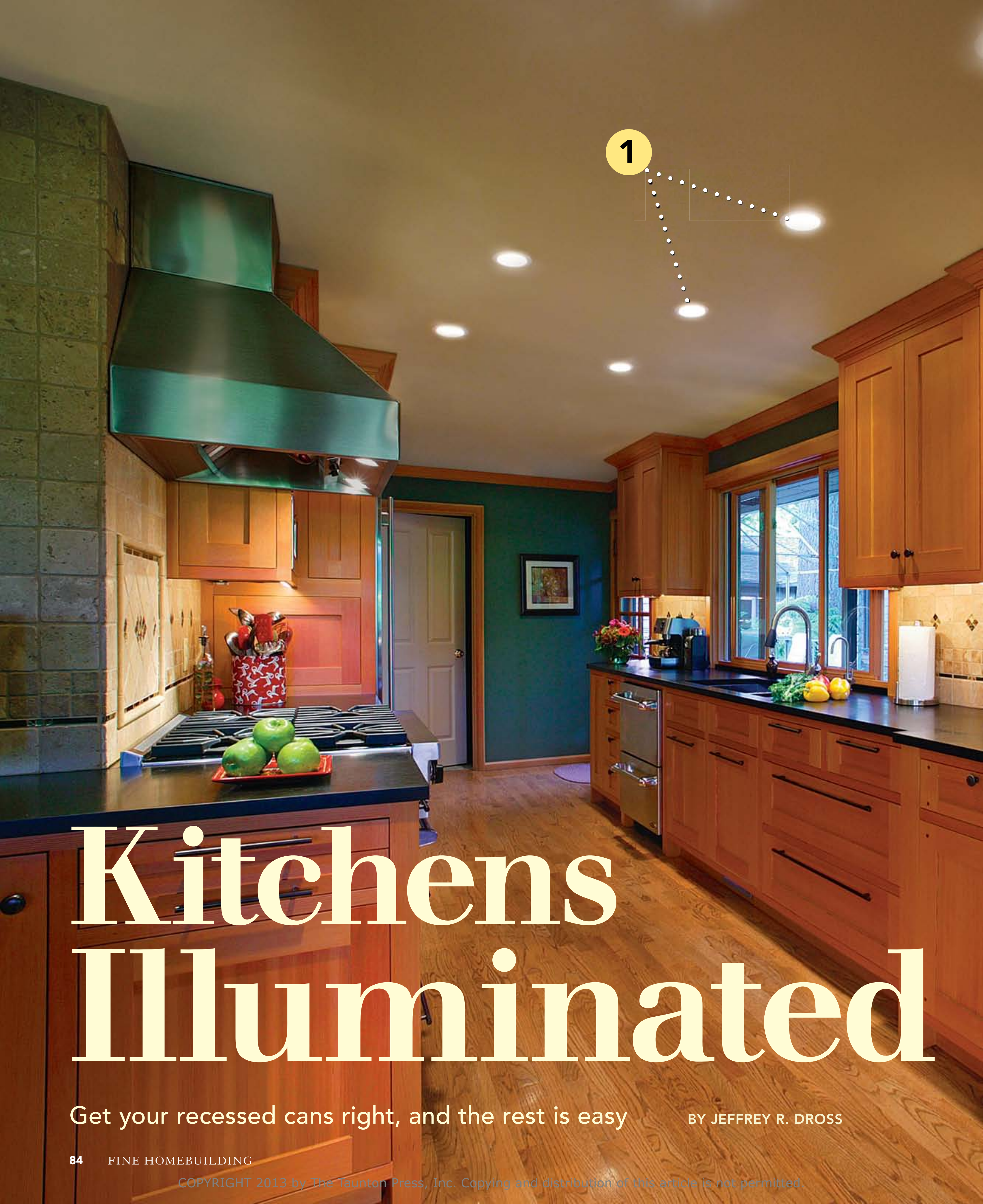


Kitchens Illuminated

Get your recessed cans right, and the rest is easy

BY JEFFREY R. DROSS

We used to light kitchens with one fixture placed in the middle of the ceiling, an arrangement that rarely provided enough light in the right location and often made kitchens stark, gloomy places. Unfortunately, the trend today toward recessed-can lighting has not improved the situation. Often improperly placed and poorly chosen, recessed cans cast inopportune shadows and create undesirable washes of glare that make it almost impossible to see what you're cutting on the counter, even with the added benefit of undercounter lighting. The truth is that despite opulent fixtures, cans by the dozen, and undercabinet lights, many of the lighting layouts that I see today are ineffective because designers chose the wrong fixtures and didn't optimize their placement.

If, however, you follow a few simple steps that help you properly position those cans and choose the right lamps to put in them, your kitchens will suddenly seem bigger, look brilliant, and function beautifully.

The foundation layer

Good lighting consists of three basic layers: ambient (general) lighting, accent (decorative) lighting, and task (work) lighting. Strategically linking these layers creates a cohesive design that takes the place of that single light source of the past.

Light layering *involves using several types of light in one room to serve different purposes. The basic layers are:*

1 *Ambient lighting*

2 *Task lighting*

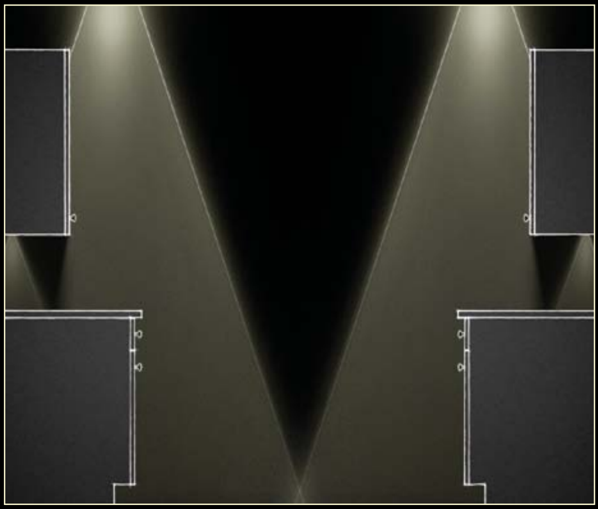
3 *Accent or decorative lighting*

Like a basic coat of paint, ambient light serves as a backdrop for all other light. By itself, it may not be interesting, but it serves the total design and the visual comfort of the end user. In today's kitchens, ambient light is provided primarily by recessed cans. Unfortunately, it's in this initial ambient-lighting layer that most designers make their

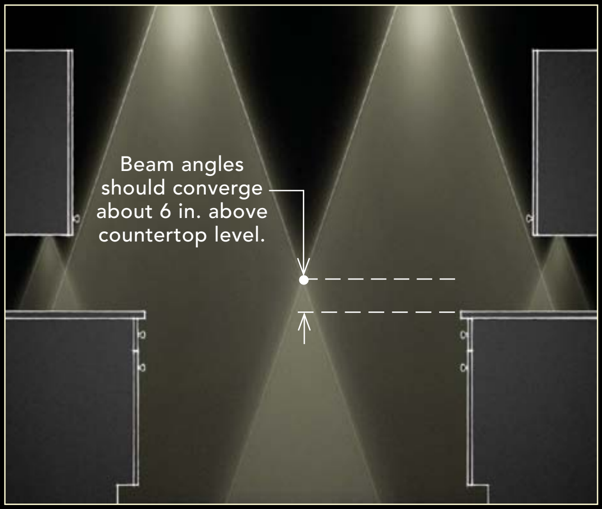
SPACE LIGHTS USING BEAM ANGLE

Pay attention to the beam angle of overhead lights to eliminate glare and shadows in the kitchen. Wide-beam lights placed too close to cabinets create glare on the doors and shadows underneath. Improper placement of undercounter task lighting compounds this problem. Well-placed lighting positions the beam angle so that it misses the cabinet front, illuminating the countertop area and overlapping adjacent lights to produce solid overall illumination. Undercounter lights placed toward the front of the cabinets provide supplemental task lighting.

Poor placement



Good placement



Beam angle *refers to the angle at which light radiates from a lamp. The narrower the beam, the more intense the light. Narrow beam angles often are used for highlighting objects; wider beam angles are used for general illumination.*

most egregious mistakes. Understanding how light is emitted from recessed fixtures is essential for positioning them correctly.

Beam angle is the key to spacing cans

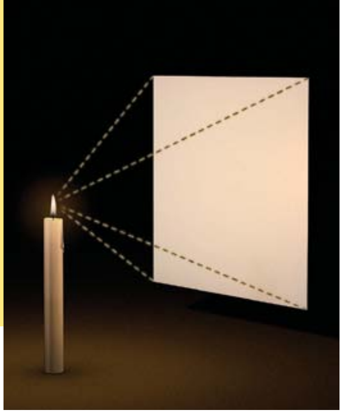
Unlike surface-mounted fixtures, which emit light in a 360° angle, light emitted from recessed fixtures forms a parabolic or cone-shaped beam. This is why they are also colloquially called *downlights*. Think of recessed cans as automobile headlights installed upside down on the ceiling.

The shape of the cone of light is determined by a reflector that focuses the light into a specific beam angle. This reflector may be part of the fixture itself, or it may be built into the lamp (bulb). The "R" found in the popular bulb designations "R," "MR," and "PAR" indicates that these lamps have reflectors. In either case, whether built into the fixture or the bulb, you will find the beam angle specified by the manufacturer, generally on the box. This angle ranges from an extremely narrow 8° to a very wide 55°.

A narrow beam angle pushes all of the light into a slender cone, resulting in an intense quantity of light in a tiny space appropriate for illuminating a small worksurface, such as a cutting board or a sink. Wider beams take that same amount of light and disperse it over a broader area, which is generally more appropriate to ambient lighting.

Photos this page: Charles Miller. Illustrations this page and facing page: Christopher Mills.

A **footcandle** *is a measurement of light intensity that represents the illumination of an average candle at a distance of 1 ft. from the surface being lit. Although largely abandoned abroad, footcandles (fc) are still used in the United States to express how much light is needed for a particular application, such as IES's recommended 30 fc for ambient lighting in an average kitchen.*



When using wide beam angles for ambient lighting, however, remember that the wider the beam, the lower the light intensity. To end up with an even distribution of the right amount of light, the quantity of fixtures and their beam angle must work in tandem so that beams overlap to cast even lighting, and that beams don't intersect upper cabinets to create shadows on worksurfaces (sidebar facing page).

When calculating ambient lighting for a kitchen, lighting designers take most of their lighting measurements at countertop level. It's the place where eyes generally focus when in the kitchen. The first rule of recessed-light placement is that cans must be positioned so that the beam angle will just miss the lower lip of the upper cabinets. If your light beam touches the front surface of the upper cabinets, it will cast an unfortunate shadow on the countertop worksurface below.

Plotting it on paper

To position cans correctly, find the beam angle of your lights, which is listed on the fixture, the manufacturer's website, the packaging, or the lamp itself. On your kitchen section drawing (a side view of the kitchen showing cabinets), use a protractor to plot the beam angle you want to use (40° is a good place to start, although you may find you need to adjust this later). Plot the beam's path relative to your upper cabinets, placing the first row of cans so that the beam angle just misses the front edge of the upper cabinet. To pinpoint the perpendicular placement of the next can along this first row, use the protractor again, this time on an elevation drawing (front view of the cabinets). Find a point 6 in. above the worksurface, and intersect the first beam angle with the second. Working backward, place the second can where that beam angle hits the ceiling. Using the protractor and beam-angle method, place the remainder of the cans.

Following this simple method will help you to avoid the most basic and most frequent mistakes I see in kitchen lighting.

Calculating the light requirements

Once you've created a layout based on beam angle, you still have some work to do. The next step is determining how strong the lamps in your cans need to be to illuminate the space properly. The Illuminating Engineering Society (IES) recommends a minimum of 30 footcandles (fc) for general ambient lighting in a kitchen. This means you'll want an even distribution of 30 fc at countertop height.

This is an adequate amount of light for most kitchens. In some situations, however, more lighting might be needed. For example, if occupants are age 55 or older, the base recommendation from IES jumps to 40 fc. Someone with very poor vision may need much more. Young folks with excellent eyesight may get along with less, but stick to 30 fc as a starting point.

A footcandle is based on the output of one standard candle, burning 1 ft. away from the surface it illuminates. The other measure I use in lighting calculations is candlepower, which represents the traveling power of light emitted from a lamp.

These two measurements are the basis for the formulas I use to figure out how much light is needed at point A (the fixture) to see clearly at point B (countertop height).

Adjusting to the situation

To complete our calculations, we have two more factors to take into account: room reflectance (how much of the lamp's light is absorbed or reflected) and ceiling height (the distance light has to travel to get to the countertop-height sweet spot).

A dark room absorbs light, requiring additional illumination. A kitchen finished with light colors requires less light. Because they become nonreflective black rectangles at night, windows increase lighting needs. Countertop materials factor into reflectance as well: Black-granite countertops may be beautiful, but they do not reflect much light.

To deal with these variables, IES recommends adjustment factors that can be applied to the base recommendation (30 fc) to ensure proper illumination. You can see an example on pp. 88-89 of how I would apply these adjustments to a typical kitchen.

After these adjustments are made, one last formula is needed to determine the amount of light required from your fixtures. That's because a lamp placed 18 in. from a surface delivers a lot more light than the same lamp located 8 ft. away. To calculate how much candle-

WHY NOT LUMENS?

A lumen represents how much light a lamp emits. Since the introduction of super-energy-efficient lighting, lumens have largely replaced watts as the go-to measurement for lamp intensity. As a result, it's the number you'll find on most lamp packaging (indoor lamps typically have light outputs ranging from 50 to 10,000 lumens). The number of lumens, however, does not take into account the intensity of the light at any one point in the beam. That is why professionals gauge the illumination power of focused lights (such as can lights) in candlepower rather than lumens.

power a lamp must produce to get the required illumination where it's needed, lighting designers use the inverse-square law. According to this rule, the candlepower (cp) of your fixture should be equal to the distance from the light source to the countertop area squared (D^2) and then multiplied by the footcandles required. The equation is written cp = D^2 x fc. The example at right demonstrates this formula for an 8-ft. ceiling.

Just a reminder: I've been measuring light needs at countertop height, but I'm focusing only on ambient light. For countertop tasks, you'll want to supplement this 30 fc of ambient light with another 40 fc or more of undercabinet lighting to reach the 70 fc recommended for worksurfaces.

Ceiling height makes a significant difference in the amount of illumination required to light a kitchen properly. If the ceiling height is just 2 ft. taller (10 ft.), you need almost twice as much illumination to deliver an adequate amount of light to that countertop sweet spot.

Candlepower (cp) *is a measure of light concentration in a light beam. The higher the candlepower, the more powerful the illumination is at that point. Also referred to as candela, mean candlepower, or center-beam candlepower (CBCP), this measurement is found on the same manufacturers' spec sheets where you'll find beam angle and other useful information.*

Now find your lights ... or maybe start over

After you've established the location of your cans and calculated the beam angle and candlepower, you need to select the right lamps. Invariably, after looking through manufacturers' catalogs and websites, or receiving help from a lighting consultant, you'll seek out the product that emits the requisite candlepower combined with the beam angle you used in your lighting layout, only to discover that this lamp or integrated fixture does not exist.

So it's back to the drawing board for some recalculation. For example, if you planned the spacing based on a wide beam spread and the ceilings are very high, you may not find a lamp that can deliver the required amount of light. You may need to lay out the cans again and add more fixtures, using a tighter beam angle. Remember, fixtures that have a smaller beam angle deliver a larger concentration of light. Or you may opt to use fixtures that hang from the ceiling, effectively lowering the level of your light source.

You also may discover that you cannot place those cans in the ideal location because of a stray joist or other obstruction that sits in the middle of your perfect layout. I encountered this problem in my own kitchen. To provide the right amount of light on my counters, I sacrificed the amount of light at the center of the room. If a kitchen does not include an island, this is a good place for less light. I made the necessary adjustments in can placement to accommodate my joists, favoring worksurfaces and de-emphasizing perfect light in the center of the room. These kinds of adjustments are always a judgment call. Use logic and common sense, and you'll like the results. □

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LIGHTING BY THE NUMBERS

Getting ambient light right requires calculations based on real-world conditions. To demonstrate, let's look at the kitchen pictured on pp. 84-85. This kitchen has an 8-ft. ceiling, and a floor and cabinets in midtone woods. The ceiling is white, and one wall is dark green. We'll assume the occupant is 58 years old. Here's how to calculate the ambient lighting needed for that room.

1 Plan for cans

With a protractor, mark your chosen beam angle on a section drawing so that the beams from the first row of cans miss the cabinets and intersect just above countertop height. To place adjacent cans, repeat the process on an elevation or plan view, maintaining the same overlap. (See drawings, facing page.)

2 Calculate overall ambient-light needs

Adjust ambient-light needs based on occupant age and room reflectance. IES adjustments are shown in charts 1 and 2, at right.

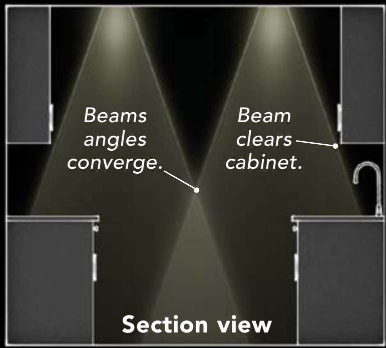
30 fc .... Start with IES-recommended level of 30 fc.

30 fc x 1.33 = 39.9 fc ...... Multiply by age factor of 1.33 because the homeowner is 58 years old (see chart 1).

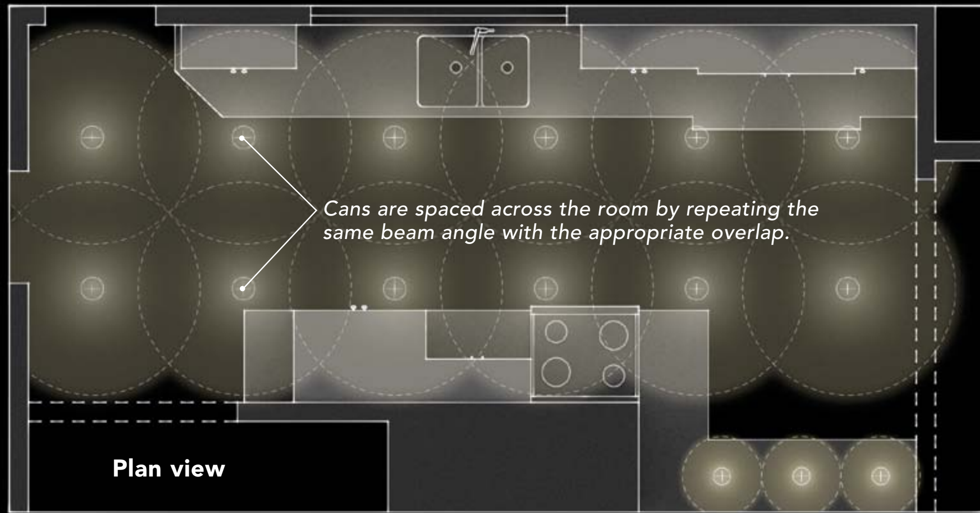
39.9 fc x 1 = 39.9 fc .... Multiply by room reflectance factor of 1 because the wall, ceiling, and floor colors are of medium colorations (see charts 1 and 2).

39.9 fc x 1.33 = 53.07 fc .... Multiply by countertop background factor of 1.33 because the countertops are dark (see chart 1).

Total footcandles required: 53.07. We can round to 53 before proceeding to the next step.



A section view (above) allows you to correctly position the cans relative to the cabinets. An elevation (frontal) view or a plan view (right) then can be used to space cans in each row for full illumination.



3 Calculate required candlepower

Based on the footcandle requirements established in step 2, we now factor in the ceiling height to arrive at the candlepower required for each fixture.

cp = D² x fc......................Start with the inverse-square law.

cp = 25 x 53 ....The room has 8-ft. ceilings, so the worksurface is 5 ft. away; 5 x 5 = 25. We know the required fc is 53 from our calculations in step 2.

cp = 1325........................Each recessed can must provide a candlepower of at least 1325 to illuminate the room adequately.

4 Find fixtures

Match candlepower needs to a lamp or fixture with the right beam spread and candlepower. This information can be found on the manufacturers' spec sheets, websites, and catalogs. A little more candlepower is better than not enough.

For more calculations, check out *Kitchen and Bath Lighting Made Easy* by Michael DeLuca (National Kitchen & Bath Association, 2001).

CHART 1

Adjustment factors for footcandle levels

Adjustment factor	0.66	1.0	1.33
Age	Under 40	40-55	Over 55
Average room reflectance (ceiling, walls, and floor)	Light (over 70%)	Medium (30%-70%)	Dark (under 30%)
Task background reflectance (countertop color)	Light (over 70%)	Medium (30%-70%)	Dark (under 30%)

CHART 2

Calculating room reflectance*

Wall or ceiling colors	Reflectance (%)
White, light cream	70-80
Light yellow	55-65
Light green, pink	45-50
Light blue, light gray	40-45
Beige, ocher, light brown, olive green	25-35
Orange, vermilion, medium gray	20-25
Dark colors (green, blue, red, gray)	10-15
Materials	**Reflectance (%)**
White plaster	80
White tile	65-75
Limestone	35-70
Marble	30-70
Sandstone	20-40
Granite	20-25
Gray concrete	15-40
Brick	10-20
Carbon/black	2-10
Mirror	95
Clear glass	6-8
Maple	60
Birch	35-50
Oak (light)	25-35
Cherry	15-30
Oak (dark)	10-15
Mahogany	6-12
Walnut	5-10
Tin	67-72
Stainless	50-60
Aluminum	55-58

*If unknown, assume medium (30%-70%).