

# PELCO® Silicon Nitride Support Films for TEM

## Product Overview and Manufacturing Details

### Manufacturing Method

PELCO® Silicon Nitride Support Films are manufactured using the latest, patented, state-of-the-art semiconductor and MEMS manufacturing techniques. The thin amorphous silicon nitride film is grown on a 200µm thick silicon wafer to the desired membrane thickness of 8, 15, 35, 50, or 200nm. The specimen viewing area is created by etching away a window in the silicon wafer substrate underneath the Si<sub>3</sub>N<sub>4</sub> membrane, leaving a perfectly smooth, resilient and chemically robust silicon nitride film. The membrane is not supported in the window area, enabling large viewing areas without any disturbing bars. After finishing the window etching process, the individual frames with the membranes are lifted from the wafer. Wafers used are P-type (B doped) with a resistivity of 2-15 ohm-cm.

### Window sizes and shape:

#### Five single window sizes are available:

- 0.25 x 0.25mm, most robust membrane and most cost effective
- 0.5 x 0.5mm, sturdy and cost effective
- 0.75 x 0.75mm, less fragile, relatively large membrane
- 1 x 1mm, larger area, but more fragile
- 1.5 x 0.5mm, resilient for large viewing area or tomography

#### Two multiple window sizes are available:

- 2 each 0.1 x 1.5mm, rectangular window
- 3 x 3 array of 0.1 x 0.1mm window

#### Window with apertures for 8 and 35nm:

- 200nm silicon nitride support mesh
- 25 ea. 60 x 60µm apertures with 8nm membrane; 25 ea. 70 x 70µm apertures with 35nm membrane
- Total window size 0.5 x 0.5mm

Due to the structure of the silicon and the etching process the window in the silicon substrate is etched with a 35° angle, leaving a much larger opening than the membrane window at the back side of the frame:

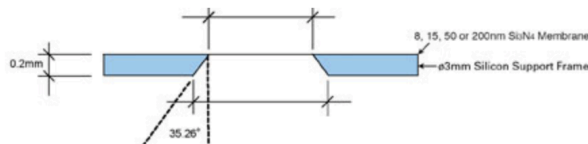


Table 1. Window dimensions on standard 200µm frame thickness

| X dimensions (mm) | Y dimensions (mm) | Area (mm <sup>2</sup> ) | Frame thickness (µm) | Membrane thickness (nm) | X Back side opening (mm) | Y Back side opening (mm) |
|-------------------|-------------------|-------------------------|----------------------|-------------------------|--------------------------|--------------------------|
| 0.25              | 0.25              | 0.06                    | 200                  | 15/50/200               | 0.53                     | 0.53                     |
| 0.5               | 0.5               | 0.25                    | 200                  | 50/200                  | 0.78                     | 0.78                     |
| 0.75              | 0.75              | 0.56                    | 200                  | 50/200                  | 1.03                     | 1.03                     |
| 1                 | 1                 | 1                       | 200                  | 50/200                  | 1.28                     | 1.28                     |
| 1.5               | 0.5               | 0.75                    | 200                  | 50/200                  | 1.78                     | 0.78                     |
| 1.5               | 0.1               | 2 x 0.15                | 200                  | 15/50/200               | 1.78                     | 0.38                     |
| 0.1               | 0.1               | 9 x 0.01                | 200                  | 15/50/200               | 0.38                     | 0.38                     |
| 0.5               | 0.5               | 0.09 for 8nm            | 200                  | 8                       | 0.78                     | 0.78                     |
| 0.5               | 0.5               | 0.12 for 35nm           | 200                  | 35                      | 0.78                     | 0.78                     |

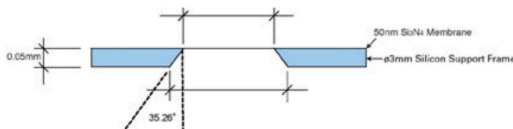


Table 2. Window dimensions on special 50µm thin frame version

| X dimensions (mm) | Y dimensions (mm) | Area (mm <sup>2</sup> ) | Frame thickness (µm) | Membrane thickness (nm) | X Back side opening (mm) | Y Back side opening (mm) |
|-------------------|-------------------|-------------------------|----------------------|-------------------------|--------------------------|--------------------------|
| 0.25              | 0.25              | 0.06                    | 50                   | 50                      | 0.32                     | 0.32                     |
| 1.5               | 0.1               | 2 x 0.15                | 50                   | 50                      | 1.57                     | 0.17                     |
| 0.1               | 0.1               | 9 x 0.01                | 50                   | 50                      | 0.17                     | 0.17                     |

## Frame dimensions

The frame is manufactured as a 3mm silicon disc with smooth EasyGrip™ edges for easy manipulation by tweezers and will fit perfectly in standard TEM holders. The standard frame thickness of 200µm is more than the typical TEM grid with a thickness of 15-50µm, but should not present a problem in regular TEM holders. It is recommended that you check the TEM holders you are using. For special TEM holder, versions with 50µm frame thickness are available. 50µm frame thickness is compatible with any Ø3mm TEM holder.

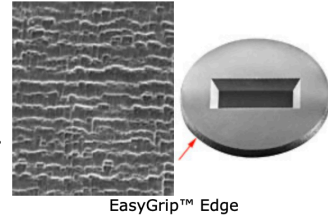


Table 3. Manufacturing Tolerances

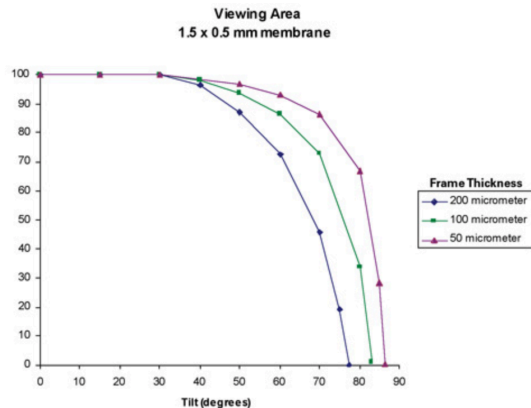
| Manufacturing Tolerances |  |
|--------------------------|--|
| Frame Thickness:         | 200µm ±15µm<br>50µm ±10µm  |
| Membrane Thickness:      | 200nm ±10nm<br>50nm ±5nm<br>35nm ±4nm<br>15nm ±3nm<br>8nm ±2nm   |
| Frame Diameter:          | 3.0mm ±0.05mm  |
| Window Dimensions:       | 0.1 x 0.1mm (9) - 100µm ±5µm<br>0.25 x 0.25mm - 250µm ±10µm<br>0.5 x 0.5mm - 500µm ±20µm<br>0.75 x 0.75mm - 750µm ±25µm<br>1.0 x 1.0mm - 1000µm ±30µm<br>0.1 x 1.5mm (2) - 100µm ±5µm & 1500µm ±40µm<br>0.5 x 1.5mm (2) - 500µm ±20µm & 1500µm ±40µm |
| Hydrophilic Coatings:    | 2.5nm ±0.25nm  |
| Hydrophobic Coatings:    | 2.5nm ±0.25nm  |

## Debris Free Products

Handling capabilities and smoothness of the edges are design advantages over other brands of silicon nitride support films. The PELCO® Silicon Nitride Support Films are manufactured like TEM grids with a 3mm diameter using a unique and patented manufacturing process. They have no broken edges are circular and are completely free from debris particles unlike other brands of silicon nitride membranes. The mechanical and chemical stability allow for cleaning or treating of the silicon nitride support films with chemicals (solvents, acids and bases), glow discharge and plasma cleaning. It is recommended that ultrasonic cleaning is not be used, as it can easily shatter the silicon nitride support films.

## Effects On Tilt

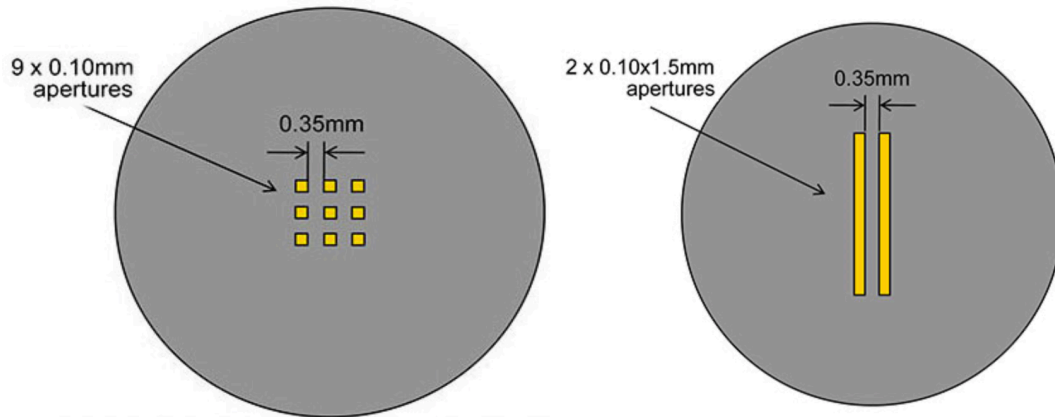
Due to the 35° etching angle the PELCO® Si<sub>3</sub>N<sub>4</sub> support films on the frames can be tilted to 35° for unobstructed viewing, even if the specimen is close to the edge of the membrane. For higher tilting angles, the specimen needs to be in the center of the membrane. To allow for the highest possible tilt angle a window size of 1.5 x 0.5mm has been made available, which allows for tilting angles up to 70° with a viewable area of 40%. Maximum tilt angle with a specimen in the center, maximum tilt angle is 75°.



### Versions with multiple windows:

- 2 each 0.1 x 1.5mm windows
- 3 x 3 array of 0.1 x 0.1mm windows

This style is made using the same manufacturing techniques as the single window style  $\text{Si}_3\text{N}_4$  membranes. The 200 $\mu\text{m}$  frame is available with 50 and 15nm membrane thickness. The 50 $\mu\text{m}$  frame is available with the 50nm membrane thickness.

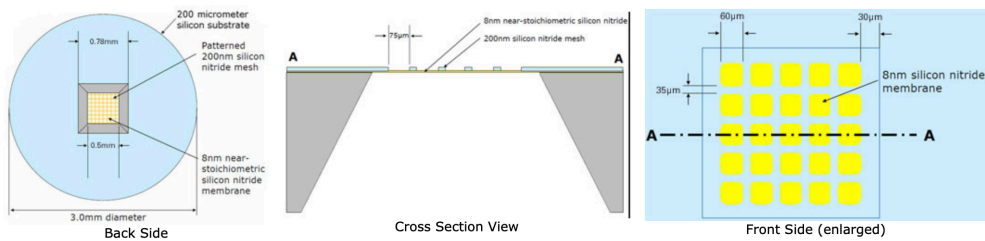


Available for 200 and 50 $\mu\text{m}$  substrates with 50 or 15nm silicon nitride membrane thickness.

### 8 and 35nm Membrane Versions

The structure-free 8 and 35nm ultra-thin films are supported by a 200nm mesh, creating 25 apertures.

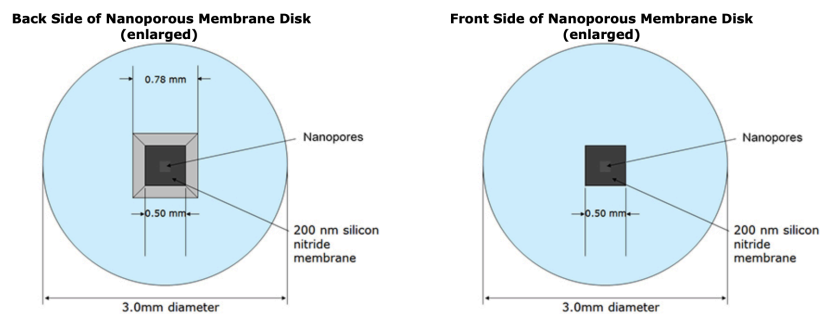
- 8nm  $\text{Si}_3\text{N}_4$  membrane: 60 x 60 $\mu\text{m}$  apertures, 35 $\mu\text{m}$  bar width, 30 $\mu\text{m}$  edge
- 35nm  $\text{Si}_3\text{N}_4$  membrane: 70 x 70 $\mu\text{m}$  apertures, 25 $\mu\text{m}$  bar width, 25 $\mu\text{m}$  edge



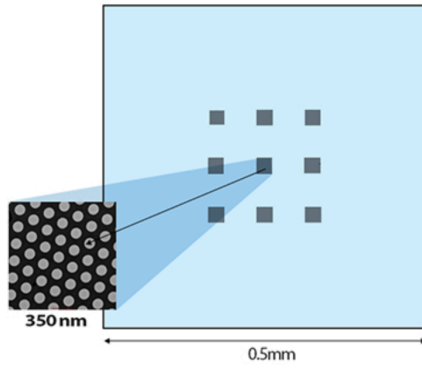
- 8 or 35nm silicon nitride membrane with 25 apertures
- 200nm silicon nitride support mesh
- 200 $\mu\text{m}$  silicon substrate
- Low stress ultra-thin membranes, close to stoichiometric composition ( $\text{Si}_3\text{N}_4$ )

### Nanoporous $\text{Si}_3\text{N}_4$ Membrane

All the Nanoporous  $\text{Si}_3\text{N}_4$  membranes are made using the 200nm membrane with a 0.5 x 0.5mm window.



**Front Side window of Multiple Sized Nanoporous  
(enlarged)**



**Front Side window of Single Size Nanoporous  
(enlarged)**

