

## Semper 6 Command Reference

### solid

<b>keys:</b>	<b>[from]</b>	<i>&lt;number&gt;</i>	source picture
	<b>[to]</b>	<i>&lt;number&gt;</i>	output picture
	<b>threshold/with</b>	<i>&lt;number&gt;</i>	single threshold level applicable to all layers, or 1-D picture containing independent thresholds for each layer in turn
	<b>theta</b>	<i>&lt;number&gt;</i>	first rotation applied to object before viewing, anti-clockwise about the positive z axis
	<b>psi</b>	<i>&lt;number&gt;</i>	second rotation applied to object before viewing, anti-clockwise about the new positive x axis
	<b>size</b>	<i>&lt;x&gt;, &lt;y&gt;</i>	output picture dimensions
	<b>times</b>	<i>&lt;number&gt;</i>	magnification factor for output
	<b>value</b>	<i>&lt;number&gt;</i>	background value for use outside view of object
	<b>ltheta</b>	<i>&lt;number&gt;</i>	angle between main light source direction and viewing direction, in radians
	<b>lphi</b>	<i>&lt;number&gt;</i>	azimuth of main light source direction, anti-clockwise from positive x axis, in radians
	<b>main</b>	<i>&lt;number&gt;</i>	brightness of main light source
	<b>forward</b>	<i>&lt;number&gt;</i>	brightness of subsidiary (forward) light source
	<b>ambient</b>	<i>&lt;number&gt;</i>	brightness of non-directional ambient lighting
	<b>dcontrast</b>	<i>&lt;number&gt;</i>	depth contrast, brightness difference between front and rear of object
	<b>sdr</b>	<i>&lt;number&gt;</i>	ratio of specular diffuse reflection, describing surface polish

Use **solid** to generate a shaded image of a 3-D solid object, defined by thresholding a density distribution tabulated in a multi-layer 3-D picture. **solid** allows you to vary the viewing orientation, output image size etc.

### Examples

```
gaussian 1 size 40,40,40; min=0 max=255; solid threshold .02
```

This command generates a shaded image on the display of a sphere truncated at the edges of a cube.

### solid

```
solid 1 to 5 theta pi/3 psi -pi/6 threshold .03
```

This command generates an image of the object differently oriented in picture 5. The image is rotated by 60 degrees clockwise in-plane, then tilted 30 degrees with the top towards you.

```
solid size 300,200 times 3
```

This command generates an image magnified by three, in an output picture of the specified size.

```
solid 1 with 37
```

This command generates an image of the object with independent thresholds for each layer, as given in the pixels of the 1-D picture 37.

#### Description

The **solid** commands allows you to specify keys that affect the following:

- the 3-D object (**threshold**, **with**)
- orientation of the object (**theta**, **psi**)
- 2-D output picture (**times**, **size**, **value**)
- illumination (**ltheta**, **lphi**, **main**, **forward**, **ambient**, **dcontrast**, **sdr**)

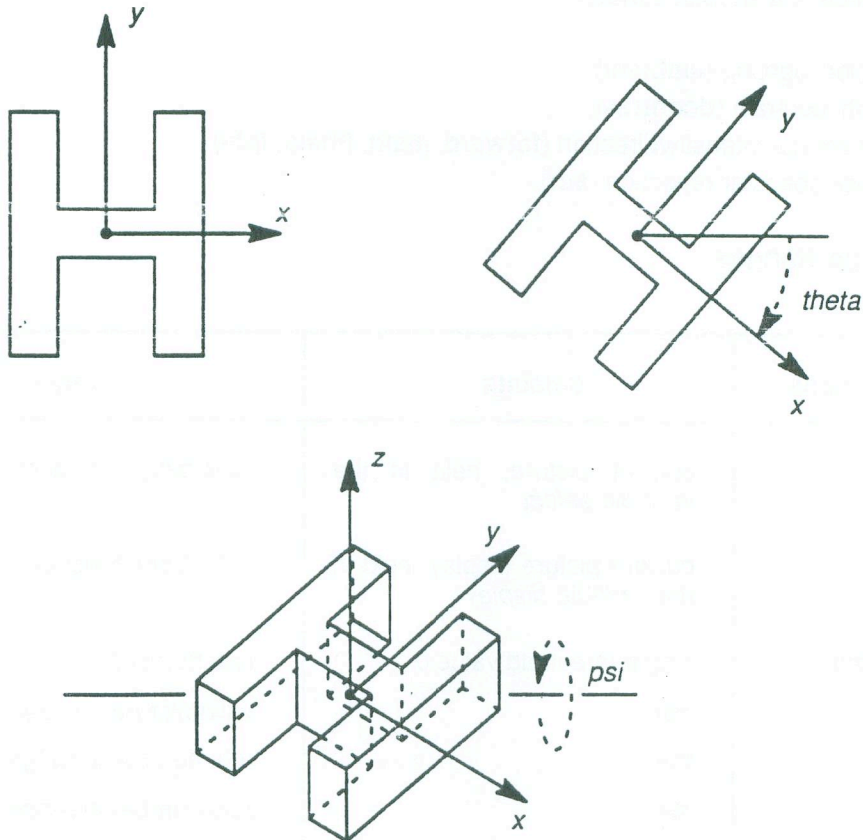
The object, for which **solid** will generate a shaded image, is defined by thresholding the pixels in the source picture. The source picture should be a multi-layer picture with its data describing a 3-D density distribution. All pixels with values greater than or equal to the threshold value (specified with the **threshold** key) are treated as part of a solid object and all the remaining pixels are treated as being transparent.

You can also give different thresholds for each layer of the 3-D picture using the **with** key. The **with** key specifies a 1-D picture whose pixels (from left to right) are the threshold levels to be applied to the various layers (from back to front). This is useful, for example, in viewing the 3-D reconstruction of a 2-D crystal.

When a 2-D image is displayed the viewing direction is along the negative  $z$  axis, with the  $x$  axis to the right and the  $y$  axis pointing upwards. With the keys **theta** and **psi** you can alter the orientation of the object to be viewed, away from the standard 2-D orientation. The object is rotated first by angle **theta** clockwise about the  $z$  axis and then by angle **psi** anti-clockwise about the new positive  $x$  axis (with the top away from you). The default value for both **theta** and **psi** is  $\pi/4$ .

**solid**

The diagram below illustrates the effect of **theta** and **psi**.



Use the **times** key to increase or decrease the size of the output picture. The **times** key takes fractional as well as well as integral values, for example **sheet..times .75** or **sheet..times 1.5**. By default, the output picture is created large enough to accommodate the 3-D box enclosing the object, in the orientation you select.

If you want to force the size of the output picture, for example, to stop the size changing with the orientation, use the **size** key to specify the dimensions. If necessary, **solid** truncates the shaded image to fit the specified **size**. Note that the default values for the illumination keys ensure that the output pixel values lie in the range 0–255 allowed for *Byte* pictures, and *Byte* is accordingly the default output form. The object is normally presented on a background of zero (dark) pixels, but you can change the background value using the **value** key.

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A full description of the lighting parameters **ltheta**, **lphi**, **ambient**, **dcontrast**, **forward**, **main** and **sdr** is to be found in *Appendix H, Illumination*. With these you can determine the following aspects of the appearance of a shaded surface:

- ambient lighting (**ambient**)
- depth contrast (**dcontrast**)
- light source intensity/direction (**forward**, **main**, **ltheta**, **lphi**)
- diffuse/specular reflection (**sdr**)

#### Defaults and Ranges

keys/options	defaults	range
<b>[from]</b>	current picture, held in the variable <i>select</i>	valid picture number
<b>[to]</b>	current picture display, held in the variable <i>display</i>	valid picture display number
<b>threshold</b>	single threshold value 0	real number
<b>with</b>	<i>none</i>	valid picture number
<b>theta</b>	$\pi/4$	real number in range 0 to $2\pi$
<b>psi</b>	$\pi/4$	real number in range 0 to $2\pi$
<b>size</b>	depends on source picture size, height range, and viewing direction	positive integers
<b>times</b>	1	positive real number
<b>value</b>	0	real number
<b>ltheta</b>	$\pi/4$	real number in range 0 to $2\pi$
<b>lphi</b>	0	real number in range 0 to $2\pi$
<b>main</b>	154	positive real number
<b>forward</b>	42	positive real number
<b>ambient</b>	40	positive real number
<b>dcontrast</b>	30	real number
<b>sdr</b>	0.4	positive real number