The form XObject specified by the **O** entry is subject to the following restrictions; failure to abide by them could result in misalignment of the overlay with the rendered 3D graphics:

- The form XObject is associated with a specific view (not with the camera position defined by the 3D view dictionary). It should only be drawn when the user navigates using the 3D view, not when the user happens to navigate to the same orientation by manual means.
- It should only be drawn if the artwork-to-world matrix has not been altered.
- It may only be specified in 3D view dictionaries in which both a camera-to-world matrix (**MS** and associated entries) and a projection dictionary (the **P** entry) are present.

The **CO** entry specifies the distance from the camera to the *center of orbit* for the 3D view, which is the point around which the camera should rotate when performing an orbit-style navigation. Figure 9.4 illustrates camera positioning when orbiting around the center of orbit.

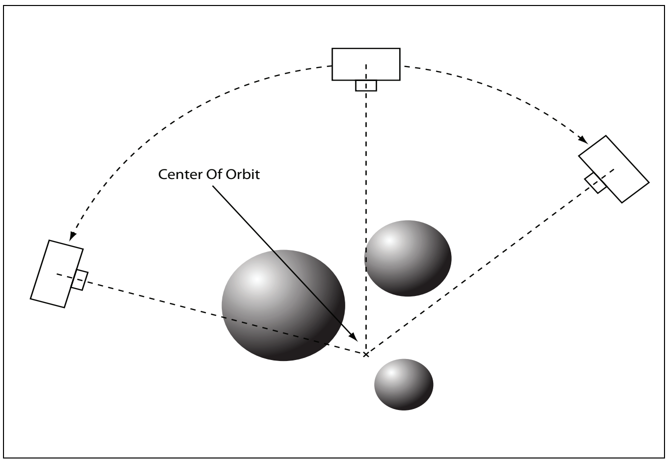


FIGURE 9.4 *RID 2otation around the center of orbit*

The **LS** entry allws the lghting of the 3D artwork to be changed without chang -
ing the artwork itself. This enables consumers to view a given piece of 3D artwork with a variety of lighting options without requiring multiple copies of the 3D artworkID 2 stream that differ only in lighting. It also enables artwork with poor lighting

far planes[redacted]spectively. A value of **ANF** for **CS** means that the near and far planes are deter[redacted]ed automatically based on the objects in the artwork.

The **Subty**[redacted] entry specifies the type of projection, which determines how objects are projec[redacted] onto the near plane and scaled. The possible values are **O** for *ortho-graphic pr*[redacted]*tion* and **P** for *perspective projection*.

For ortho[redacted]phic projection, objects are projected onto the near plane by simply discarding[redacted]eir *z* value. They are scaled from units of the near plane's coordinate system to [redacted]se of the annotation's target coordinate system by the combined factors specif[redacted] by the **OS** entry and the **OB** entry.

For perspe[redacted]e projection, a given coord[redacted]nate (x, y, z) is projected onto the near plane, defi[redacted]g a 2D coordinate (x_1, y_1) u[redacted]ing the following formulas:

$$x_1 = x \times \frac{n}{z}$$ [redacted]

$$y_1 = y \times \frac{n}{z}$$ [redacted]

where n is [redacted] z coordinate of the near plane.

Scaling wi[redacted]erspective projection is more complicated than for orthographic projection.[redacted]e **FOV** entry specifies an angle that defines a cone centered along the z axis i[redacted]e camera coordinate system (see Figure 9.5). The cone intersects with the ne[redacted]plane, forming a circular area on the near plane. Figure 9.6 shows this circle a[redacted]graphics from the position of the camera.

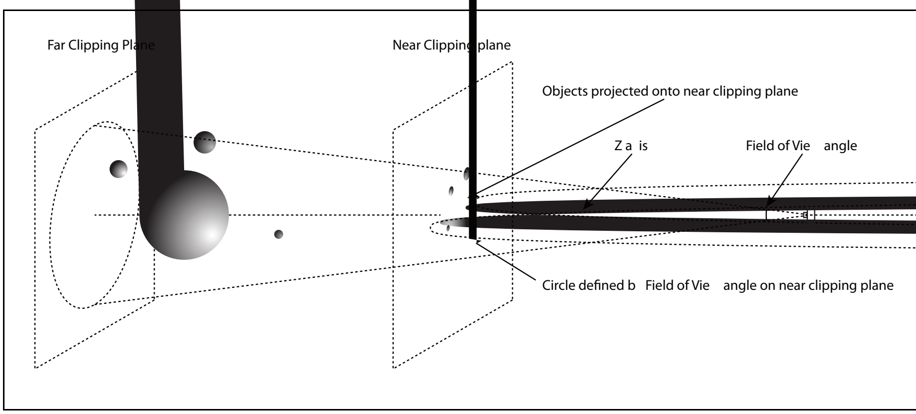


FIGURE 9.5 *Perspective projection of 3D artwork onto the near plane*

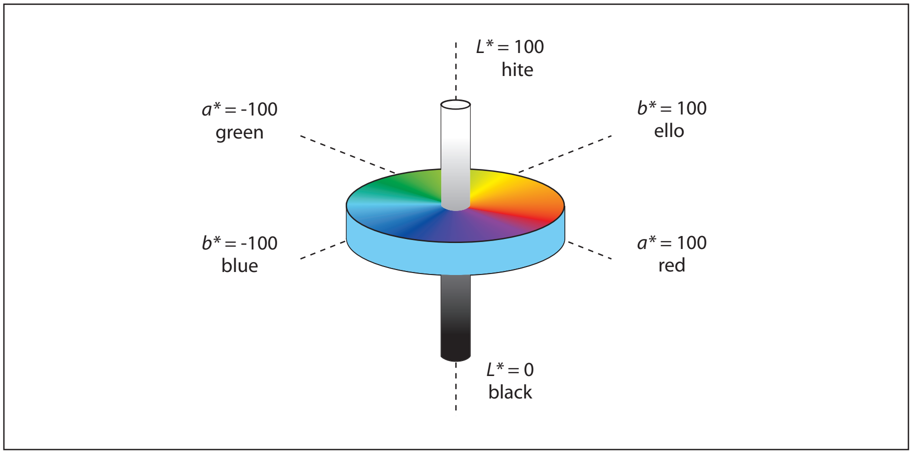


PLATE 3 ***Lab*** *color space ("Lab Color Spaces," page 250)*

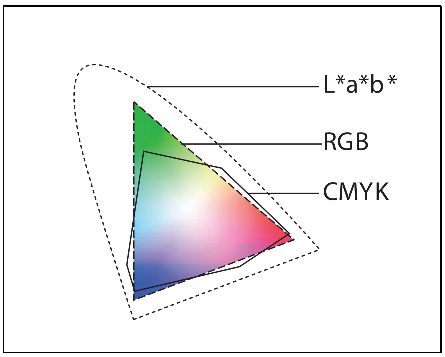


PLATE 4 *Color gamuts ("Lab Color Spaces," page 250)*

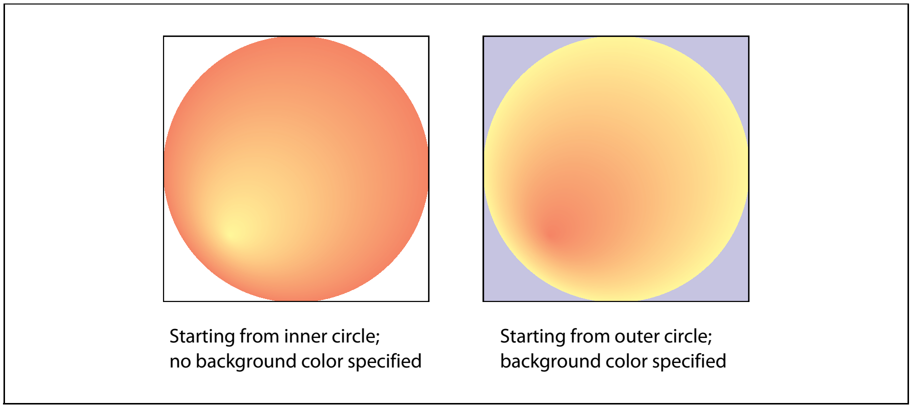


PLATE 12 *Radial shadings depicting a sphere (“Type 3 (Radial) Shadings,” page 313)*

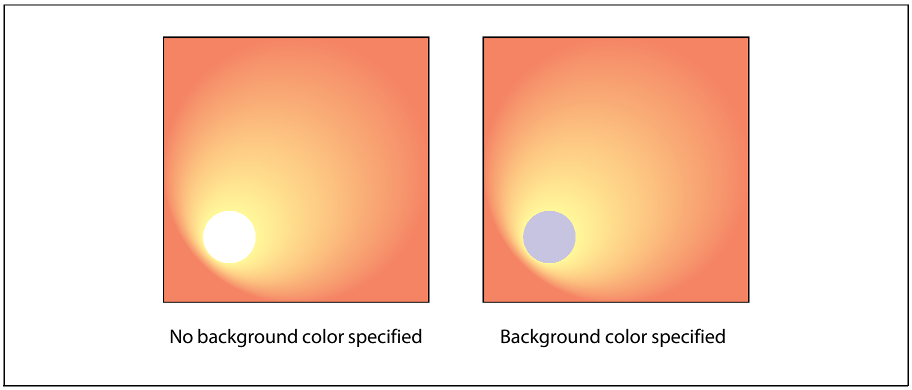


PLATE 13 *Radial shadings with extension (“Type 3 (Radial) Shadings,” page 313)*

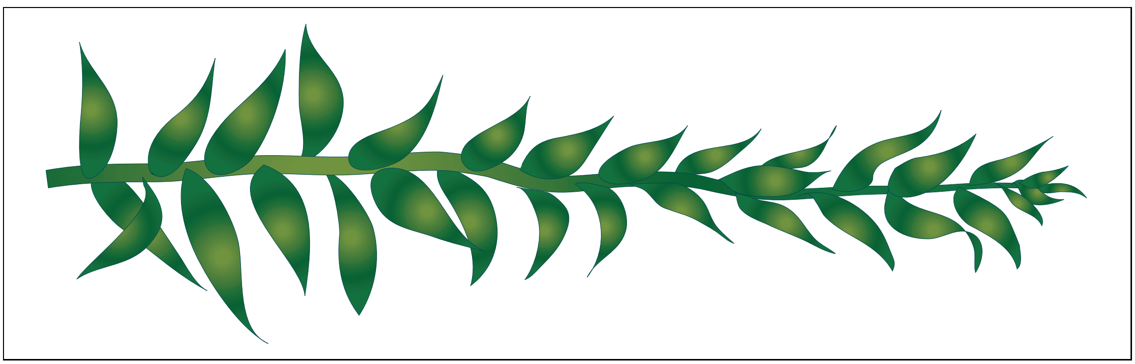
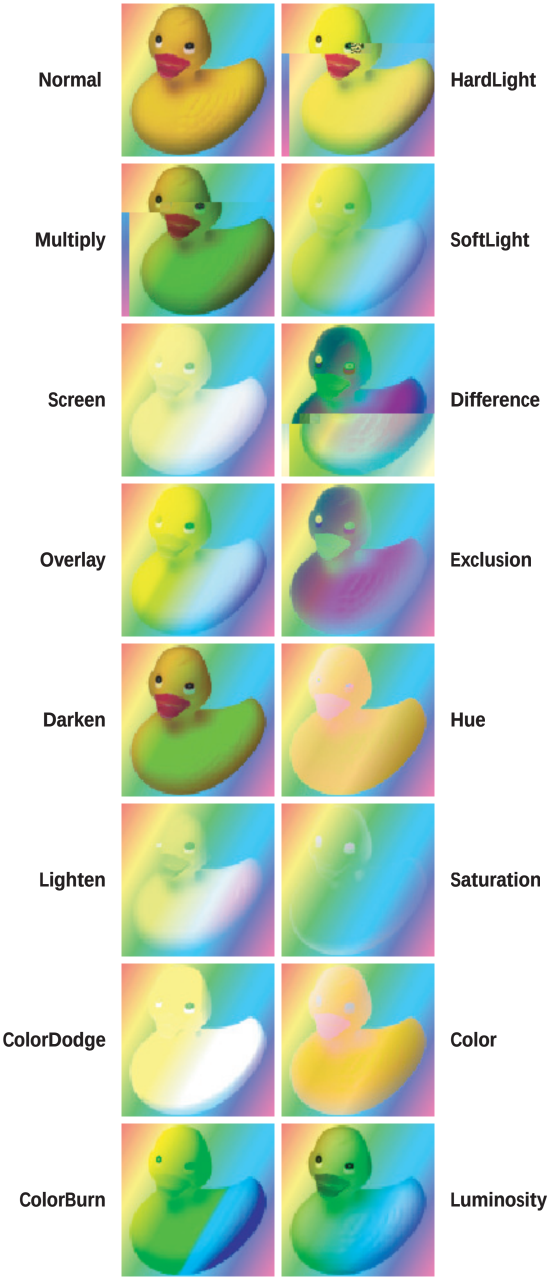


PLATE 14 *Radial shading effect (“Type 3 (Radial) Shadings,” page 313)*



Duck in foreground, rainbow in background

Rainbow in foreground, duck in background