```
kappa = Y delta^3 / (12 (1 - nu^2)) (* bending modulus per Lobkovsky thesis *)
(* Y=  young's modulus of Mylar per page 33 notebook 118*)
(* delta = thickness of the mylar sheet *)
(* nu =poisson's ratio of mylar per web page mentioned in book 118 p.. 33*)
```

$$\frac{\text{delta}^3\, Y}{12\,(1-\text{nu}^2)}$$

```
(* X = size of facet or tetrahedron *)
(* We will assume the crumpled sheet
  is filled with regular tetrahedra of edge size X *)
vtet = 2^.5 / 12 X^3 (* volume of tetrahedron, per some web page I found *)
phitet = (4 delta (1 / 2) (Sqrt[3] X / 2) X) / vtet
lambda = Sqrt[kappa / (Y delta)] / X (* reduced thickness from Alex thesis eq 2.27 *)
alpha = (Pi - ArcCos[1 / 3]) / 2
(* volume fraction of tetrahedron.  Numerator is volume of the four faces. *)
Etet = 6 * 1.16 * kappa * (lambda)^(-1 / 3) * (alpha)^(7 / 3)
(* Etet =
  4*1.16 * kappa * (Sqrt[kappa/(Y delta)]/X)^(-1/3) *(1.23)^(7/3)  old version*)
 (* energy of a tetrahedron per Lobkovsky thesis page 47
  This is 4 times the ridge energy reported there.  *)
V = Pi * (diam / 2)^2 * h
Energy = Etet V / vtet
weight = .1 * 9.8 joule / meter (* weight added *)
```

$$0.117851\,X^3$$

$$\frac{14.6969\,\text{delta}}{X}$$

$$\frac{\sqrt{\frac{\text{delta}^2}{1-\text{nu}^2}}}{2\sqrt{3}\,X}$$

$$\frac{1}{2}\left(\pi - \text{ArcCos}\left[\frac{1}{3}\right]\right)$$

$$\frac{0.98\,\text{joule}}{\text{meter}}$$

```
delta = 12.5 * 10^(-6) meter (* delta = thickness of the mylar sheet *)
L = .34 meter(* diameter of the mylar sheet *)
diam = .102 meter(* diameter of the cylinder*)
Y = (700000*9.8/2.2)/.0254^2 joule /meter^3
(* Y=  young's modulus of Mylar per page 33 notebook 118*)
nu = .38 (* nu =poisson's ratio of mylar per web page mentioned in book 118 p.. 33*)
```

0.0000125 meter

0.34 meter

0.102 meter

$$\frac{4.83319\times 10^9\ \text{joule}}{\text{meter}^3}$$

0.38

```
phi = (L/diam)^2 delta/h
```

$$\frac{0.000138889\ \text{meter}}{\text{h}}$$

```
spacefillingrule = Solve[phitet == phi, X]
```

{{X → 1.32272 h}}

```
eofh = Energy /. spacefillingrule
```

$$\left\{\frac{0.0000120164\ \text{joule}\ \text{meter}^2}{\text{h}^2\left(\frac{\sqrt{\text{meter}^2}}{\text{h}}\right)^{1/3}}\right\}$$

```
hh = h /. Last[Solve[mg == 5/3*eofh[[1]]/h, h]]
```

$$\frac{0.0173025\ \text{joule}^{3/8}\sqrt{\text{meter}}\ (\text{meter}^2)^{1/16}}{\text{mg}^{3/8}}$$

```
hh /. mg → weight
```

$$\frac{0.0174341\ \text{joule}^{3/8}\sqrt{\text{meter}}\ (\text{meter}^2)^{1/16}}{\left(\frac{\text{joule}}{\text{meter}}\right)^{3/8}}$$

```
PowerExpand[%]
```

0.0174341 meter