TECHNICAL MEMORANDUM

PROJECT MATTERHORN

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US Atomic Energy Commission

PRINCETON UNIVERSITY

PRINCETON, NEW JERSEY

Project Matterhorn
Princeton University
Princeton, N.J.

Test of Granville-Phillips Type C Ultra-High Vacuum Valve

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AEC RESEARCH AND DEVELOPMENT REPORT

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Test of Granville-Phillips Type C Ultra-High Vacuum Valve

Tests were made of one Granville-Phillips UHV valve to determine its characteristics, and in particular, the feasability of baking the valve closed at high temperatures (400°C) to enable a copper foil vapor trap to be baked while isolated from its system by means of one of these valves. A photograph and sketch of the valve will be found at the end of this report.

The valve was installed on a typical Alpert-type UHV system, and the system was given two ten-hour 400°C bake-outs. The pressure achieved in the system was 5×10^{-10} mm. Hg.

I. Conductance vs. Torque

The method used in determining the conductance was to pump the system, close the valve, and observe the rate of rise of pressure in a closed volume when the arm of the valve was exposed to dried air at atmospheric pressure. After baking the system with the valve held open with a bake-out clamp, the valve was closed to the desired torque and a rate of rise determined. Then the system was rebaked in preparation for a determination at the new closing torque. It should be noted that all bakes mentioned in this report were performed at 400°C for 10 hours. The open-valve bake-outs did not appear to affect noticeably the operation of the valve in that successive determinations of the conductance at the same closing torque were consistent.

The values found for various closing torques between 200 in. lbs. and 400 in. lbs. are tabulated below:

TABLE I

Closing torque (in. lbs.)	Conductance (l/sec)
200	4.1×10^{-10}
250	1.1×10^{-10}
300	5.5×10^{-11}
350	2.5×10^{-11}
400	1.0×10^{-11}

These values correspond reasonably with the results obtained on a valve of similar construction reported by D.G. Bills and F.G. Allen of Harvard University. (Fig. 1)

II. Feasability of Closed-Valve Bake-outs.

The valve was baked once, closed to a torque of 200 in. lbs. using the normal drive mechanism. On opening, some degree of sticking was noted but apparently the valve was not damaged in that a redetermination of the conductance at a closing torque of 300 in. lbs. yielded a value of :

$$C = 5.8 \times 10^{-11} \quad l/sec$$

which agrees very well with the previously obtained value in Table I.

At this point, the system was modified in that the valve was used to isolate the UHV system from an untrapped auxiliary mechanical pump operating at a pressure of 2-microns. It was felt that the mechanical pump would effectively simulate a source of oil and contaminates that might be expected from baking a saturated copper foil trap.

FIG. I

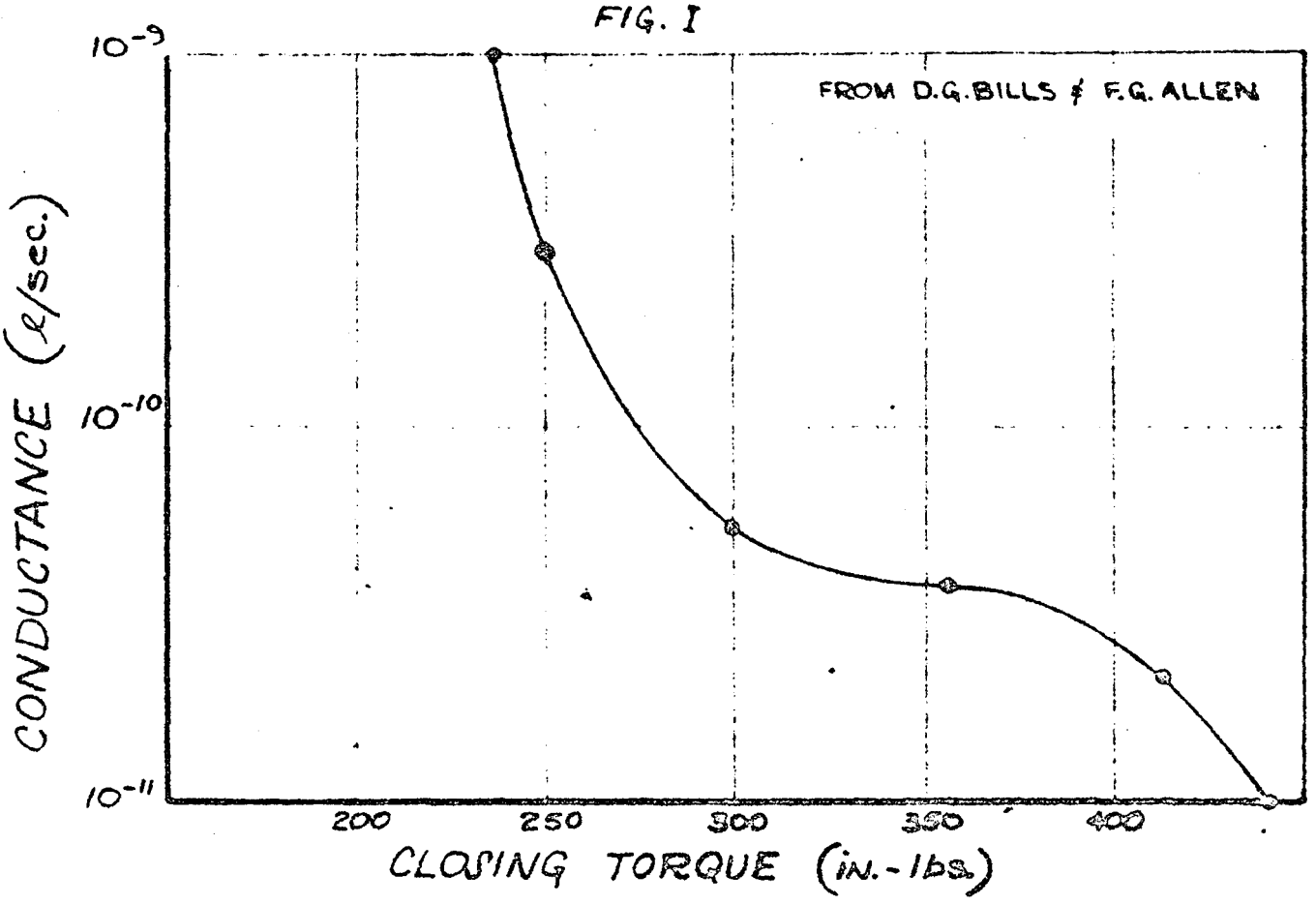

FROM D.G. BILLS & F.G. ALLEN
CONDUCTANCE (℧/sec.)
10⁻⁹
10⁻¹⁰
10⁻¹¹
200
250
300
350
400
CLOSING TORQUE (IN.-lbs.)

FIG. II

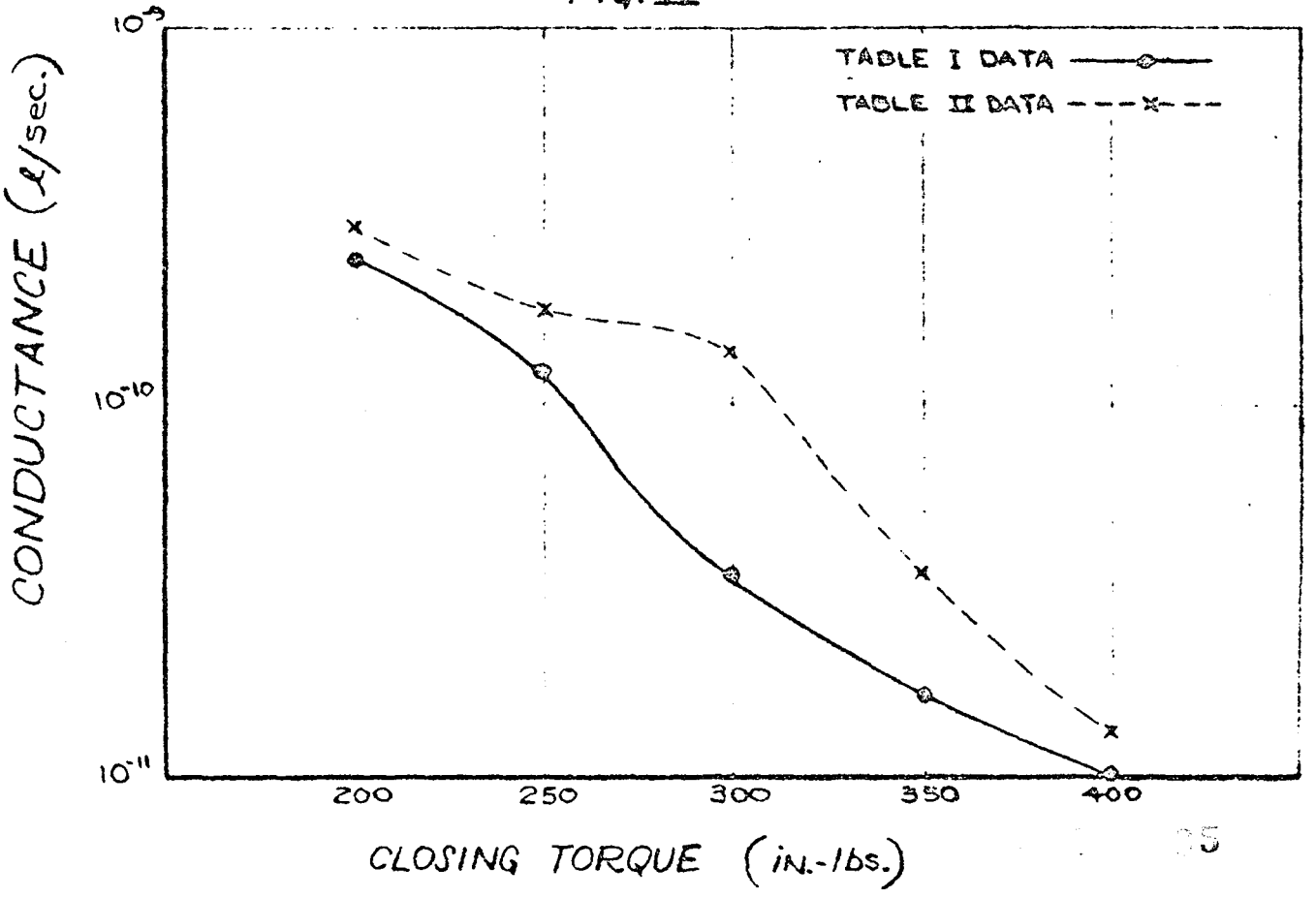


TABLE I DATA
TABLE II DATA
CONDUCTANCE (℧/sec.)
10⁻⁹
10⁻¹⁰
10⁻¹¹
200
250
300
350
400
CLOSING TORQUE (IN.-lbs.)

The valve was then re-closed to 200 in. lbs. and baked with the UHV system. Upon completion of the bake, it was backed off just a bit to determine the degree of sticking and immediately reclosed to 300 in. lbs. The pressure attained by the UHV system was found to be 5×10^{-10} mm. Hg.

This procedure was followed for a total of five bake-outs. In all cases the terminal pressure of the UHV system was approximately 5×10^{-10} mm. Hg. From this alone, a maximum value of conductance of the valve could be set at 1×10^{-9} l/sec. This value would probably be adequate for purpose of trap isolation.

It should be noted that some erratic action of the drive mechanism occurred after the second bake due to the deterioration of the screw threads and ball-bearings at temperatures for which they were not designed to operate. (ie. 400°C) This may have caused some discrepance in the thrust applied to the valve at the prescribed closing torque, but it is felt that errors from this source are not excessive.

III. Re-determined Conductance Values

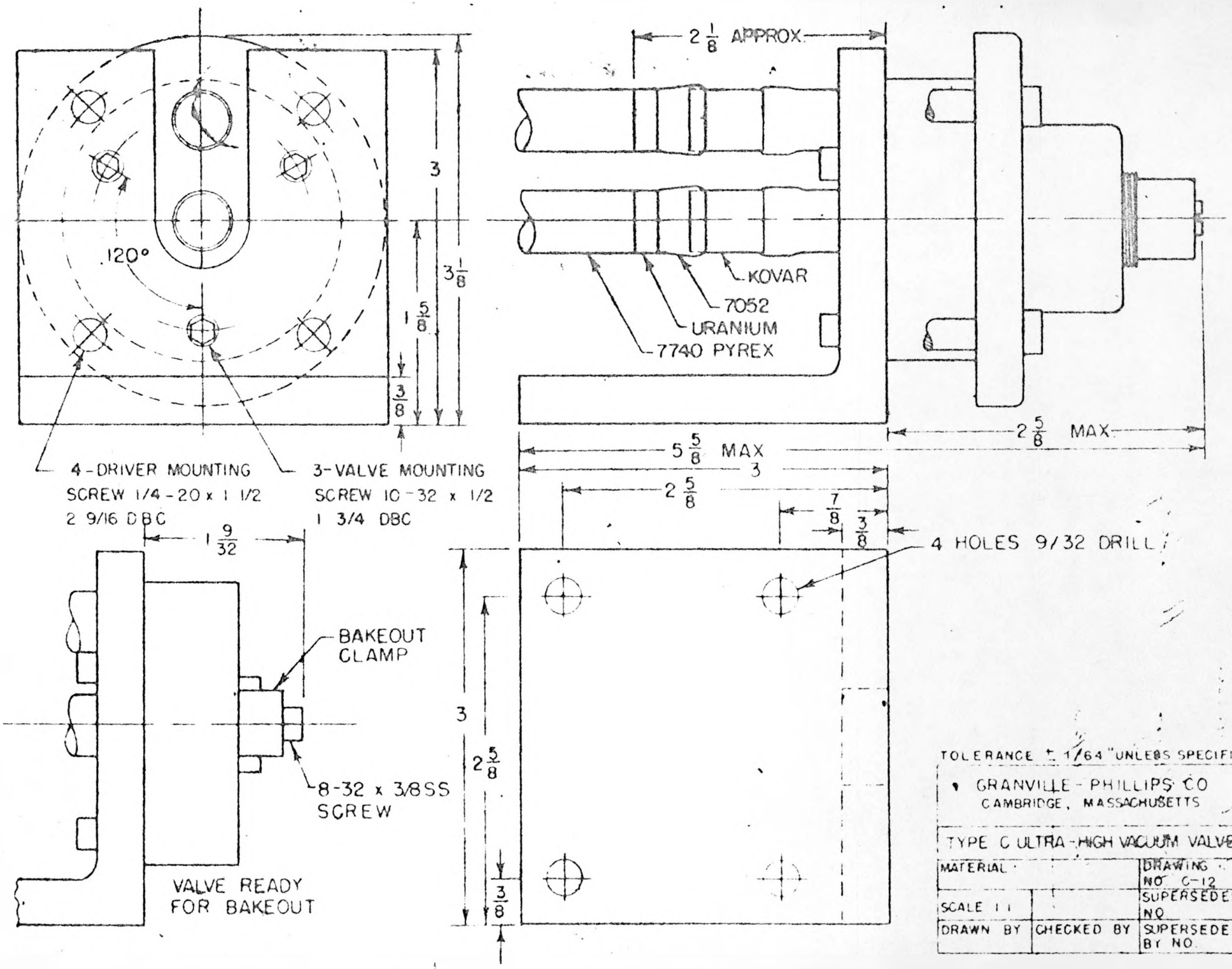
At the completion of the five closed bake-outs, the conductance of the valve was again determined as in the first part. The results are tabulated below:

TABLE II

	Closing torque (in. lbs.)	Conductance (l/sec)
	200	5×10^{-10}
	250	3.5×10^{-10}
	300	2.0×10^{-10}
*	350	5.0×10^{-11}
	400	1.5×10^{-11}

* Note: The first determination at 350 in. lbs. yielded a value of C of 3×10^{-13} 1/sec. Three subsequent determinations yielded the value tabulated. It is not certain whether this extremely low value was true or merely the result of faulty data.

These values of conductance, while deviating from the original run, seem to indicate that certainly this valve did not seriously suffer from the high temperature bake-outs and could be considered still reliable.

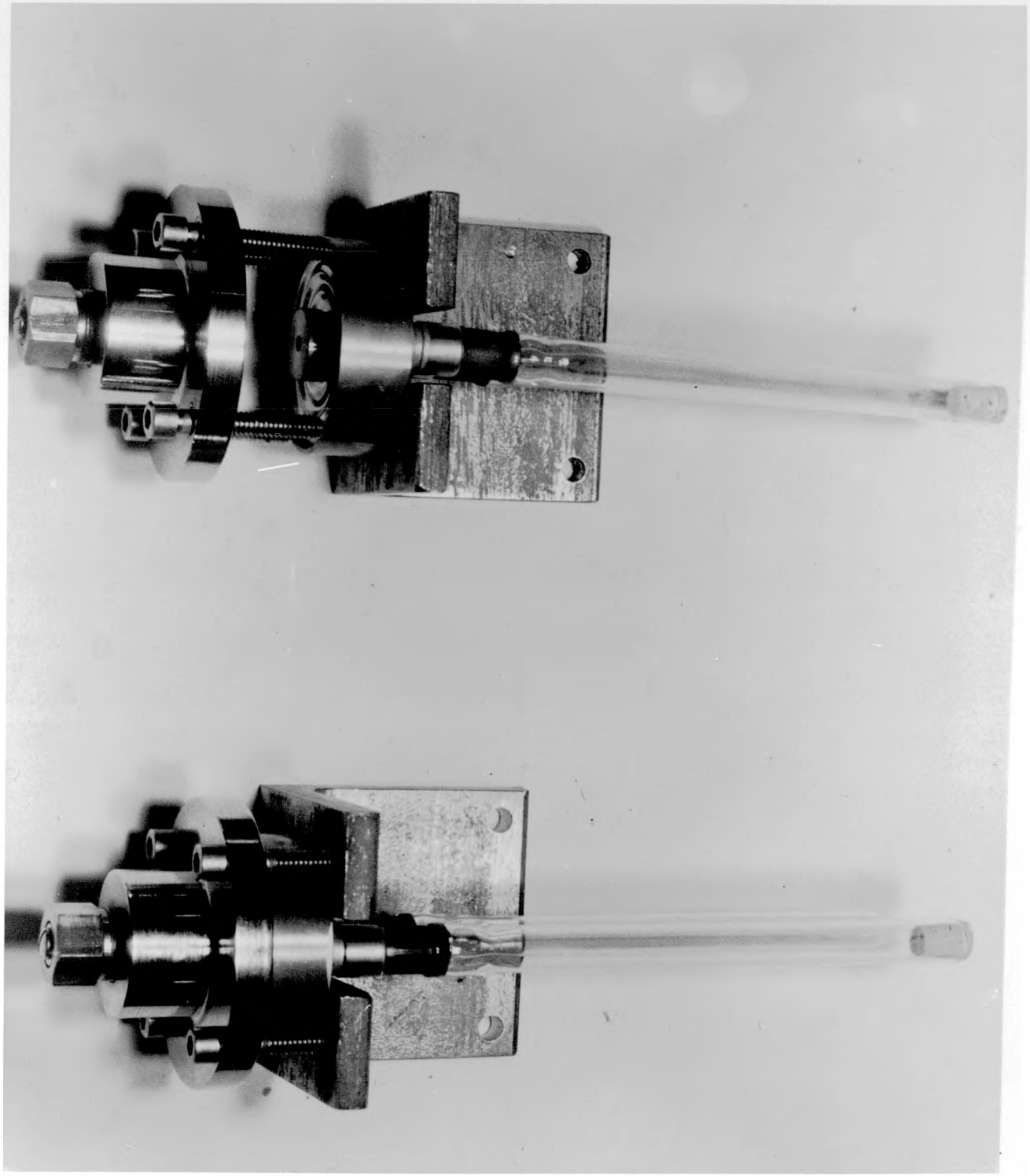


TOLERANCE ± 1/64" UNLESS SPECIFIED

GRANVILLE-PHILLIPS CO
CAMBRIDGE, MASSACHUSETTS

TYPE C ULTRA-HIGH VACUUM VALVE

MATERIAL		DRAWING NO C-12
SCALE 1:1		SUPERSEDES NO
DRAWN BY	CHECKED BY	SUPERSEDED BY NO.



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