

# ***Cell Geometry Measurement Summary***

*Yawei Zhang*

## ***- Diameter measurement for the Cells:***

The diameter's measurements were done by taking five consecutive measurements in each point's zone, and the final diameter's value was averaged over them. However, the extraction of the water cell's diameter was done by taking only one measurement in different points along the cell.

Water Cell: Aqua										
Points	A	B	C	D	E	F	G	H	I	J
Diam. (mm)	18.62	18.77	19	18.95	19.66	18.62	18.77	19	18.95	19.66
Average Diameter: $19 \pm 0.38$ mm										

Reference Cell: GMB2(Target Chamber Diameter)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
A	19.20	19.10	19.08	19.18	19.13
B	19.13	19.18	19.15	19.18	19.20
C	19.22	19.22	19.20	19.08	19.15
D	19.18	19.13	19.08	19.13	19.10
E	19.41	19.43	19.43	19.43	19.48
Average Diameter: $19.21 \pm 0.12$ mm					

3He Cell: Dominic(Target Chamber Diameter)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
A	19.08	19.02	19.02	19.02	18.95
B	18.62	18.67	18.67	18.69	18.72
C	18.77	18.80	18.82	18.82	18.87
D	18.92	19.00	19.10	19.08	19.13
E	18.87	18.85	18.77	18.59	18.62
Average Diameter: $18.86 \pm 0.17$ mm					

3He Cell: Dominic(Geometry)				
Item	Hight (mm)	Top Width (mm)	Bottom Width (mm)	Length (mm)
Pull Off	31.75h/38.10v	8.28	13.72	
Pumping Chamber	76.73	76.81		
Transfer Tube	88.90	12.27		
Target Chamber				398.78

3He Cell: Dominic(Pumping Chamber Wall Thickness)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
Thickness	3.175	2.963	3.197	3.352	2.873
Points	M6 (mm)	M7 (mm)	M8 (mm)	M9 (mm)	M10 (mm)

Thickness	3.072	2.957	3.385	3.364	3.210
Average Wall Thickness: $3.16 \pm 0.18$ mm					

3He Cell: Dominic(Transfer Tube Wall Thickness)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
Thickness	1.604	1.527	1.965	1.314	1.732
Points	M6 (mm)	M7 (mm)	M8 (mm)		
Thickness	1.782	2.143	1.991		
Average Wall Thickness: $1.76 \pm 0.27$ mm					

3He Cell: Dominic(Target Chamber Wall Thickness)					
Points	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
Thickness	1.691	1.702	1.716	1.691	1.656
Points	F (mm)	G (mm)	H (mm)	I (mm)	J (mm)
Thickness	1.598	1.710	1.695	1.662	1.654
Average Wall Thickness: $1.68 \pm 0.04$ mm					

Dominic cell has the pull off divided to 2 parts: horizontal and vertical. So I measured the length of both parts.

3He Cell: Moss(Target Chamber Diameter)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
A	18.67	18.75	18.72	18.69	18.67
B	18.67	18.77	18.72	18.69	18.72
C	18.69	18.75	18.75	18.75	18.77
D	18.80	18.80	18.80	18.82	18.85
E	18.80	18.77	18.82	18.80	18.77
Average Diameter: 18.75 ± 0.05 mm					

3He Cell: Moss(Geometry)				
Item	Hight (mm)	Top Width (mm)	Bottom Width (mm)	Length (mm)
Pull Off	38.10	7.32	14.43	
Pumping Chamber	76.73	76.56		
Transfer Tube	93.98	12.47		
Target Chamber				398.78

3He Cell: Moss (Pumping Chamber Wall Thickness)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
Thickness	2.315	2.708	2.521	2.343	2.852

Points	M6 (mm)	M7 (mm)	M8 (mm)	M9 (mm)	M10 (mm)
Thickness	2.361	2.813	2.536	2.862	3.062
Average Wall Thickness: $2.64 \pm 0.26$ mm					

3He Cell: Moss (Transfer Tube Wall Thickness)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
Thickness	1.390	1.362	1.320	1.652	1.621
Points	M6 (mm)				
Thickness	1.573				
Average Wall Thickness: $1.49 \pm 0.15$ mm					

3He Cell: Moss(Target Chamber Wall Thickness)					
Points	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
Thickness	1.607	1.606	1.625	1.601	1.698
Points	F (mm)	G (mm)	H (mm)	I (mm)	J (mm)
Thickness	1.678	1.633	1.651	1.596	1.679
Average Wall Thickness: $1.64 \pm 0.04$ mm					

<sup>3</sup> He Cell: Samantha					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
A	19.25	19.2	19.15	19.18	19.23
B	19.05	18.8	18.72	18.8	18.72
C	18.77	18.67	18.7	18.67	18.67
D	18.75	18.67	18.72	18.67	18.72
E	18.8	19	19.13	19.13	19.05
Average Diameter is: 18.95 ± 0.537 mm					

3He Cell: Samantha(Geometry)				
Item	Hight (mm)	Top Width (mm)	Bottom Width (mm)	Length (mm)
Pull Off	36.83	5.99	13.28	
Pumping Chamber	78.31	76.2		
Transfer Tube	93.98	12.75		
Target Chamber				398.78

3He Cell: Samantha (Pumping Chamber Wall Thickness)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
Thickness	2.757	2.674	3.005	3.023	3.152
Points	M6 (mm)	M7 (mm)	M8 (mm)	M9 (mm)	M10 (mm)
Thickness	2.854	2.647	2.723	2.854	3.098
Average Wall Thickness: 2.88 ± 0.18 mm					

3He Cell: Samantha (Transfer Tube Wall Thickness)					
Points	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)	M5 (mm)
Thickness	1.353	1.227	1.462	1.727	1.676
Points	M6 (mm)				
Thickness	1.554				
Average Wall Thickness: $1.50 \pm 0.19$ mm					

3He Cell: Samantha(Target Chamber Wall Thickness)					
Points	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
Thickness	1.563	1.556	1.75	1.7	1.7
Points	F (mm)	G (mm)	H (mm)	I (mm)	J (mm)
Thickness	1.7	1.67	1.671	1.614	1.678
Average Wall Thickness: $1.66 \pm 0.06$ mm					

### Calculation of the internal cell volume

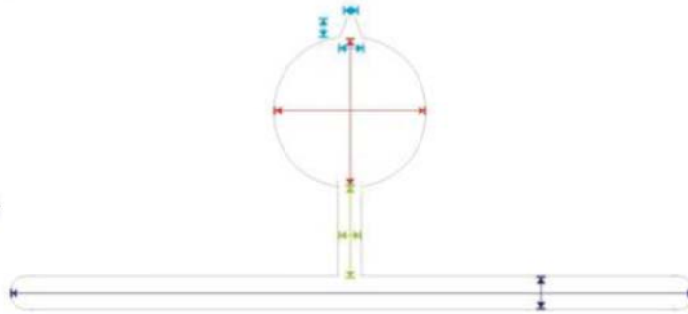
Cell name: Aqua  
 Fill date: 3/18/2008

**Pulloff:**  
 Height, meas.: 40.0  
 Top width: 7.9  
 Bottom width: 15.5  
 Wall thickness: 2.5 (2.5)\*

**Pumping chamber:**  
 Height: 74.5  
 Width: 76.4  
 Wall thickness: 4.0 (1.1)\*

**Transfer tube:**  
 Height: 98.0  
 Width: 11.9  
 Wall thickness: 2.3 (2.3)\*

**Target chamber:** \* = These values  
 Diameter: 19.0 are measure-  
 Length: 393.0 ments of an  
 Wall thickness: 1.00 (given avg. value: 0.85) old cut cell.



All measurements are external in units of mm.

**Internal Volumes:**

**Pulloff:**

Volume is estimated by a truncated cone. The total height of the cone is given by the measured height plus an addition of 5.0 mm for the truncation.

$$\begin{aligned} \text{Cone volume} &= \frac{1}{3} \pi r^2 h \\ \text{Truncated cone volume} &= \left\{ \frac{1}{3} \pi (r_{\text{bottom}})^2 \cdot h_{\text{total}} \right\} - \left\{ \frac{1}{3} \pi (r_{\text{top}})^2 \cdot (h_{\text{total}} - h_{\text{measured}}) \right\} \\ &= 1288 \text{ mm}^3 \\ &= 1.288 \text{ ml} \end{aligned}$$

**Pumping chamber:**

For this calculation the diameter of the sphere is estimated by the mean value of its height and width.

$$\begin{aligned} \text{Sphere volume} &= \frac{4}{3} \pi r^3 \\ &= 160674 \text{ mm}^3 \\ &= 160.674 \text{ ml} \end{aligned}$$

**Transfer tube:**

$$\begin{aligned} \text{Cylinder volume} &= \pi r^2 h \\ &= 4102 \text{ mm}^3 \\ &= 4.102 \text{ ml} \end{aligned}$$

**Target chamber:**

The volume of the target chamber consists of a cylindrical volume whose length is decreased by two times its radius with an addition of the volume of a sphere with the same radius.

$$\begin{aligned} \text{Target chamber} &= \left\{ \pi r^2 (h - 2r) \right\} + \left\{ \frac{4}{3} \pi r^3 \right\} \\ &= 87917 \text{ mm}^3 \\ &= 87.917 \text{ ml} \end{aligned}$$

$$\text{Internal cell volume} = \underline{\underline{253.98 \text{ ml}}}$$



## Calculation of the internal cell volume

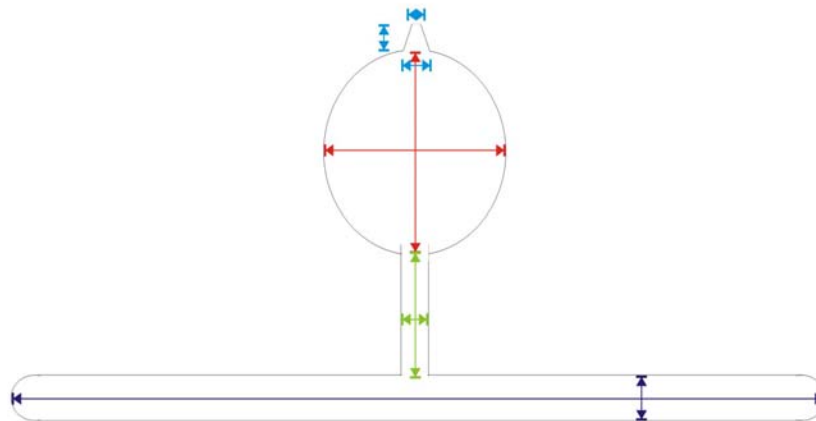
**Cell name:** Dominic  
**Fill date:** 3/9/2012

**Pulloff:**

Height, meas.: 31.8  
 Top width: 13.7  
 Bottom width: 13.7  
 Wall thickness: 1.7 (2.5)\*

**Pumping chamber:**

Height: 76.7  
 Width: 76.8  
 Wall thickness: 3.2 (1.1)\*



All measurements are external in units of mm.

**Transfer tube:**

Height: 88.9  
 Width: 12.3  
 Wall thickness: 1.8 (2.3)\*

**Target chamber:**

Diameter: 18.9  
 Length: 398.8  
 Wall thickness: 1.68 (given avg. value: 0.85)

\* = These values are measurements of an old cut cell.

**Internal Volumes:**

**Pulloff:**

Volume is estimated by a truncated cone. The total height of the cone is given by the measured height plus an addition of 5.0 mm for the truncation.

Cone volume =  $1/3 * \pi * r^2 * h$

$$\begin{aligned} \text{Truncated cone volume} &= \{ 1/3 * \pi * (r_{\text{bottom}})^2 * h_{\text{total}} \} - \{ 1/3 * \pi * (r_{\text{top}})^2 * (h_{\text{total}} - h_{\text{measured}}) \} \\ &= 885 \text{ mm}^3 \\ &= 0.885 \text{ ml} \end{aligned}$$

**Pumping chamber:**

For this calculation the diameter of the sphere is estimated by the mean value of its height and width.

$$\begin{aligned} \text{Sphere volume} &= 4/3 * \pi * r^3 \\ &= 183080 \text{ mm}^3 \\ &= 183.080 \text{ ml} \end{aligned}$$

**Transfer tube:**

$$\begin{aligned} \text{Cylinder volume} &= \pi * r^2 * h \\ &= 5248 \text{ mm}^3 \\ &= 5.248 \text{ ml} \end{aligned}$$

**Target chamber:**

The volume of the target chamber consists of a cylindrical volume whose length is decreased by two times its radius with an addition of the volume of a sphere with the same radius.

$$\begin{aligned} \text{Target chamber} &= \{ \pi * r^2 * (h - 2*r) \} + \{ 4/3 * \pi * r^3 \} \\ &= 74272 \text{ mm}^3 \\ &= 74.272 \text{ ml} \end{aligned}$$

## Calculation of the internal cell volume

**Cell name:** Samantha  
**Fill date:** 3/13/2012

**Pulloff:**

Height, meas.: 36.8  
 Top width: 6.0  
 Bottom width: 13.3  
 Wall thickness: 2.5 (2.5)\*

**Pumping chamber:**

Height: 78.3  
 Width: 76.2  
 Wall thickness: 2.9 (1.1)\*

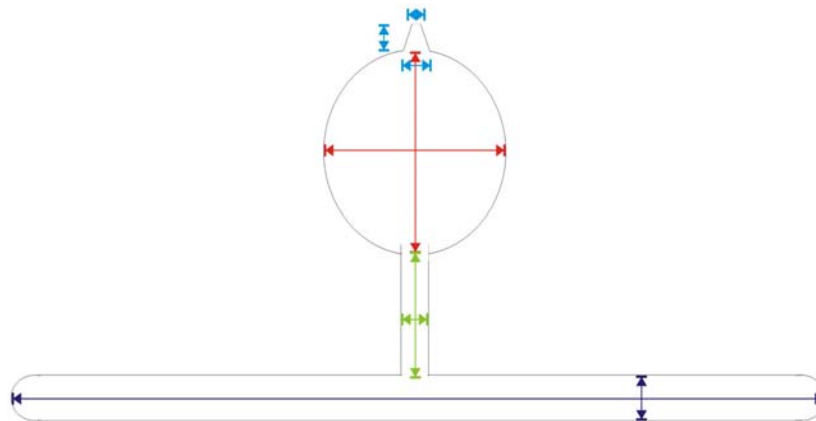
**Transfer tube:**

Height: 94.0  
 Width: 12.8  
 Wall thickness: 1.5 (2.3)\*

**Target chamber:**

Diameter: 19.0  
 Length: 398.8  
 Wall thickness: 1.66 (given avg. value: 0.85)

\* = These values are measurements of an old cut cell.



All measurements are external in units of mm.

**Internal Volumes:**

**Pulloff:**

Volume is estimated by a truncated cone. The total height of the cone is given by the measured height plus an addition of 5.0 mm for the truncation.

Cone volume =  $1/3 * \pi * r^2 * h$

$$\begin{aligned} \text{Truncated cone volume} &= \{ 1/3 * \pi * (r_{\text{bottom}})^2 * h_{\text{total}} \} - \{ 1/3 * \pi * (r_{\text{top}})^2 * (h_{\text{total}} - h_{\text{measured}}) \} \\ &= 750 \text{ mm}^3 \\ &= 0.750 \text{ ml} \end{aligned}$$

**Pumping chamber:**

For this calculation the diameter of the sphere is estimated by the mean value of its height and width.

$$\begin{aligned} \text{Sphere volume} &= 4/3 * \pi * r^3 \\ &= 191349 \text{ mm}^3 \\ &= 191.349 \text{ ml} \end{aligned}$$

**Transfer tube:**

$$\begin{aligned} \text{Cylinder volume} &= \pi * r^2 * h \\ &= 7017 \text{ mm}^3 \\ &= 7.017 \text{ ml} \end{aligned}$$

**Target chamber:**

The volume of the target chamber consists of a cylindrical volume whose length is decreased by two times its radius with an addition of the volume of a sphere with the same radius.

$$\begin{aligned} \text{Target chamber} &= \{ \pi * r^2 * (h - 2*r) \} + \{ 4/3 * \pi * r^3 \} \\ &= 75514 \text{ mm}^3 \\ &= 75.514 \text{ ml} \end{aligned}$$

## Calculation of the internal cell volume

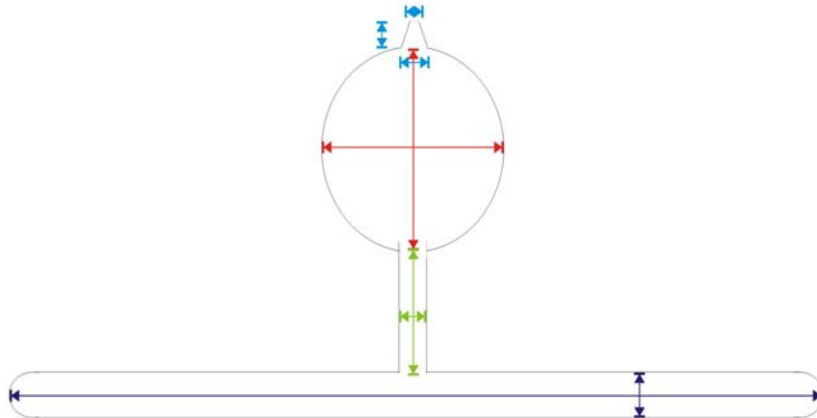
**Cell name:** Moss  
**Fill date:** 3/13/2012

**Pulloff:**

Height, meas.: 38.1  
 Top width: 7.3  
 Bottom width: 14.4  
 Wall thickness: 2.5 (2.5)\*

**Pumping chamber:**

Height: 76.7  
 Width: 76.6  
 Wall thickness: 2.6 (1.1)\*



All measurements are external in units of mm.

**Transfer tube:**

Height: 94.0  
 Width: 12.5  
 Wall thickness: 1.5 (2.3)\*

**Target chamber:**

Diameter: 18.8  
 Length: 398.8  
 Wall thickness: 1.64 (given avg. value: 0.85)

\* = These values are measurements of an old cut cell.

**Internal Volumes:**

**Pulloff:**

Volume is estimated by a truncated cone. The total height of the cone is given by the measured height plus an addition of 5.0 mm for the truncation.

Cone volume =  $1/3 * \pi * r^2 * h$

$$\begin{aligned} \text{Truncated cone volume} &= \{ 1/3 * \pi * (r_{\text{bottom}})^2 * h_{\text{total}} \} - \{ 1/3 * \pi * (r_{\text{top}})^2 * (h_{\text{total}} - h_{\text{measured}}) \} \\ &= 996 \text{ mm}^3 \\ &= 0.996 \text{ ml} \end{aligned}$$

**Pumping chamber:**

For this calculation the diameter of the sphere is estimated by the mean value of its height and width.

$$\begin{aligned} \text{Sphere volume} &= 4/3 * \pi * r^3 \\ &= 190307 \text{ mm}^3 \\ &= 190.307 \text{ ml} \end{aligned}$$

**Transfer tube:**

$$\begin{aligned} \text{Cylinder volume} &= \pi * r^2 * h \\ &= 6647 \text{ mm}^3 \\ &= 6.647 \text{ ml} \end{aligned}$$

**Target chamber:**

The volume of the target chamber consists of a cylindrical volume whose length is decreased by two times its radius with an addition of the volume of a sphere with the same radius.

$$\begin{aligned} \text{Target chamber} &= \{ \pi * r^2 * (h - 2*r) \} + \{ 4/3 * \pi * r^3 \} \\ &= 73990 \text{ mm}^3 \\ &= 73.990 \text{ ml} \end{aligned}$$