

# Hall A Target Configuration

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PREX

## Revision History

1. March 1, 2010: Original document.
2. March 17, 2010: Updated BDS positions with new survey data.

## Overview

This document describes the Hall A target configuration for the run period beginning in March 2010. The PREX experiment starts with a water cell active and the cryogenic target warm. The entire water cell solid target ladder is replaced with the standard solid target ladder before the cryogenic lead target is cooled. The following tables list the available targets and their BDS (lifter) positions for each running period. The target stack has three major subcomponents, the optics target, the lead ladder, and the standard solid target ladder (or water cell ladder for optics commissioning). Appended to this document is a paper from R. Michaels and P. Adderley giving more detail for the cryogenic lead target ladder.

## Water Cell Installed

This table lists the targets installed with the water cell. The lead target foils are not permitted in the beam in this configuration. The current limits are lower for all targets as well.

Table 1: BDS Positions Water Cell Installed

Target	Description/Material	BDS Encoder Position	Corrected Encoder Position	BDS Enabled
Optics Target	Carbon foils 0,±7.5,±15	34466880		Yes
PB Diamond #1	Lead diamond sandwich	30087744		No
PB Diamond #2	Lead diamond sandwich	28295744		No
PB Diamond #3	Lead diamond sandwich	26503744		No
BeO Viewer	BeO Foil	22438464		Yes
Tantalum	Ta	20812864		Yes
Super Thin Carbon	Carbon foil 0.075 mm thick	19187264		Yes
H2O Cell	H2O	15936064		Yes
Empty	N/A	14310464		Yes

## No Water Cell

This is the normal target configuration. The lead diamond foils are allowed.

Table 2: BDS Positions Production Running

Target	Description/Material	BDS Encoder Position	Corrected Encoder Position	BDS Enabled
Optics Target	Carbon foils 0,±7.5,±15	34466880		Yes
PB Diamond #1	Lead diamond sandwich	30087744		Yes
PB Diamond #2	Lead diamond sandwich	28295744		Yes
PB Diamond #3	Lead diamond sandwich	26503744		Yes
BeO Viewer	BeO Foil	22173504		Yes
Ta Foil	Ta	20710464		Yes
Thin Lead	Lead	19247424		Yes
Thick Carbon	Carbon	17784384		Yes
Thin Carbon	Carbon	16321344		Yes
Super Thin Carbon	Carbon foil 0.075 mm thick	14858304		Yes
Empty	N/A	13395264		Yes
Carbon Hole	Carbon	11932224		Yes
Empty	N/A			Yes

## Standard Solid Target Ladder

The standard solid target ladder is installed when the water cell is not. The following table lists the solid targets and their thicknesses. Errors reported are systematic and assume that the foil is of uniform thickness and density (that there are no voids in the material). The standard solid target ladder is shown in JLAB drawing TGT-101-5000-4012. Individual target foils are clamped in holders and mounted to this frame in the same fashion shown in TGT-101-5000-4001.

Target Name	Material	Purity	Thickness (g/cm <sup>2</sup> )
BeO	BeO	99.0%	0.149 ± 0.001
Tantalum	Ta	99.9%	0.12237±0.000341
Thin Lead	Pb		0.05524±0.000080
Thick Carbon	C	99.95%	0.4422±0.00049
Thin Carbon	C		0.026867±0.000057
Super Thin Carbon	C	99.8%	0.008991±0.000047
Carbon Hole	Carbon	99.95%	0.08388 ± 0.00012

## Water Cell Target Ladder

The water cell ladder is only installed when the water cell is in operation. The ladder has different spacing and positions to accommodate the water cell. The water cell has two thin windows made from SST shim stock.

Target Name	Material	Purity	Thickness (g/cm <sup>2</sup> )
BeO	BeO	99.0%	0.149 ± 0.001
Super Thin C	C	99.8%	0.008991±0.000047
Empty	n/a	n/a	n/a
H2O cell	H2O	99.9%	~5 mm

## Optics Target

The optics target consists of 5 carbon foils cut from the same sheet. The foils are 99.5% chemically pure carbon. Each foil is  $0.042 \pm 0.001$  g/cm<sup>2</sup>. Upstream face of each foil is located at 0 cm, ±7.5 cm and ± 15 cm nominally in Z. The optics target is shown in JLAB Drawing TGT-101-5000-3002.

## Lead Ladder

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The PREX target ladder has the optics sled at the top, followed by the Lead/Diamond assembly, with the auxiliary target ladder at the bottom, see fig 1. During the optics commissioning phase, the aux. target ladder consists of a water cell and three other targets (fig 2). There is no liquid-He cooling during the optics phase. After optics commissioning, we will break vacuum and remove the aux. target ladder, replacing it with another ladder that has seven targets (fig 3). In this note we show the data on mass, thickness, area, and locations of all the targets.

The Lead/Diamond target is a stack of diamond + lead + diamond. The lead is isotopically pure  $^{208}\text{Pb}$ . The diamond foils are nominally 0.15 mm thick and the lead is 0.5 mm thick. Precise measurements of these foils as well as the aux. targets are listed in the tables below.

It was found that the diamond did not have uniform thickness. Therefore, the orientation was defined and thicknesses measured in a grid at five points as shown in fig 4. The marked corner is at the upper left as viewed by the beam. The measurements were made with a micrometer (Starrett 436 – 1 in with  $\frac{1}{4}$ " head) and were reproducible to 0.0002" (0.2mil). The lead had better uniformity and was measured in a grid at 7 points (fig 5).

Fig 4 – Diamond Foil Grid

Upper left

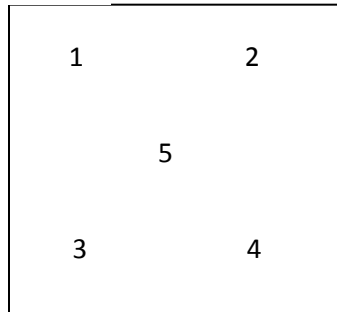


Fig 5 – Thick Lead Foil Grid

Upper left



**Diamond Foils** on Lead target ladder. Thickness in inches.

Location #1 is for the bottom assembly. “front” means it sees the beam first.

See fig 5 for the grid point locations.

Location	Grid pt 1	Grid pt 2	Grid pt 3	Grid pt 4	Grid pt 5
1 front	0.0056	0.0052	0.0052	0.0056	0.0050
1 back	0.0055	0.0059	0.0060	0.0058	0.0055
2 front	0.0043	0.0045	0.0058	0.0055	0.0050
2 back	0.0065	0.0048	0.0042	0.0054	0.0051
3 front	0.0075	0.0085	0.0095	0.0088	0.0082
3 back	0.0080	0.0092	0.0088	0.0072	0.0082

**Diamond Foils** on Main Target. Mass and Area

Notation same as above. Phil’s # refers to notation used by Phil Adderley.

Location	(Phil’s #)	Mass (grams)	Area (X,Y) inches
1 front	new #1	0.2924	1.000, 1.000
1 back	new #4	0.3403	1.000, 1.001

2	front	old #3	0.2571	0.998, 0.999
2	back	old #9	0.2624	0.996, 0.998
3	front	new #2	0.4676	1.000, 1.000
3	back	new #3	0.4670	1.000, 1.001

**Lead Foils for Main Targets**      thicknesses in inches

#1 is for the bottom assembly.

Location    Grid pt 1    pt 2            pt 3            pt 4            pt 5            pt 6            pt 7

1	0.0200	0.0199	0.0201	0.0198	0.0199	0.0200	0.0199
2	0.0202	0.0203	0.0201	0.0203	0.0202	0.0203	0.0201
3	0.0195	0.0195	0.0195	0.0194	0.0194	0.0195	0.0195

**Lead Foils for Main Targets**      Mass and Area

Notation same as above. Phil's # refers to notation used by Phil Adderley.

Location	(Phil's #)	Mass (grams)	Area (X,Y) inches
1	new #1	3.3737	0.954, 0.948
2	new #2	3.2984	0.926, 0.945
3	old #1	3.2232	0.950, 0.950

**Thin Lead Foil**      thicknesses in inches

Measured at 5 grid points (fig 4)

Mass = 0.3406 grams. Area 0.990" x 0.976"

Grid pt 1	pt 2	pt 3	pt 4	pt 5
0.0024"	0.0022"	0.0022"	0.0023"	0.0021"

**Thin Graphite** (nom. 0.15 mm)      thicknesses in inches

Measured at 5 grid points (fig 4)

Mass = 0.1678 grams. Area 0.985" x 0.985"

Grid pt 1	pt 2	pt 3	pt 4	pt 5
0.0060"	0.0060"	0.0060"	0.0059"	0.0060"