Accelerator Department
BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.
Upton, L.I.,N.Y.

EP & S DIVISION TECHNICAL NOTE

No. 22

G.E . Tanguay
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G10 BeO CERAMIC TARGET, ITS LOCATION, AND RELATED DATA

Introduction

The G10 target is located in the ten foot long straight section of the AGS, between synchrotron magnets G10 and G11. When in use, the target is mechanically placed in the path of the orbiting proton beam and secondary particles produced in the target form beams for use in the experimental area. Target adjustment is remotely controlled and is only in the radial direction for any given target. Target location is given in terms of a radial distance of the flipping motor shaft centerline with respect to the theoretical beam centerline; this distance is read out in the Main Control Room on a digital voltmeter (DVM). Owing to the different styles of targets used, the target tip location relative to the motor shaft centerline changes with each target style. Hence, different styles of targets require different DVM readings for a same target tip location.

The purpose of this paper is to outline in a series of topics certain technical details about the G10 target. Specifically, the topics below cover such areas as: target material; vacuum box details and target location; BeO ceramic target assembly; target and ram assembly; radial adjustment and read-outs; target monitoring and controls; and vertical alignment.

I. Target Material

Thin pure beryllium wire (about 0.050 inches in diameter) was formerly used for targetting. Recently, a new ceramic target, made of BeO, has been put to use. It has been determined that the BeO ceramic target has a much superior

structural stability under particle bombardment than does the Be wire target (with the Be wire target, the tip tended to drift under particle bombardment).

In addition to the above information, attached are four sketches which give pertinent technical information as to the coordinated planar location and the operation of the G10 target within the G10 vacuum box.

II. G10 Target Vacuum Box Details and Target Location: (1st Sketch)

Sheet #1 shows an overall plan view of the G10 target vacuum box located between AGS magnets G10 and G11. The G10 target is located in the upstream end of the vacuum box. Extending from the sides of the vacuum box at appropriate angles are a number of cylindrical "snouts", each with a vacuum window, and two separate windows from which emanate the secondary particle beams produced at the G10 target (e.g., G10-20°, G10 + 4.706°, G10 + 10°, etc.). Indicated also on sheet #1 are reference lines (Theoretical Beam ℄ , Airlock ℄, etc.) and *survey points (e.g. E11998.206, N11952.691) used to locate the G10 target.

*A two-dimensional rectangular coordinate system is utilized to establish survey points at the AGS. The origin of this coordinate system is the intersection of the AGS survey reference circle and the radial line between the center of the reference circle and primary survey monument G. The abscissa extends positively (East) in the radial direction, and the ordinate positively (North) in the tangential direction; axial increments are in 100-inch steps and the origin is coordinately designated as [E12000.000, N12000.000]. Pins in the floor of the experimental area locate the intersections of east and north incremental axes, and form the AGS grid network utilized to survey points and lines.

III G10 BeO Ceramic Target, Assembly Of: (2nd Sketch)

Sheet #2 shows an isometric pictorial assembly of the G10 BeO ceramic target and target holder (blade). The BeO target is bolted into a compact doweled plate fixture, which in turn is bolted to the blade. The whole assembly,

as shown, is then snap-connected to the shaft of a small flipping motor (not shown) at the tapered slot in the base of the blade. The motor rotates the longitudinal axis of the blade in a vertical plane about an angle of 63.5^{o} (mechanical stops on the motor face determine the angle). When the longitudinal axis is 90^{o} to the horizontal plane passing through the motor shaft centerline, the BeO target is in the AGS proton beam path; otherwise it is out of the beam path.

IV. G10 Target and Ram Assembly: (3rd Sketch)

Sheet #3 gives a simplified diagram of the G10 target and motor, and of the ram assembly. Once the target motor is equipped with a target, the whole (target, motor, and motor support) assembly is then "rammed" in toward the proton orbital path. This places the target in a position such that it can be flipped into the beam. At this point, the motor shaft centerline can be accurately adjusted radially (to within 0.005 inches) with a small 110 volt "Slo-Syn" motor. Mounted on top of the ram assembly box is an automatically sequenced transfer machine (not shown) which can, when the target assembly pulls out ot the airlock, remove a worn target and reinstall a new target; the mechanism is remotely controlled.

A. DVM Read-Out and Adjustment Controls:

The G10 target adjustment control chassis is located in Main Control. With the target selector switch on G10, the motion control buttons can be manipulated to energize the 110 volt "Slo-Syn" motor at the opposite end of the target ram assembly. The "Slo-Syn" motor engages a rack and pinion mechanism connected to the adjustment shaft and drives the target motor support assembly radially in the close proximity of the theoretical beam centerline. A potentiometer connected to the adjustment shaft inside the motor feeds back voltages commensurate with radial distances of the motor shaft $\mathcal{L}$ from the theoretical beam $\mathcal{L}$ to a digital voltmeter (Volt-Ratio Meter)

in Main Control; the voltmeter reads out in 0.001 inch units. The potentiometer is connected such that when the target motor shaft ℄ coincides with the theoretical beam ℄ the digital voltmeter (DVM) read "0.000". The DVM Circuit is calibrated to within ± 0.001 inch every time the G10 target is optically surveyed. Calibration is done by comparing DVM readings with actual vernier measurements taken off the capped end of the adjustment shaft.

B. Target Motor Monitor and Controls:

The G10 target motor monitor and controls are also located in Main Control. When the target is flipped, its motion is monitored on an oscilloscope which indicates its rise time, dwell(flattop) time, and descent time. The motor is controlled to give a required "flattop" period, or length of time in the proton beam. Any vibratory motions at the mechanical stops on the motor face cause "spiking" in the sinusoidal segments of the monitored signal. These vibrations are damped out through induced dynamic braking in the target motor. The target blade is flipped on a predetermined signal so that the target is up to meet the oncoming proton beam.

V. G10 BeO Target Location (Blow-Up): (4th Sketch)

Sheet #4 is a detailed blow-up of the G10 BeO ceramic target as noted in the first sketch. Since sheet #4 is a plan view, what are shown are plane dimensions in a horizontal plane at beam height. This view shows the location of the BeO target relative to the theoretical beam ℄ and to the survey origins of the extracted secondary beam centerlines at G10. The target is fixed with respect to the motor shaft centerline; hence, the target tip location (point D) relative to any reference line or point is dependent solely on the DVM setting. Thus, the target can only vary radially (East-West). To vary tangentially, the target assembly must be physically modified; vertical adjustment (perpendicular to the plane) is achieved by shimming the target motor. The theoretical beam ℄,

magnet socket line, airlock ℄, and line joining vacuum chamber ℄'s are fixed lines; coordinates at A are fixed. Target dimensions are given in the cross-sectional view. Pertinent coordinate points are tabulated at the top of sheet #4.

VI. Vertical Alignment:

To align the G10 target with the AGS proton beam, a small mylar target is inserted in the beam path. This target or foil gives evidence as to where the proton beam is relative to the flipping motor shaft centerline. Based on this result, the actual target used is then vertically aligned with the proton beam by either inserting or removing shims from the base of the target motor. At times, the target itself is shimmed within its holder.

Distr: EP & S Staff
Dept. Administration
G10 Experimenters

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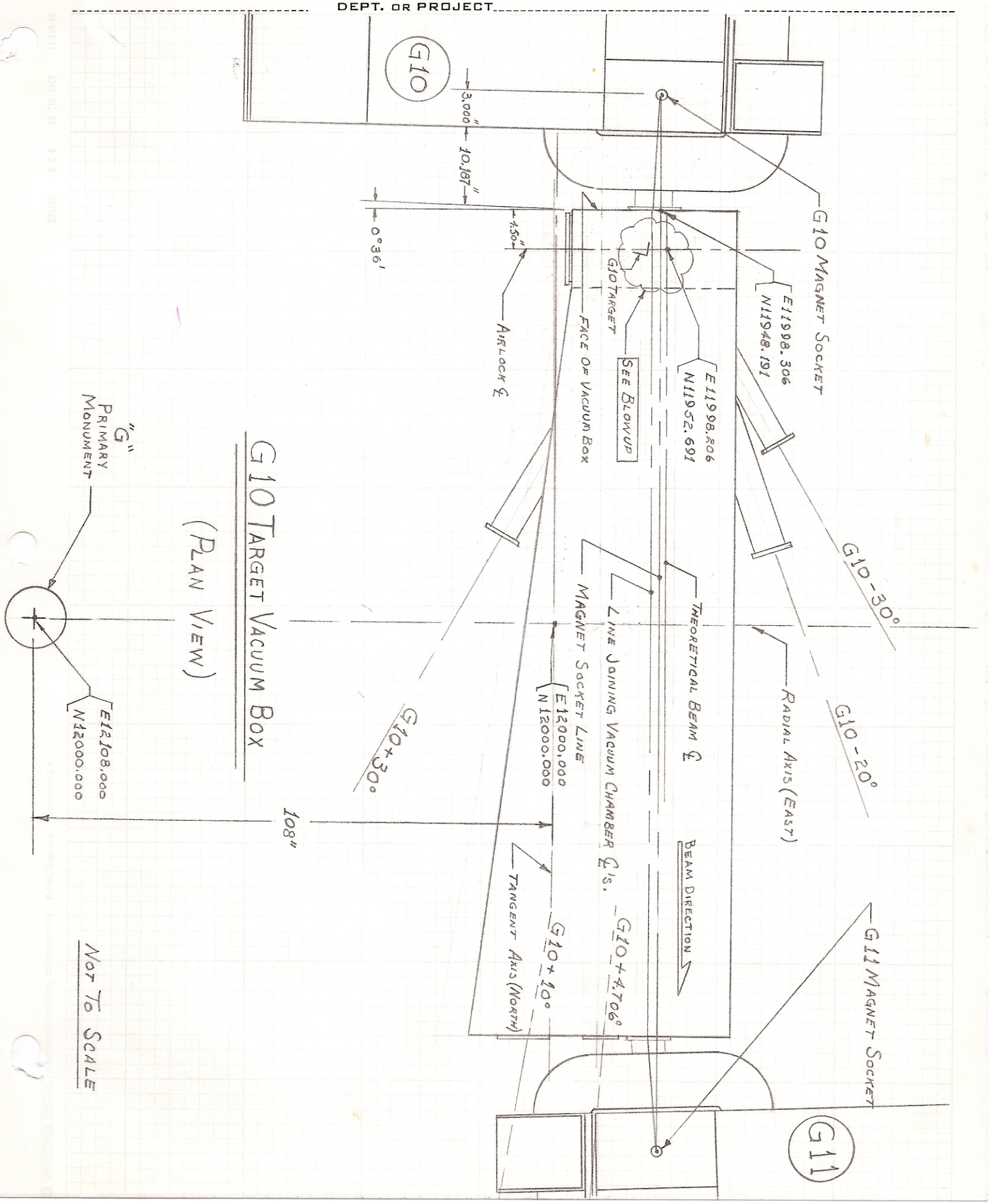
BY G. TANGUAY DATE ____ SUBJECT G10 TARGET VACUUM BOX DETAILS & TARGET LOCATION. SHEET No. 1 OF 4

CHKD. BY ____ DATE ____ JOB No. ____

DEPT. OR PROJECT ____



G10 TARGET VACUUM BOX

(PLAN VIEW)

NOT TO SCALE

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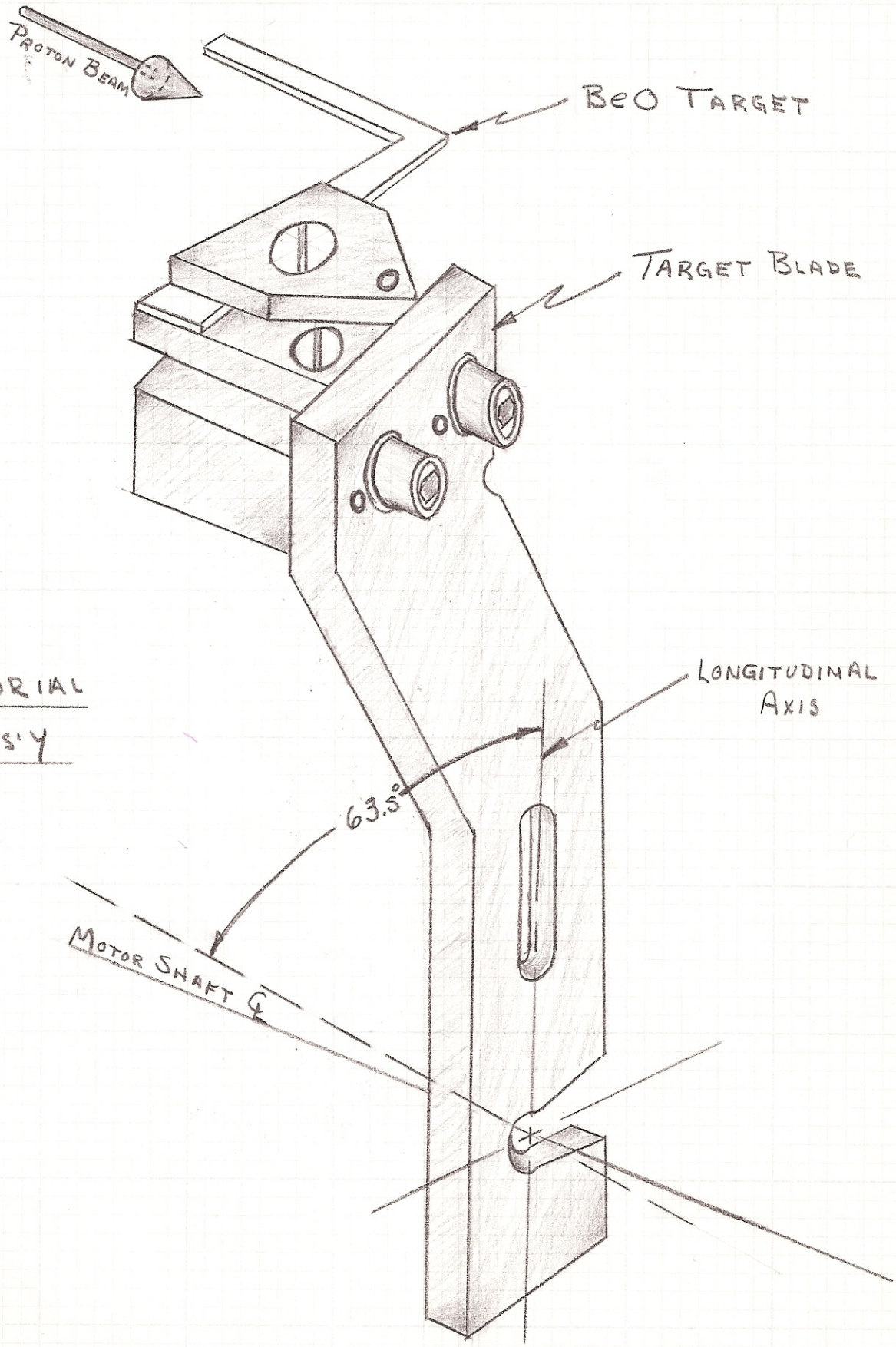
BY G. TANGUAY DATE _____ SUBJECT PICTORIAL ASS'Y OF G10 BeO CERAMIC TARGET SHEET No. 2 OF 4

CHKD. BY _____ DATE _____ JOB No. _____

DEPT. OR PROJECT _____



PICTORIAL ASS'Y

NOT TO SCALE

BROOKHAVEN NATIONAL LABORATORY

BY G.E.T. DATE

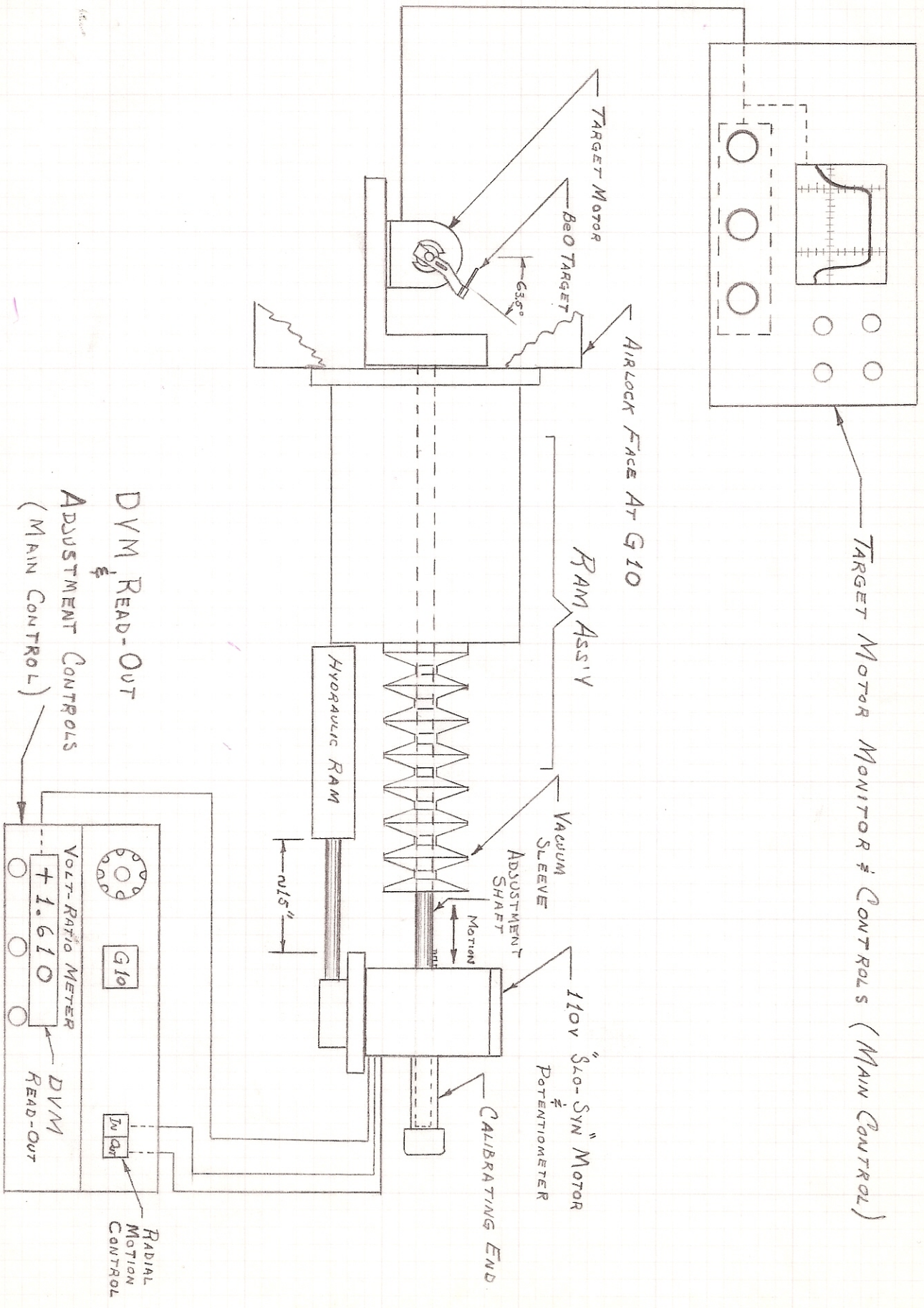
CHKD. BY DATE

SUBJECT CONTROL DIAGRAM OF G10 TARGET & RAM

DEPT. OR PROJECT

SHEET No. 3 OF 4

JOB No.



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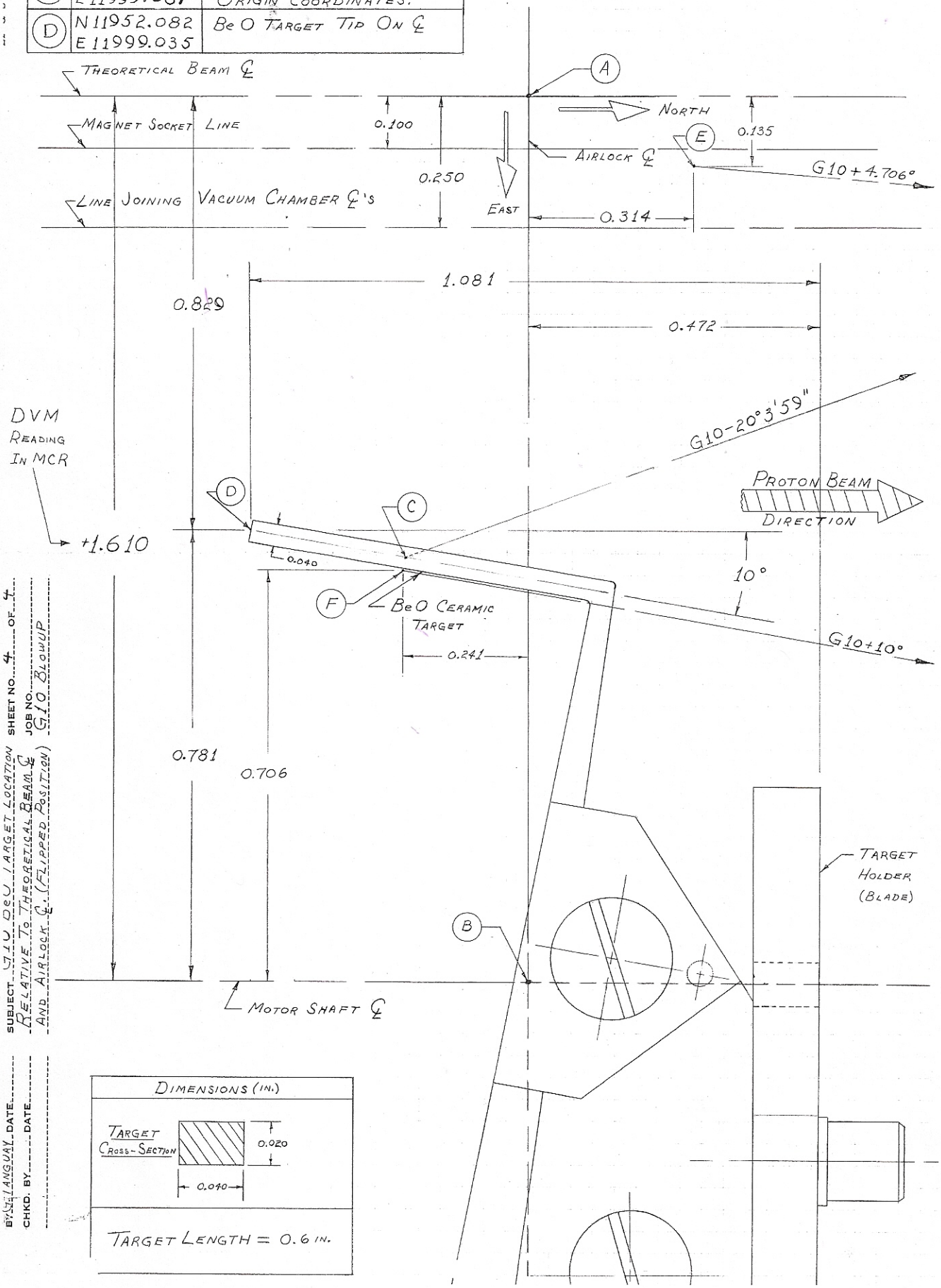
SCALE: 6"=1"

	COORDINATES	SIGNIFICANCE
A	N11952.691 E11998.206	INTERSECTION OF THEOR. BEAM ℄ & AIRLOCK ℄ (ZERO DVM)
B	N11952.691 E11999.816	INTERSECTION OF AIRLOCK ℄ & MOTOR SHAFT ℄
C	N11952.377 E11999.087	G10−20°3'59" SURVEY ORIGIN COORDINATES.
D	N11952.082 E11999.035	BeO TARGET TIP ON ℄
E	N11953.005 E11998.341	G10+4.706° SURVEY ORIGIN COORDINATES
F	N11952.450 E11999.110	G10+10° SURVEY ORIGIN COORDINATES.



DIMENSIONS (IN.)

TARGET CROSS-SECTION

0.020

0.040

TARGET LENGTH = 0.6 IN.

SUBJECT G10 DEU TARGET LOCATION RELATIVE TO THEORETICAL BEAM ℄ AND AIRLOCK ℄ (FLIPPED POSITION)

SHEET NO. 4 OF 4

JOB NO. G10 BLOWUP

BY LANGUAY DATE

CHKD. BY DATE