

# Hall A Tritium Target Configuration for December 2017



## Engineering Report

Thomas Jefferson National Accelerator Facility  
12000 Jefferson Ave.  
Newport News Virginia, 23606

Document Title: Hall A Tritium Target Configuration for December 2017	
Document Number: TGT-RPT-17-007	
1/4/2018	Revision: 0
Author:	David Meekins
Check:	David Meekins
Approved:	David Meekins

Description: Configuration report for the Hall A Tritium Target ladder. This document gives BDS positions, target thicknesses, cell thicknesses and overall assembly data. The target ladder is shown in the assembly drawing TGT-103-1006-0000 which can be found in the JLAB document repository.

# 1 Revision History

Revision: 0	1/4/2018	Original
-------------	----------	----------

## 2 Purpose and Scope

This report documents the configuration for the Hall A Tritium Target as installed for the Fall 2017 run period. Target thicknesses and uncertainties are included. Reference TGT-CALC-17-020 for calculation details. Reference e-log entry <https://logbooks.jlab.org/entry/3501694> for thickness data.

### 3 Target list and lifter positions

The following lifter positions were determined by alignment of the system.

<b>Position</b>	<b>BDS Position</b>	<b>Material</b>
T2 Cell	33,307,200	Aluminum 7075 and Tritium Gas
D2 Cell	29,563,200	Aluminum 7075 and Deuterium Gas
H2 Cell	25,798,720	Aluminum 7075 and Hydrogen Gas
He-3 Cell	22,059,840	Aluminum 7075 and Helium 3 Gas
Empty Cell	18,300,480	Aluminum 7075
25 cm Dummy	15,376,182	Aluminum 7075
optics	14,595,894	Carbon 99.95%
Carbon Hole	13,295,414	Carbon 99.95%
Raster Target	12,563,253	N/A
Thick Aluminum	11,929,910	Aluminum 6061
Carbon	11,214,646	Carbon 99.95%
Titanium	10,499,382	Titanium Gr 2
BeO	9,784,118	Beryllium Oxide 99%
Home	0	N/A

These positions shall be updated after the beam centering procedures with the carbon hole target have been performed.

## 4 Gas Cell Data

### 4.1 General

Thickness of the gas cells (including the empty cell) was determined using an Olympus Magna-Mike. The device was calibrated prior to performing the measurements. Each cell was measured at several points along the main body and on the entrance window. Multiple shots were taken at each location and are averaged. The standard deviation of this average is reported as an uncertainty as is the error (0.01 mm) determined at the calibration check at the end of the measurements. The volume of each cell has been determined at the calibration check at the end of the measurements. The volume of each cell has been measured within the measurement uncertainty all cells measured the same volume of  $33.38 \pm 0.2 \text{ cm}^3$ . These measurements are summarized in report TGT-RPT-17-002.

The thickness of each cell was measured at eight locations as shown in Figure 1 below.

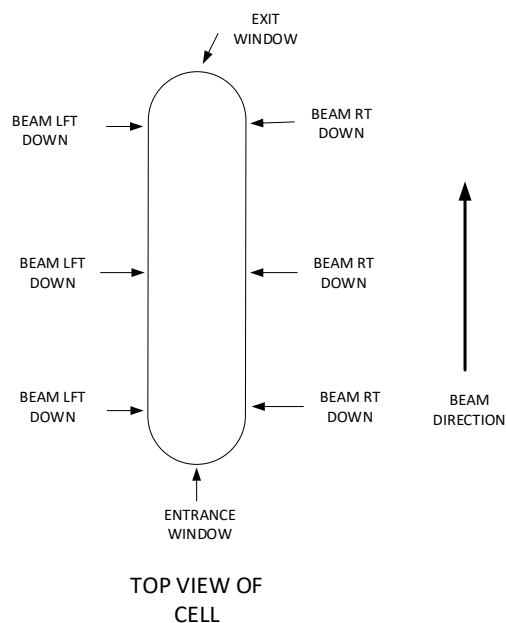


Figure 1: Measurement locations on cells

These locations are in the plane of the beam and the spectrometers. A linear interpolation should be employed to determine the thickness at intermediate locations.

The uncertainty in the length of each cell is about 1 mm.

### 4.1.1 Cell Wall Thickness Data

Cell wall thickness data is shown below in the table below. Dimensions are in mm.

Position on Cell	Empty Cell	T2 Cell	H2 Cell	D2 Cell	He-3 Cell
Entrance	0.254 ± 0.0051	0.253 ± 0.004	0.311 ± 0.001	0.215 ± 0.004	0.203 ± 0.007
Exit	0.279 ± 0.0051	0.343 ± 0.047	0.330 ± 0.063	0.294 ± 0.056	0.328 ± 0.041
Exit left	0.4064 ± 0.0051	0.379 ± 0.007	0.240 ± 0.019	0.422 ± 0.003	0.438 ± 0.010
Exit right	0.4216 ± 0.0051	0.406 ± 0.004	0.519 ± 0.009	0.361 ± 0.013	0.385 ± 0.016
Mid left	0.457 ± 0.0051	0.435 ± 0.001	0.374 ± 0.004	0.447 ± 0.009	0.487 ± 0.060
Mid right	0.432 ± 0.0051	0.447 ± 0.004	0.503 ± 0.005	0.371 ± 0.012	0.478 ± 0.007
Entrance left	0.508 ± 0.0051	0.473 ± 0.003	0.456 ± 0.010	0.442 ± 0.005	0.504 ± 0.003
Entrance right	0.424 ± 0.0051	0.425 ± 0.003	0.457 ± 0.006	0.332 ± 0.011	0.477 ± 0.011

## 4.2 Tritium Cell

The entrance window serial number for the tritium cell is T2-2-ENT. The main body (exit) serial number is T2-2-M. The tritium cell was filled with 0.102 grams of T2 gas. The fill parameters are shown below.

- Actual Fill Pressure 203 psia
- Fill Date [10/23/2017](#)
- Grams Tritium 0.102 grams
- Grams Deuterium  $3.20 \times 10^{-5}$  grams
- Grams Helium-3  $3.01 \times 10^{-5}$  grams
- Grams Nitrogen  $9.47 \times 10^{-6}$  grams

The uncertainty assigned to this fill is about 1% for the total target thickness. This includes pressure and temperature as well as purity. The total target thickness at the time the cell was filled is:

$$\rho t = 77 \pm 0.01 \frac{g}{cm^2}$$

Details regarding how this was determined can be found in TGT-CALC-17-020.

## Deuterium Cell

The deuterium cell was filled to 514.7 psia. The fill gas was 99.9% deuterium isotopic enrichment and 99.999% hydrogen chemically. The density was determined from NIST data tables. The total target thickness is:

$$\rho t = 142.2 \pm 0.8 \frac{mg}{cm^2}$$

The cell is assembled from T2-5M main body and T2-5ENT for the entrance window.

## 4.3 Hydrogen Cell

The hydrogen cell was filled to 514.7 psia. The fill gas was 99.9999% hydrogen chemical. The density was determined from NIST data tables. The total target thickness is:

$$\rho t = 70.8 \pm 0.4 \frac{mg}{cm^2}$$

The cell is assembled from T2-3M main body and T2-3ENT for the entrance window

## 4.4 Helium-3 Cell

The hydrogen cell was filled to 252.7 psia. The fill gas was 99.999% helium chemical 99.9% isotopic. The density was determined from NIST data tables. The total target thickness is:

$$\rho t = 53.4 \pm 0.6 \frac{mg}{cm^2}$$

The cell is assembled from T2-4M main body and T2-4ENT for the entrance window

## 4.5 Empty Cell

The empty cell is a fully assembled tritium type cell with no fluid (vacuum). It is open to the chamber vacuum. This is to better simulate the background subtraction of the windows.

## 5 Dummy Target

The dummy target has foils located at  $\pm 12.5$  cm about the  $z = 0$  position. These foils are made from aluminum 7075 (same alloy as the cells). The dummy target thicknesses are given in the table below.

Foil	Thickness (g/cm <sup>2</sup> )
Dummy foil 1	$0.3495 \pm 0.0006$
Dummy foil 2	$0.3495 \pm 0.0006$



## 6 Optics Target

There are eleven (11) carbon foils roughly 0.25 mm thick each. The density of each foil is about 1.8 g/cm<sup>3</sup>. These foils are centered about the  $z = 0$  position and project 12.5 up and down stream. They are evenly spaced at 2.5 cm. Each carbon foil is made from the same sheet which is carbon 99.95%.

## 7 Solid Targets

Solid targets are located on the solid target ladder nominally at Z = 0.

Target	Thickness (g/cm <sup>2</sup> )	Material
Titanium	0.4081 ± 0.0008	Ti
BeO	0.142 ± 0.0006	BeO (99%)
C with 2 mm hole near X = Y = 0	0.883 ± 0.0002	C (99.95%)
C	0.883 ± 0.0002	C (99.95%)
Thick Aluminum	1.37 ± 0.007	Aluminum 7075
Raster Tube	-	Aluminum 7075 tube