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OCT 14 1958
Case No. 756.00
Ref. Sym: 1612 (852)
Project No. TM-896
File: XW-40, 3-2

MR. W. E. TREIBEL - 1246

Attn: Mr. L. Keller - 1246-2

Re: Volume Determination of XW-40 Warhead

Summary of Results

The internal volume or void space of the XW-40 was computed to be 2185 cu. in. or 1.264 cu. ft.

Object of Test

The object of the test was to determine the void space in the XW-40.

Reason for Test

The test was performed as a result of the Work Order Authorization dated August 11, 1958 from Division 1246 to Division 1612.

Summary of Past Tests

No previous volume determination tests have been performed by Division 1612 on the XW-40.

Setup for Test

Figure 1 shows the setup for the test.

The unit tested was a XW-40 warhead, Dwg. No. 130031.

The following equipment was used:

- Air supply with connecting hose
- Three manometers graduated in millimeters of mercury
- Container of known volume
- Two cut-off valves with connecting plumbing

Procedure

The XW-40 was connected to a container of known volume as shown in Fig. 1. Valve No. 2 was closed and valve No. 1 was opened so that the container of

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known volume was pressurized to approximately 600 millimeters of mercury above atmospheric pressure as read on manometer No. 1. Valve No. 1 was closed and the container of known volume was allowed to set for about thirty minutes. Next, valve No. 2 was opened, allowing the air at a known pressure from the known volume to escape into the XW-40 which was initially at atmospheric pressure. Valve No. 2 was left open for a period of about thirty minutes and the readings of manometers Nos. 1 and 2 were checked intermittently during this period. As soon as manometers No. 1 and No. 2 have the same reading it can be assumed that the pressure has equalized in the two containers. Four separate trials were made using the preceding procedure.

After the test was completed, the internal volume of the various sections of the plumbing was determined by weighing the water which it took to fill the individual sections.

Results

The unknown volume was computed from the basic pressure-volume-temperature relationship for gases as follows:

$$\frac{P_1V_1}{T_1} + \frac{P_2V_2}{T_2} = \frac{P^1(V_1 + V_2)}{T^1}$$

By allowing $T_1 = T_2 = T^1$ the above equation can be reduced to:

$$V_2 = V_1 \frac{(P^1-P_1)}{(P_2-P^1)}$$

Where: V_1 = Known internal volume of container plus volume of plumbing from container up to valves No. 1 and No. 2.

V_2 = Internal volume of XW-40 plus volume of plumbing from valve No. 2 to XW-40

P_1 = Absolute pressure in V_1 after V_1 has been pressurized but before valve No. 2 is opened.

P_2 = Absolute pressure (atmospheric) in V_2 before valve No. 2 is opened.

P^1 = Absolute pressure in $(V_1 + V_2)$ after valve No. 2 is opened.

T_1 = Temperature of air in V_1 after pressurization but before valve No. 2 is opened.

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T_2 = Temperature of air in V_2 before valve No. 2 is opened.

T^1 = Temperature of air in $(V_1 + V_2)$ after valve No. 2 is opened.

Using the above equation and the measured values shown in Table I, the volume of the XW-40 was determined for four separate trials. The average volume of the XW-40 for the four trials was 2184.8 cu. in. or 1.264 cu. ft. The minimum and maximum computed volumes in the four trials was 2180.9 cu. in. and 2190.1 cu. in., respectively. These extremes values are 0.18 of one per cent below and 0.24 of one per cent above the mean value of the four trials.

Harry P. Wheeler
HARRY P. WHEELER - 1612-2

Approved by: Paul H. Adams
PAUL H. ADAMS - 1612

HPW:1612-2:as

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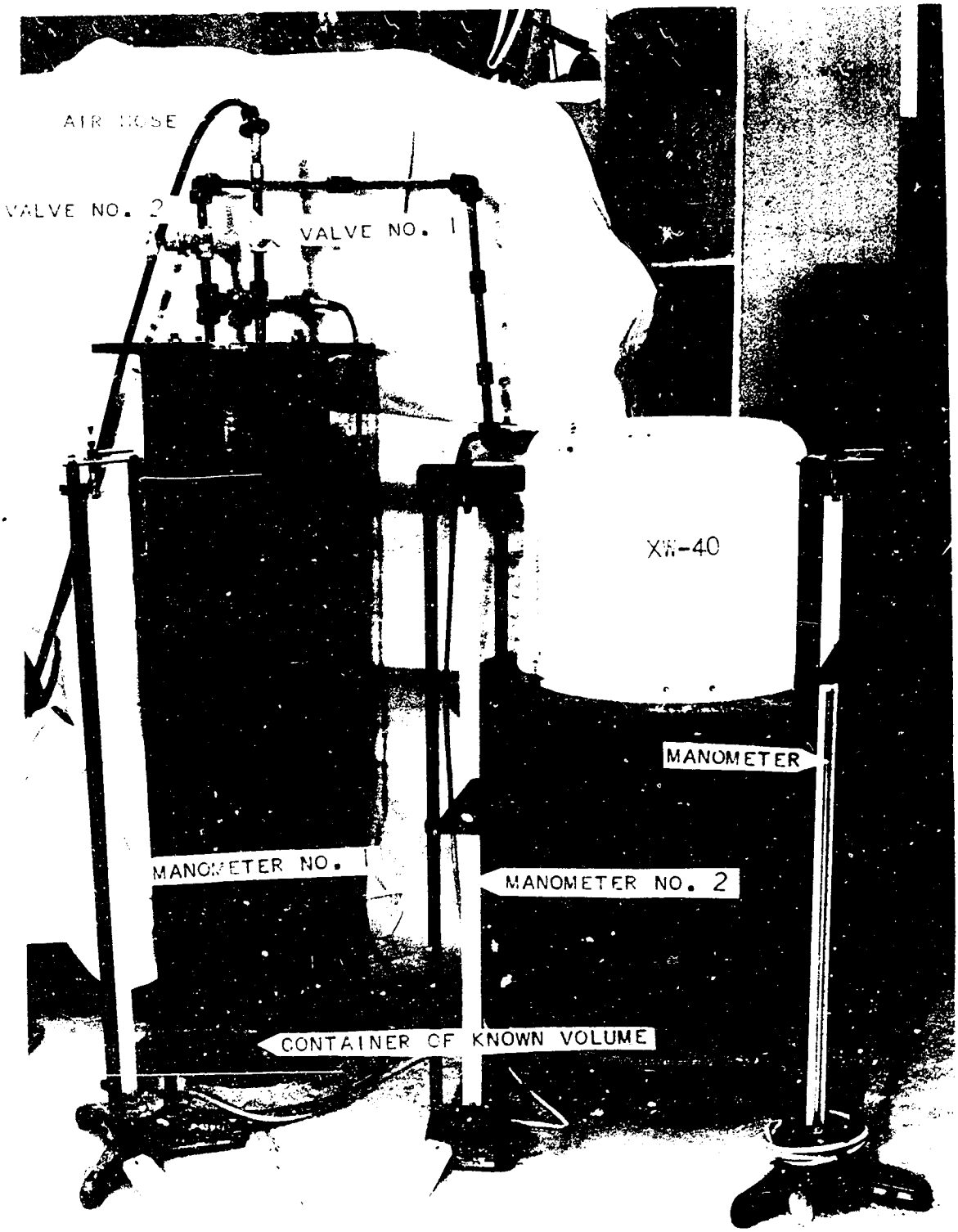

FIG. 1 -- TEST SETUP FOR VOLUME DETERMINATION OF XW-40 WARHEAD.

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TABLE I

PRESSURE-VOLUME DATA -- VOLUME DETERMINATION OF XW-40 WARHEAD

1	2	3	4	5	6	7	8
	Pressures in Millimeters of Mercury						
Trial No.	Atmospheric	Manometer No. 1 Above Atmospheric (Valve No. 2 Closed)	P_1 (2)+(3)	Manometer No. 2 Above Atmospheric (Valve No. 2 Closed)	P_2 (2)+(5)	Manometer No. 1 or No. 2 Above Atmospheric (Valve No. 2 Open)	P_1 (2)+(7)
1	629	602	1231	0	629	362	992
2	628	595	1223	0	628	358	987
3	628	597	1225	0	628	359	988
4	628	586	1214	0	628	352	981

1	9	10	11	12	13	14
	Volumes in Cubic Inches					
Trial No.	*Known Volume of Container	Volume of Plumbing for Container	V_1 (9)+(10)	V_2 (Computed)	Volume of Plumbing From Valve No. 2 to XW-40	Volume of XW-40 (12)-(13)
1	3298.7	3.8	3302.5	2189.6	5.4	2184.2
2	3298.7	3.8	3302.5	2186.3	5.4	2180.9
3	3298.7	3.8	3302.5	2189.6	5.4	2184.7
4	3298.7	3.8	3302.5	2195.5	5.4	2190.1

Volume in cu. ft. = $\frac{2184.8}{1728}$ = 1.264 cu. ft.

* This container has an inside diameter of 10 inches and a length of 42 inches.