THE BOEING COMPANY

COMMERCIAL AIRPLANE DIVISION

RENTON, WASHINGTON

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TITLE: TEST METHOD FOR DETERMINATION OF SMOKE EMISSION CHARACTERISTICS OF AIRCRAFT MATERIALS

MODEL ALL

Attachment #1

ISSUE NO. _____ TO: _____ _____ (DATE)

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1. SCOPE

This test method covers a procedure for measuring the smoke emission characteristics of materials and constructions used in aircraft interiors.

1.2 The values are based on the rate and density of smoke developed by the surfaces of materials when exposed to radiant energy with or without pilot flame ignition.

1.3 It is the intent of this method of test to register performance during the period of exposure, and not to determine suitability for use after the test exposure.

1.4 The test method is intended for use in research and development and not as a basis for regulatory purposes.

2. REFERENCES

(a) D. Gross, J. J. Loftus, and A. F. Robertson, "Method for Measuring Smoke from Burning Materials", Symposium on Fire Test Methods - Restraint and Smoke 1966, ASTM STP 422, Am. Soc. Testing Matls., 1967, p. 166.
(b) Wagge 320-E 3 1/8" Dia. 500 W or Silex-Bloomfiled Type EK6 or Eagle Electric Cat. No. 385 are examples.
(c) GTW-XX-64-20037, Heat Technology Laboratory, Inc., Huntsville, Alabama.

3. TEXT

3.1 SUMMARY OF METHOD

This method is a means of measuring the smoke developed by the surface of a material or assemblage of materials. The smoke is measured by the attenuation of a light beam. A defined area of material is exposed under fixed conditions to a regulated source of radiant heat, with or without pilot flame ignition. The smoke emitted by the material over a time period is recorded. The property defining the attenuation of the light beam is its optical density.

3.2 APPARATUS

3.2.1 Chamber (Reference a)

The smoke chamber consists of a sheet aluminum box 3 feet x 2 feet x 3 feet high. As shown in Figure 1, openings are provided to accomodate a light source and a photometer (C), with a 3 foot vertical light path, an aluminum foil safety blowout panel (D), and a hinged door with a window (E). The chamber is made fairly air tight to avoid smoke loss or air dilution during test. It is supported on an angle-iron frame (P), totally enclosed with aluminum panels. On the front panel are mounted the electric (R, X, & Y) and photometer (T, U.V) controls.

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3.2.1 (Cont'd)

An additional panel is mounted above the support box and in front of the smoke chamber on which are mounted the gas (I), water (H), and air (G & J) controls. The frame is on castors for convenience of moving. The interior of the chamber is painted with a flat black paint. Figure 2 shows power (K) and signal lead wires, air (H), gas (I) and water (J) supply lines and the exhaust duct, slide valve and fan (B).

3.2.2 Furnace and Control System

An electically powered furnace with a 3-inch diameter opening is used. As shown in Figure 3, (C) a 525-w heating element, Reference (b), by means of 3-inch I.D. rings of asbestos cement board. The element is fastened to a holding bar (E), attached to two of the tie bolts (C) running through the asbestos rings. This heating element unit is secured by holding bolts (I) and may be removed as a unit to replace a burned out element. Power is brought into the element by means of two stainless steel bus bars (F) to avoid oxidation of the copper wire leads. The furnace is backed up by asbestos cement board discs (B).

As shown in Figure 1, the control system consists of a temperature controller (X), two variable transformers (Y) and a sensing thermocouple placed within and close to the surface of the core of the furnace opening, Figure 3 (L). The temperature set point of the controller is arranged so that a radiometer, placed at the same location as the specimen, measures the prescribed irradiance level. The two transformers provide high and low voltage levels (rather than on and off) and are adjusted to minimize fluctuations.

3.2.3 Photometric System

A schematic wiring diagram for the furnace and control system is given in Figure 4. The light path is arranged vertically to reduce errors in measurement due to smoke stratification effects. The light source is a 25 W, 120V, S-11/5c frosted lamp powered by a constant voltage transformer. A small 1.25 amp variable transformer provides adjustment for zeroing. The light source is mounted in a box (C, Figure 1). A seven diopter collimating lens sends the light beam through a glass window mounted permanently in the ceiling of the chamber.

Another box containing the photometer is located directly below the source and attached to the bottom of the smoke chamber. Below a similarly mounted glass window in the chamber floor are in order, a seven diopter lens forming an image of the source, 3/16" stop over a front surface mirror that returns the light at a slight angle to a IP 39 single-stage vacuum phototube having an S-4 spectral response. Details are shown in Figure 5.

3.2.4 Specimen Holder

The 3 by 3 inch specimen is placed in a holder (Figure 6), designed for rapid positioning and for maintaining, by means of the furnace support, Figure 7, the specimen surface 1-1/2 inches in front of and parallel to the furnace opening.

The stainless steel specimen holder is fabricated by bending and brazing (or spot welding) to give a 2-9/16 by 2-9/16 inch exposed area. The back, edges, and front nonexposed surfaces of the specimen are covered with a single sheet of aluminum foil to prevent smoke passage at any but the exposed specimen surface. Behind the specimen is placed a 3 by 3 by 1/2 inch thick sheet of asbestos board. A flat spring and a steel pin are used to maintain a snug assembly.

Fabric materials that shrink and pull away at the edges are stapled at the periphery to a thin (approx. 0.020 in.) prepunched aluminum square before wrapping with foil. When the proper spacing is maintained between the spacing stops of the furnace mount (Figure 7), the loaded specimen can be quickly and accurately positioned by placing it on the support bars and sliding the radiometer (or another holder) to the limit of its travel.

3.2.5 Radiometer

The desired irradiance level (2.5 w/cm^2) at the specimen surface is measured by means of a circular foil radiometer of the Gardon type (Reference C). The water cooled unit is mounted on a 3 inch square of aluminum 1-inch thick and mounted in a specimen holder with the sensor surface flush with the opening as a specimen would be. Three stainless steel thin baffles were used to reduce the heat load on the body of the transducer. Details are shown in Figure 8.

3.2.6 Pilot Flame

The pilot flame burner is designed to impinge the specimen uniformly across the lower edge. Ignition of combustible volatiles takes place at the point of flame impingement and progressively involves the entire sample. The burner design is shown in Figure 9. A 90 degree swagelock fitting allows easy removal for cleaning. The assembly is mounted so that when rotated into position, the burner is centered in front of and parallel to the specimen holder, at a distance of 1/4 inch from the specimen surface and 1/4 inch above the holder edge. A feeler guage will allow an easy and frequent check on the burner location in relation to individual sample holders.

3.2.6 (cont'd)

The size and number of holes are designed to use a premixed fuel of air and methane. These are metered by rotometers and combined before going to the burner. The methane is supplied at a rate of 125 cc/min. and the air at 375 cc/min. The flame should appear as six spherical elements. These should make point peripheral contact with the specimen but not sufficient to distort the sphere.

3.3 TEST SPECIMENS

All specimens are cut to a 2-15/16 by 2-15/16 inch size to allow for the foil wrap, and then conditioned to equilibrium in a cabinet with an ambient temperature of 73 ± 5 F and 50 ± 5 F percent relative humidity.

The preconditioned specimen is wrapped in a single sheet of aluminum foil to cover the back, the edges and unexposed periphery of the front surface of the specimen, care being taken not to puncture the foil. The wrapped specimen is mounted in a cool specimen holder, backed with a sheet of 1/2 inch asbestos board and firmly assembled using the spring and clip. The foil is folded back over the holder frame and the excess trimmed away.

3.4 TEST PROCEDURE

To perform a test, the cooling water to the radiometer is turned on and set to approximately 300 ml/min. The electrically powered furnace and associated controls are turned on. The radiometer is positioned in front of the furnace. Turn on the recorder. The controller temperature setting is adjusted to produce a millivolt output of the radiometer corresponding to an irradiance of 2.5 w/cm^2. The two variable transformers are adjusted to suitable voltage levels to minimize cyclic variations in irradiance. The photometer, light source and phototube are turned on. Using the lamp adjusta-volt control, the output reading is set to full scale (100%) on a convenient range (250mv or higher). Be sure the lens windows are clean for this adjustment. The zero reading is verified by covering the lower lens to block off the light beam.

For tests employing pilot ignition (radiant plus flame) gas is supplied to the pilot burner at the rate of 125 cc/min (for methane) and 375 cc/min. air (air-fuel ratio 3:1). The burner is ignited in the down position then rotated behind the radiometer so as not to affect its reading. The loaded specimen holder is placed on the bar supports beside the radiometer at time zero minus 60 seconds. The door is closed, the damper is closed and the fan turned off. Final adjustments are made on the furnace and photometer. At time zero, the sample is moved into position in front of the furnace, displacing the radiometer and the flame rotated into position. As values of light transmittance are being recorded, observation of characteristic smoking, burning, glowing and sample behavior are marked on the recording trace so as to record time of occurrence.

3.4 (Cont'd)

The smoke test is run for five minutes or longer as desired. At the end of the test, the sample is displaced by moving the radiometer in front of the furnace. The damper is opened, the exhaust fan turned on and the door is opened a small amount to clear the chamber of smoke. When clear of smoke, the holder with the burned sample is removed, the photometer glass cover plates are cleaned, and the recorder reading again adjusted to 100 percent transmission if necessary in preparation for the succeeding test.

For tests using radiant heat only, the procedure is the same except the pilot flame is shut off and rotated out of the way.

3.4.1 Radiation Level

The air-cooled radiometer is standardized against the water cooled radiometer. Place the former beside the latter with cooling water connections temporarily attached. The electrically power furnace and associated controls are turned on. When the furnace reaches a steady state, the controls are adjusted to produce a millivolt output of the water cooled radiometer corresponding to an irradiance of 2.5 w/cm^2. The two variable transformers are adjusted to suitable voltage levels to minimize cyclic variations. The air cooled radiometer is moved into position. Its millivolt reading is noted and used for the balance of the day. The water-cooled radiometer is removed to avoid exposure to acid fumes that will condense on and corrode the element.

3.4.2 Photometer Adjustment

Be sure that the lens windows are clean for this adjustment. Using the lamp adjustavolt control, the output reading is set to full scale (100%) on a convenient range (250mv or higher). Cover the lower lens window to block off the light beam and adjust the zero set on the recorder if necessary.

3.4.3 Pilot Flame

The rotometers are adjusted to supply 125cc/min of gas (for methane) and 375cc/min air (air-fuel ratio 3:1). The burner is ignited in the down position then rotated behind the radiometer so as not to affect its reading.

3.4.4 Specimen Run

Before a test run, check all settings with the door closed, and a dummy holder beside the radiometer.

At time zero minus 60 seconds, replace the dummy holder with a mounted specimen. At time zero minus 20 seconds, shut off the air to the radiometer and close the vent opening tight. Verify the air

3.4.4 (Cont'd)

setting on the pilot flame rotometer. At time zero, the specimen is moved into position in front of the furnace, displacing the radiometer, and the flame simultaneously rotated into position. As values of light transmittance are being recorded, observations of characteristic smoking, burning, glowing and sample behavior are marked on the recording trace so as to record the time of occurance. The test is run for five minutes. At the end of the test, the specimen is displaced by moving the radiometer in front of the furnace. The radiometer cooling air is turned on, the vent is opened, the exhaust fan turned on, and the door is opened a small amount to clear the chamber of smoke. When clear of smoke, the holder with the burned specimen is removed and replaced with dummy holder, the photometer lens windows are cleaned. All settings are verified in preparation for the succeeding test.

For tests using radiant heat only, the procedure is the same except the pilot flame is shut off and rotated out of the way.

3.5 REPORT

3.5.1 Nomenclature

A	Surface area of specimen in $ft.^2$.
D	Optical density = log10 (Fo/F)
D_m	Maximum value of specific optical density
D_s	Specific optical density = D(V/AL)
F	Transmitted light flux in %.
F_o	Incident light flux = 100%.
L	Length of light path in ft.
SOI_4	Smoke obscuration index for first four minutes.
V	Volume of smoke chamber in ft^3,
t_c	A constant time interval in minutes at which D_s values are obtained.

3.5.2 Data Interpretation

The result of a smoke measurement test is a curve of specific optical density versus time. The reduction in the transmittance caused by smoke is converted to specific optical density using the relation:

$$D_s = \frac{DV}{AL} = \frac{V}{AL} \log_{10} \frac{Fo}{F} = 132 \log_{10} \frac{100}{F}$$

where L = 3 ft, A = 0.0456 ft^2, and V = 18 ft^3 for the standard chamber.

3.5.2 (Cont'd)

The hazard to visibility is related to the smoke accumulation for a period of time. Precisely, this would be the area under the D_s/time curve, but has been found that it is sufficiently accurate to approximate the area under the curve, using a summation of the approximate areas for each one minute interval. This is called the Smoke Obscuration Index and for a four minute period is indicated as SOI_4. The following formula is used:

(a) $$SOI_4 = (1 \text{ min.}) \left(\frac{D_o + D_1}{2} + \frac{D_1 + D_2}{2} + \frac{D_2 + D_3}{2} + \frac{D_3 + D_4}{2}\right)$$

$$= 1 \times \left(D_1 + D_2 + D_3 + \frac{D_4}{2}\right)$$

Where D_o D_1 D_2 D_3 and D_4 are the D_s's at the various one minute intervals.

Examination of the curves of various materials indicates that the SOI_4 calculation accurately combines the significant factors of time, rate and density.

Other periods and intervals of time may be used, e.g.

(b) $$SOI_{1.5} = \left(\frac{1}{4} \text{ Min.}\right) \left(D_{.25} + D_{.50} + D_{.75} + D_{1.0} + D_{1.25} + \frac{D_{1.5}}{2}\right)$$

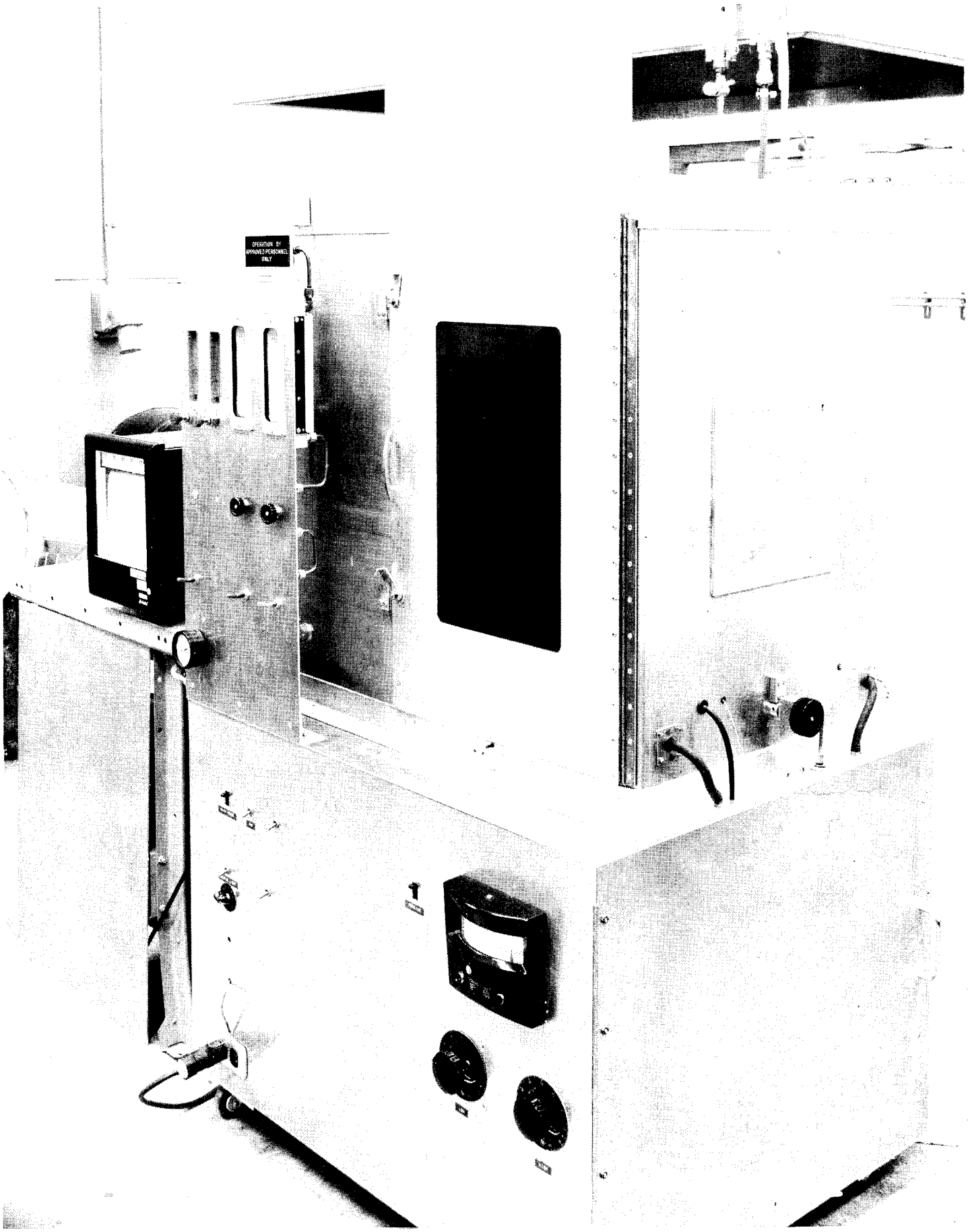
3.5.3 Data Record

The data is recorded as shown in Figure 10. The percent transmission values at the various time intervals are read off the recorder trace. These readings are converted to specific optical density values, D_s by using the Conversion Table, Table 1.

The SOI_4 is calculated using formula 3.5.2 (a), and the $SOI_{1.5}$ is calculated using formula 3.5.2 (b).

The maximum density and the time at which it occurs are recorded in the place marked D_m@ .

The burn time can be estimated by using tic marks on the recorder trace. The start and stop of burning are too indistinct to warrant stop watch values.


OPERATION BY
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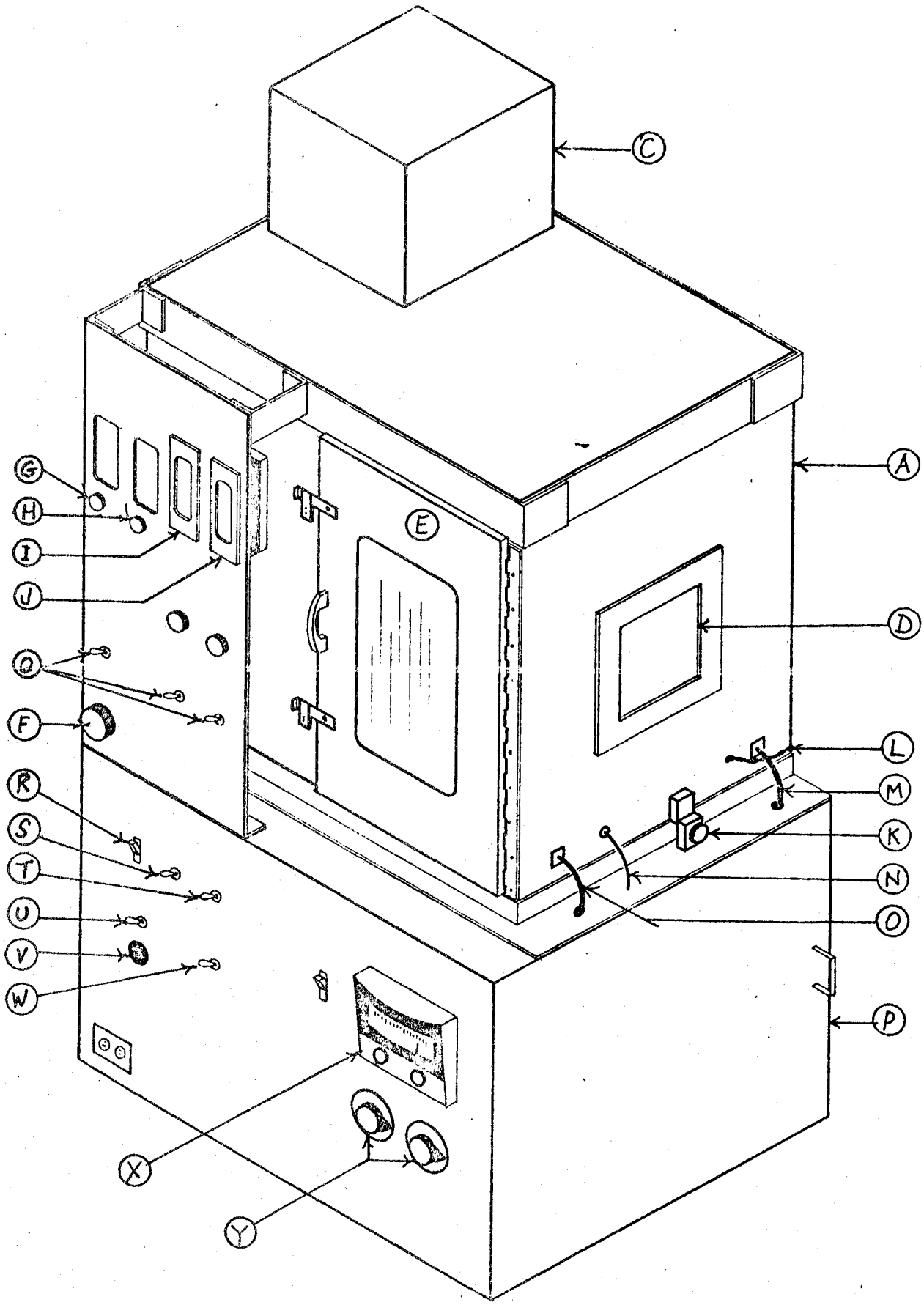
ONLY



SMOKE CHAMBER

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FIGURE 1

LEGEND

A - Chamber
B - Exhaust Fan
C - Photometer Light Source
D - Blow Out Panel
E - Hinged Door with Window
F - Air Pressure Reducer and Guage
G - Ventilation Air Flowmeter
H - Radiometer Water Flow Meter
I - Pilot Light Air Flowmeter
J - Pilot Light Gas Flowmeter
K - Pilot Light Locator
L - Radiometer Lead to Recorder
M - Radiometer Cooling Water
N - Thermocouple Lead to Controller
O - Ventilation Air Hose
P - Enclosed Support Cart
Q - Toggle Valves
R - Main Power Switch
S - Fan Switch
T - Photometer Light Source Switch
U - Photometer Phototube Switch
V - Variable Transformer
W - Inside Light Switch
X - Furnace Controller
Y - High-Low Variable Transformers

SMOKE CHAMBER
FIGURE 1

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(Sheet 3 of 3)

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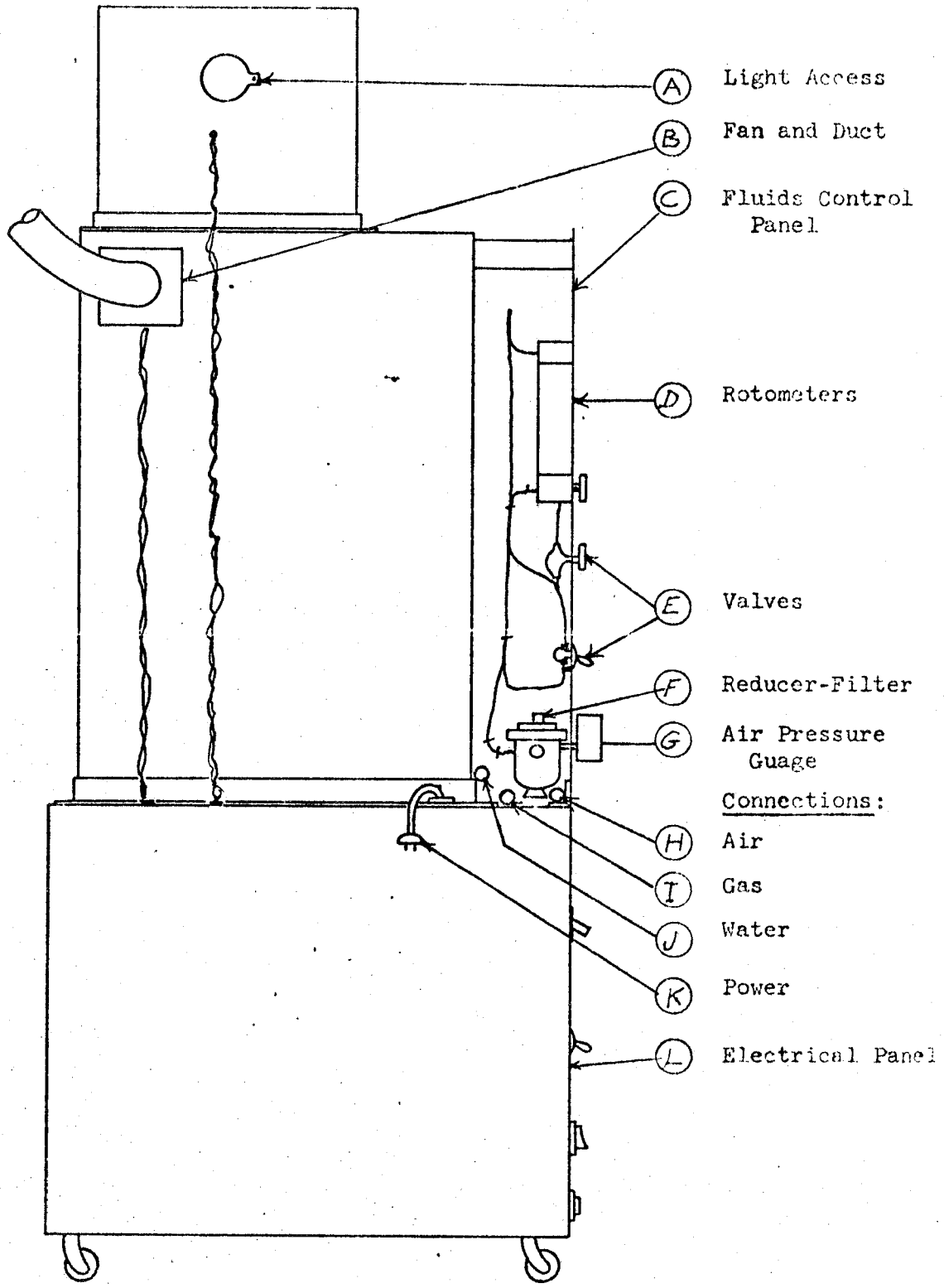

FIGURE 2

SMOKE CHAMBER

[illegible] ELEVATION

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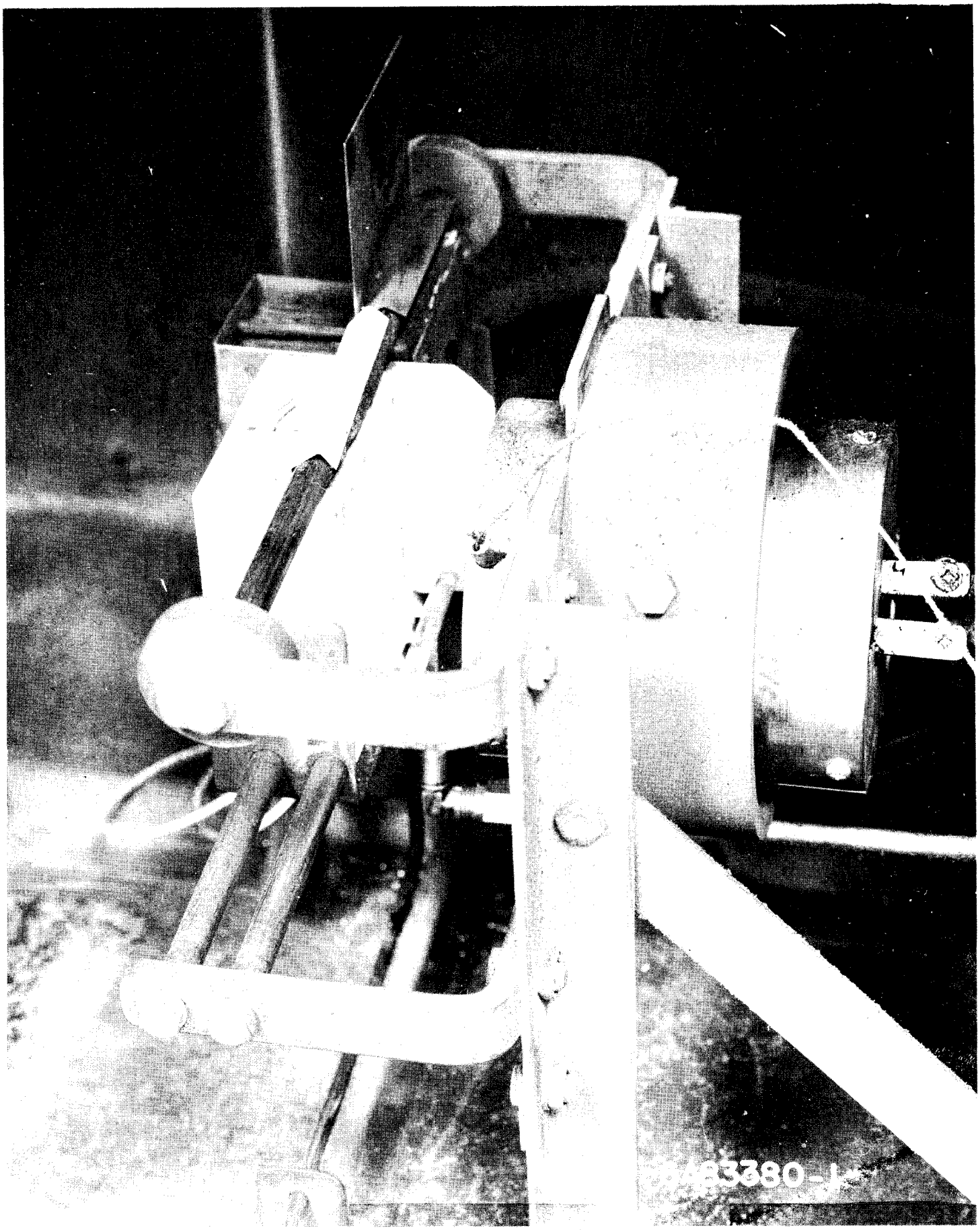
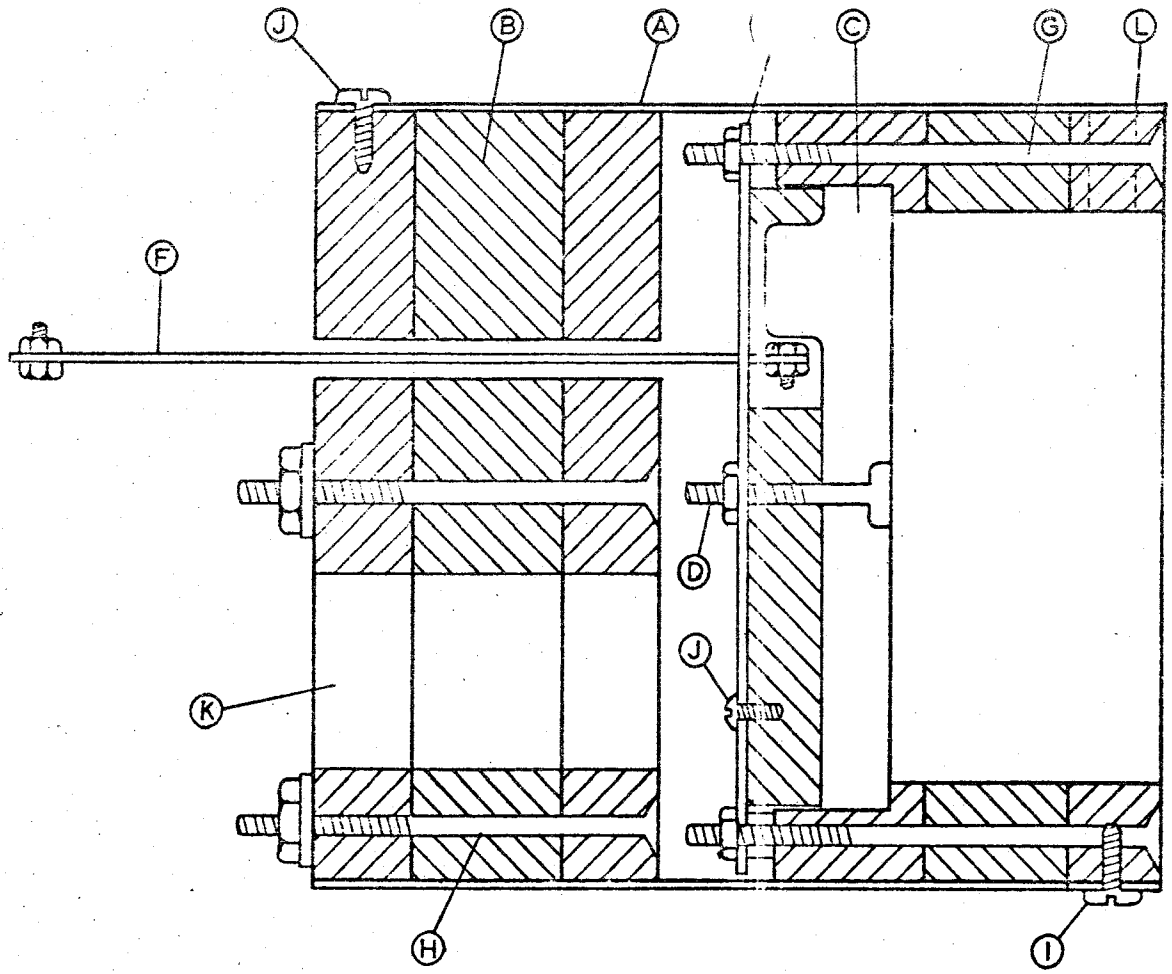




(A) Stainless Steel Tube - .020"

(B) Asbestos Cement Board

(C) Heating Element

(D) Element Mounting Bolt

(E) S.S. Holding Bar 3/8 x

(F) S.S. Bus Bars (2)

(G) Tie Bolts, 4 places

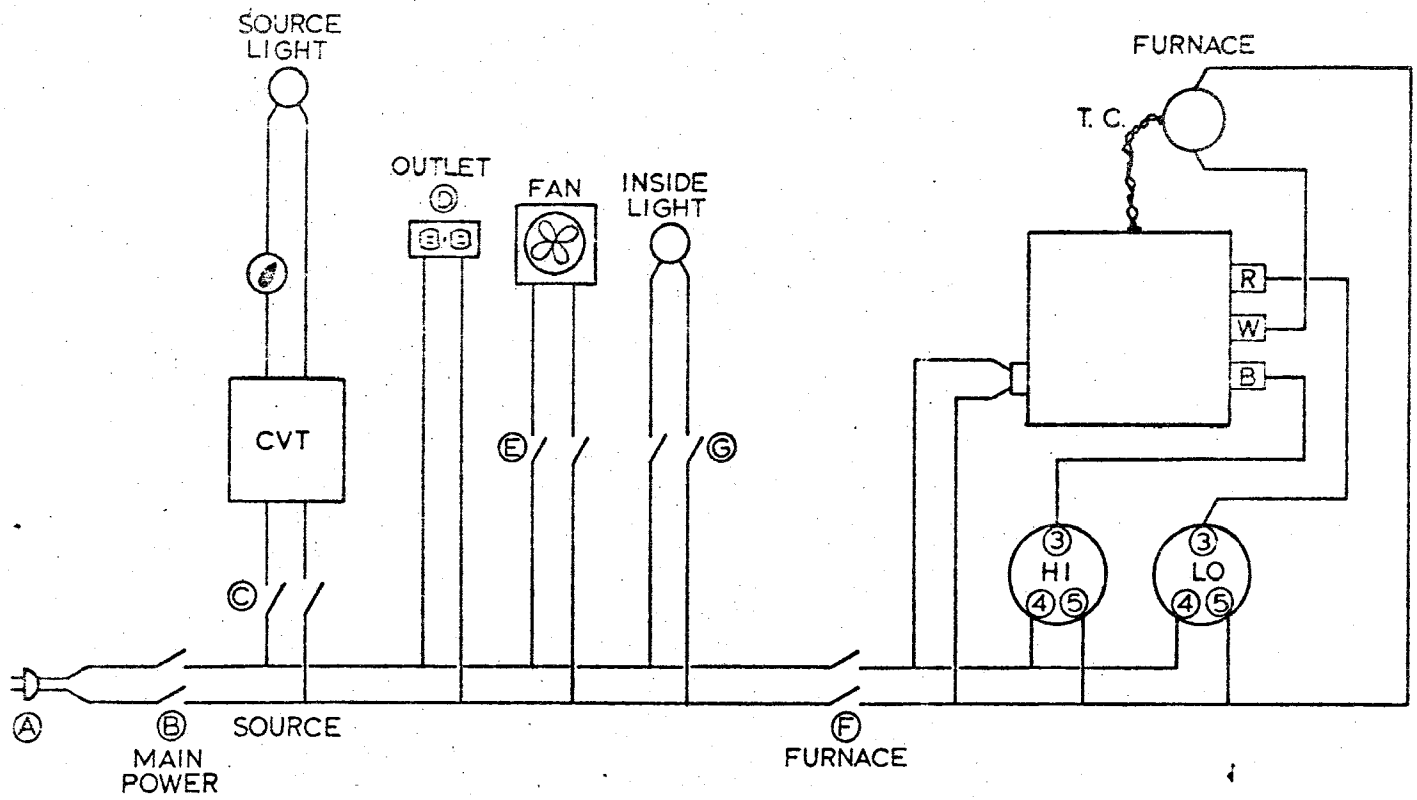
(H) Tie Bolts, 3 places

(I) (J) Line up, Holding Bolts, 7 places

(K) 1" Ventilation Hole, 2 places

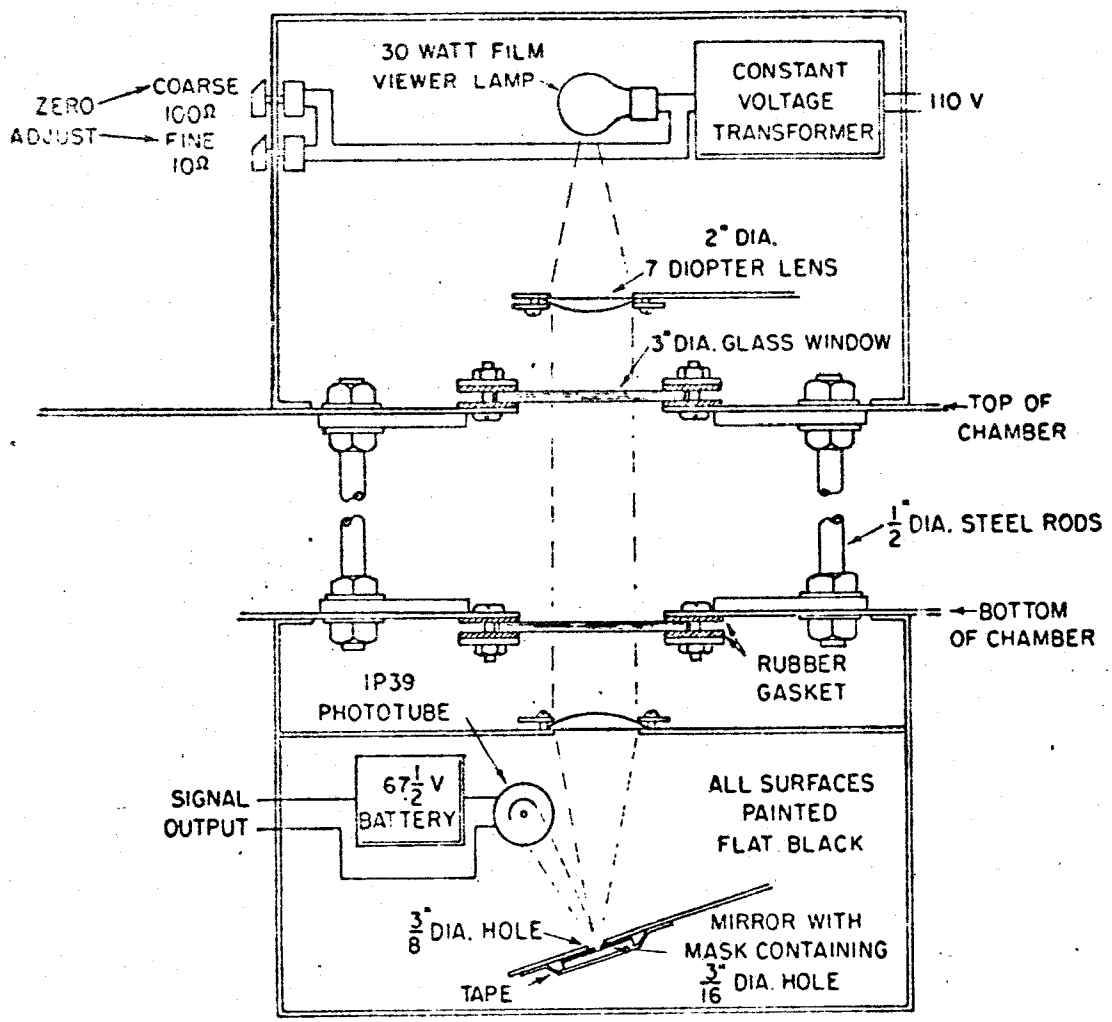
(L) Opening for Thermocouple

FURNACE ASSEMBLY



WIRING DIAGRAM

FIGURE 4



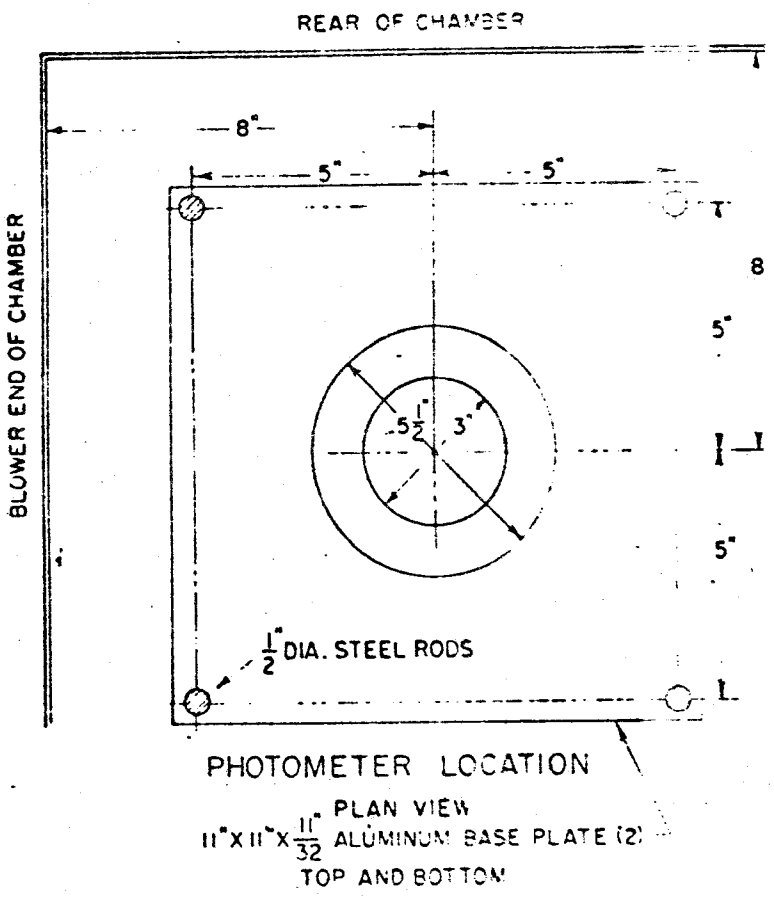
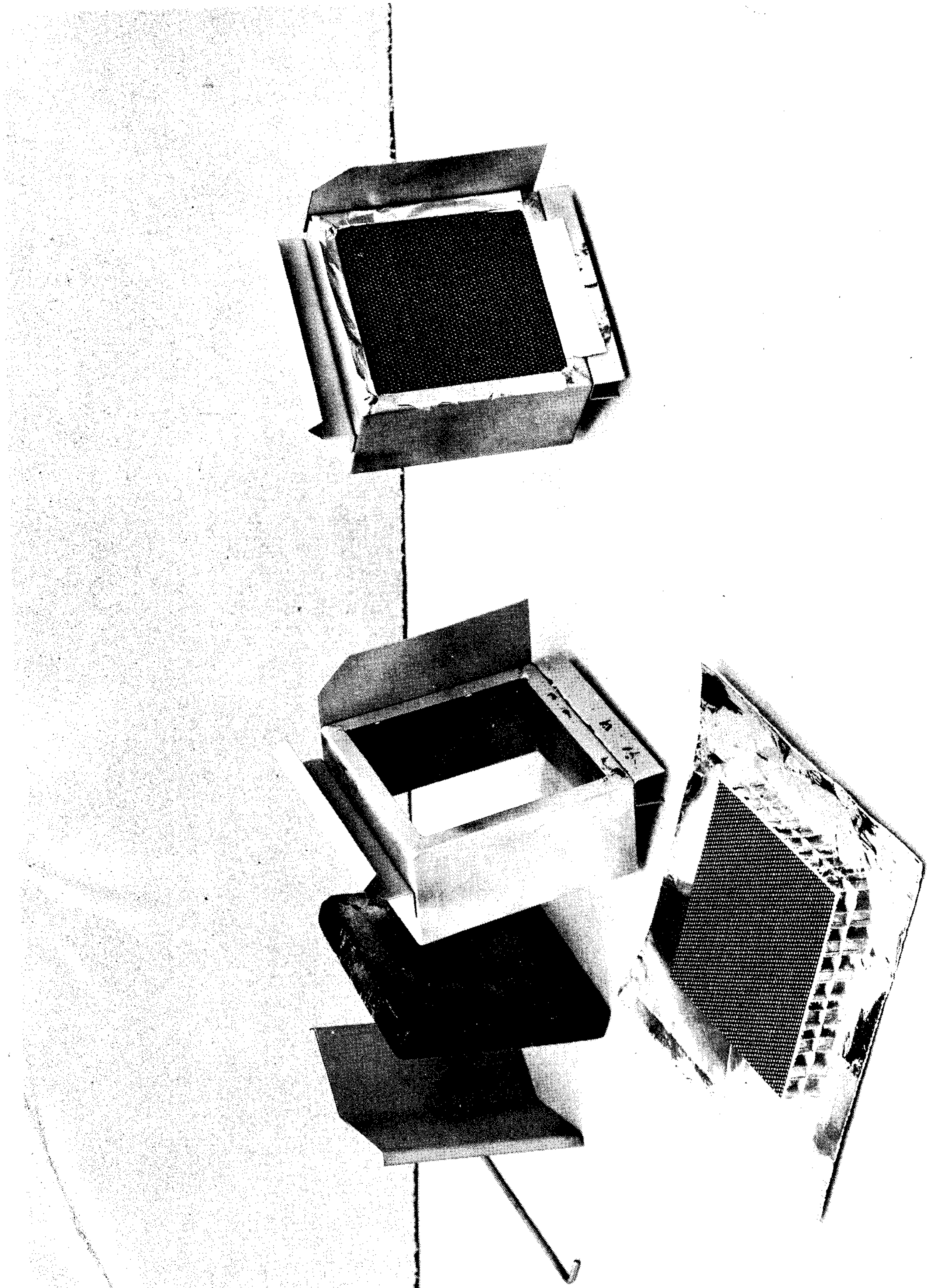
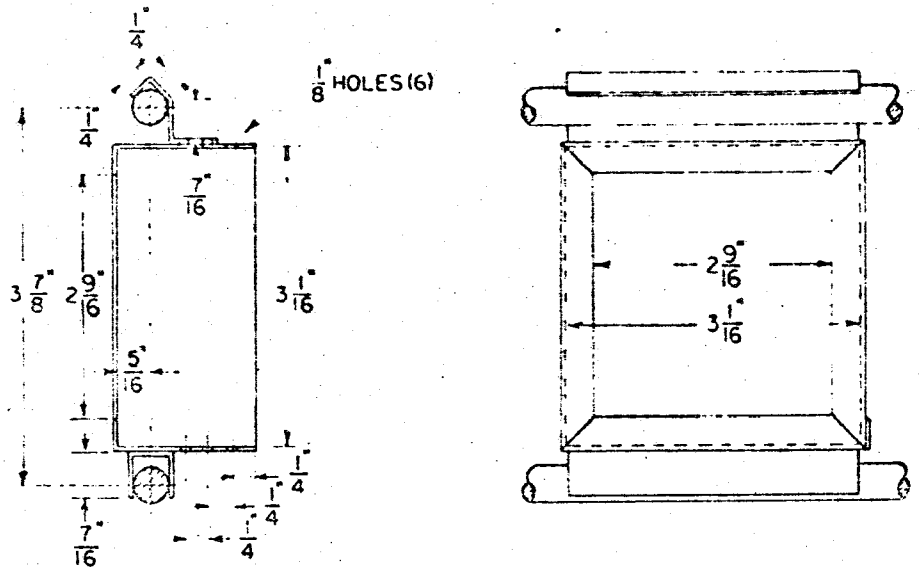
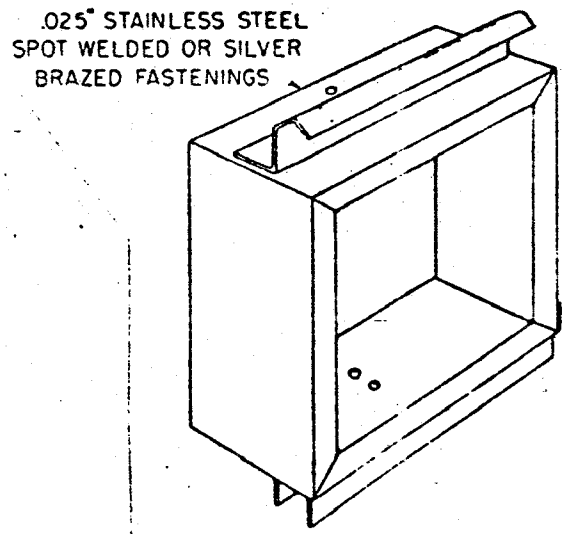
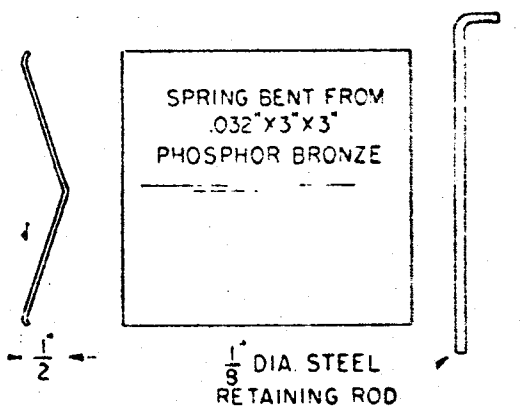


FIG. 5 PHOTOMETER DETAILS









SPECIMEN RETAINER

FIGURE 6

SPECIMEN HOLDER

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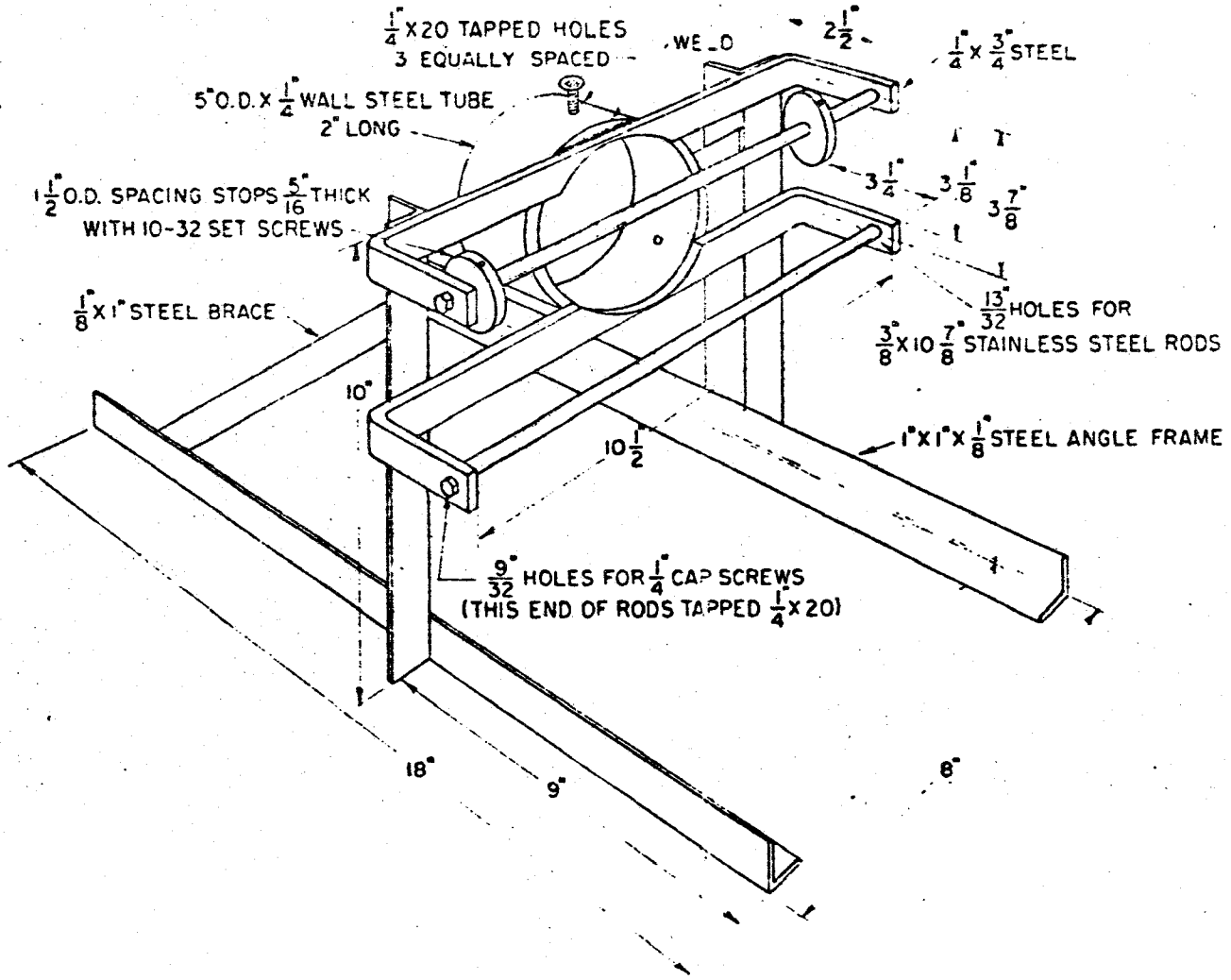
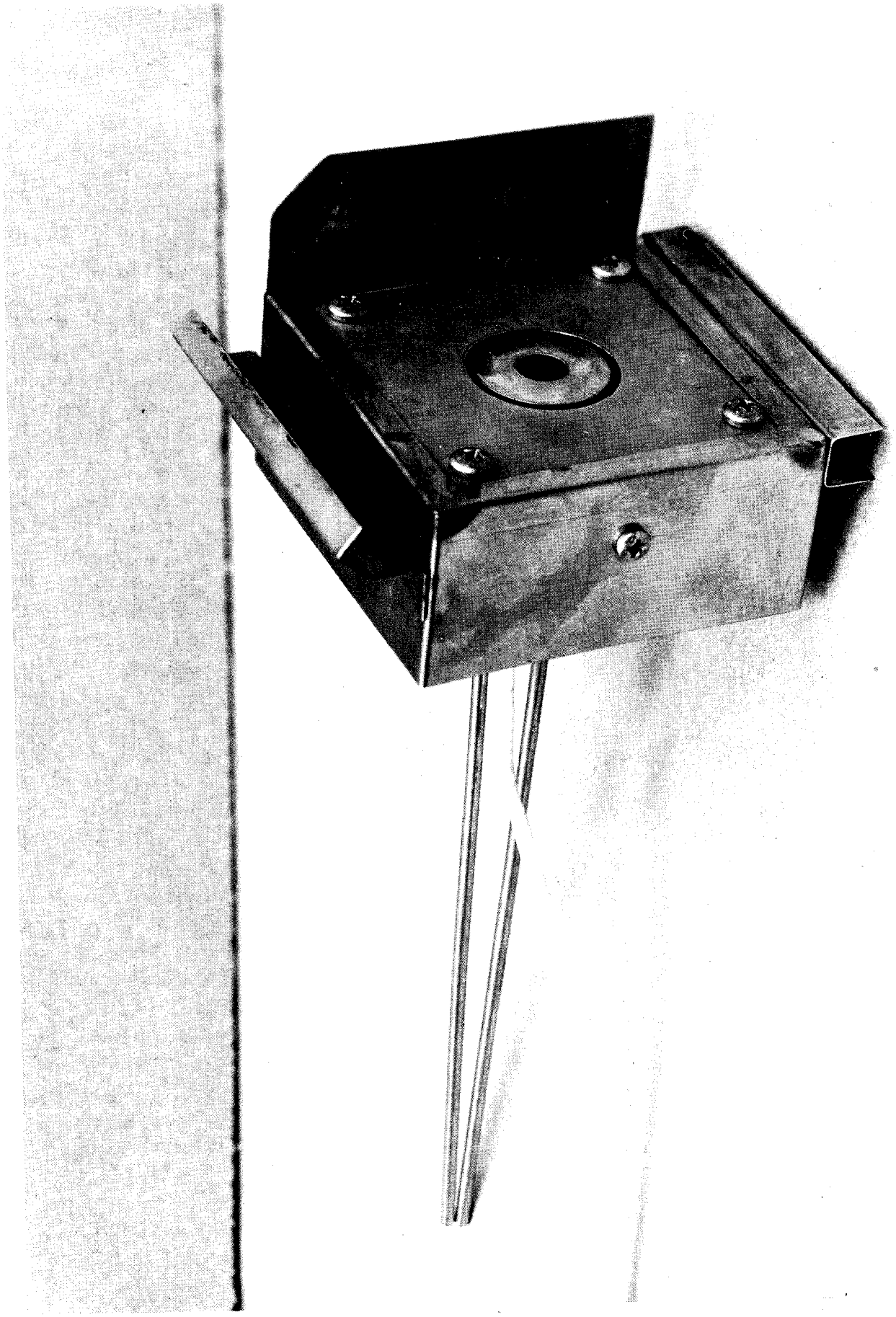
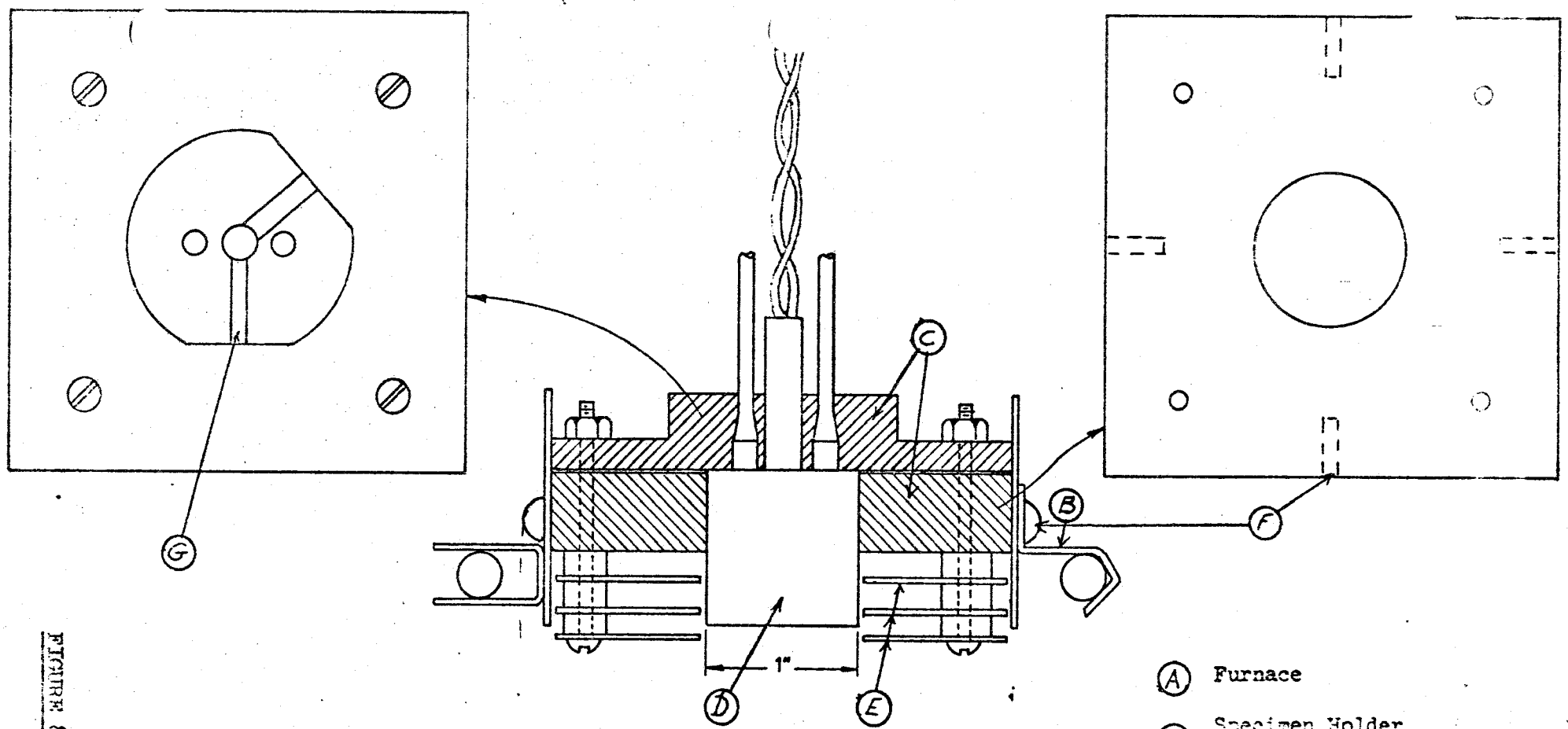


FIG. 7 – FURNACE MOUNT





(A) Furnace

(B) Specimen Holder

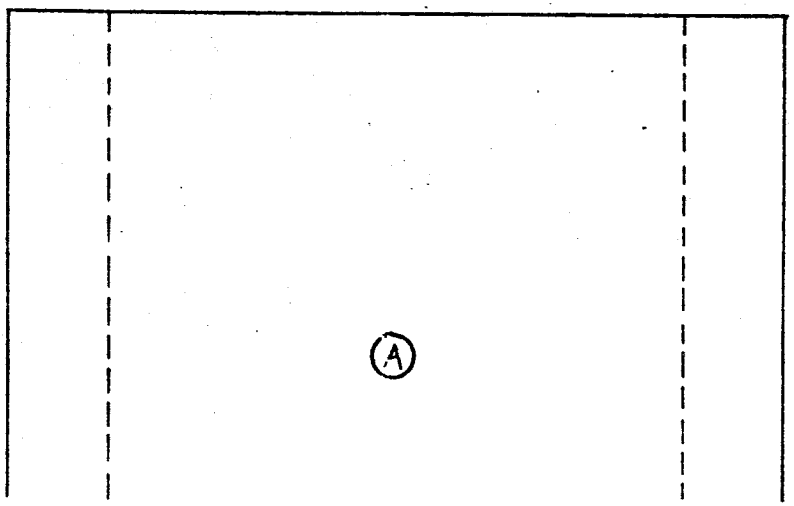
(C) Aluminum Mounting Blocks

(D) Radiometer, Water Cooled

(E) Reflectors

(F) Holding Screws (4)

(G) Set Screw

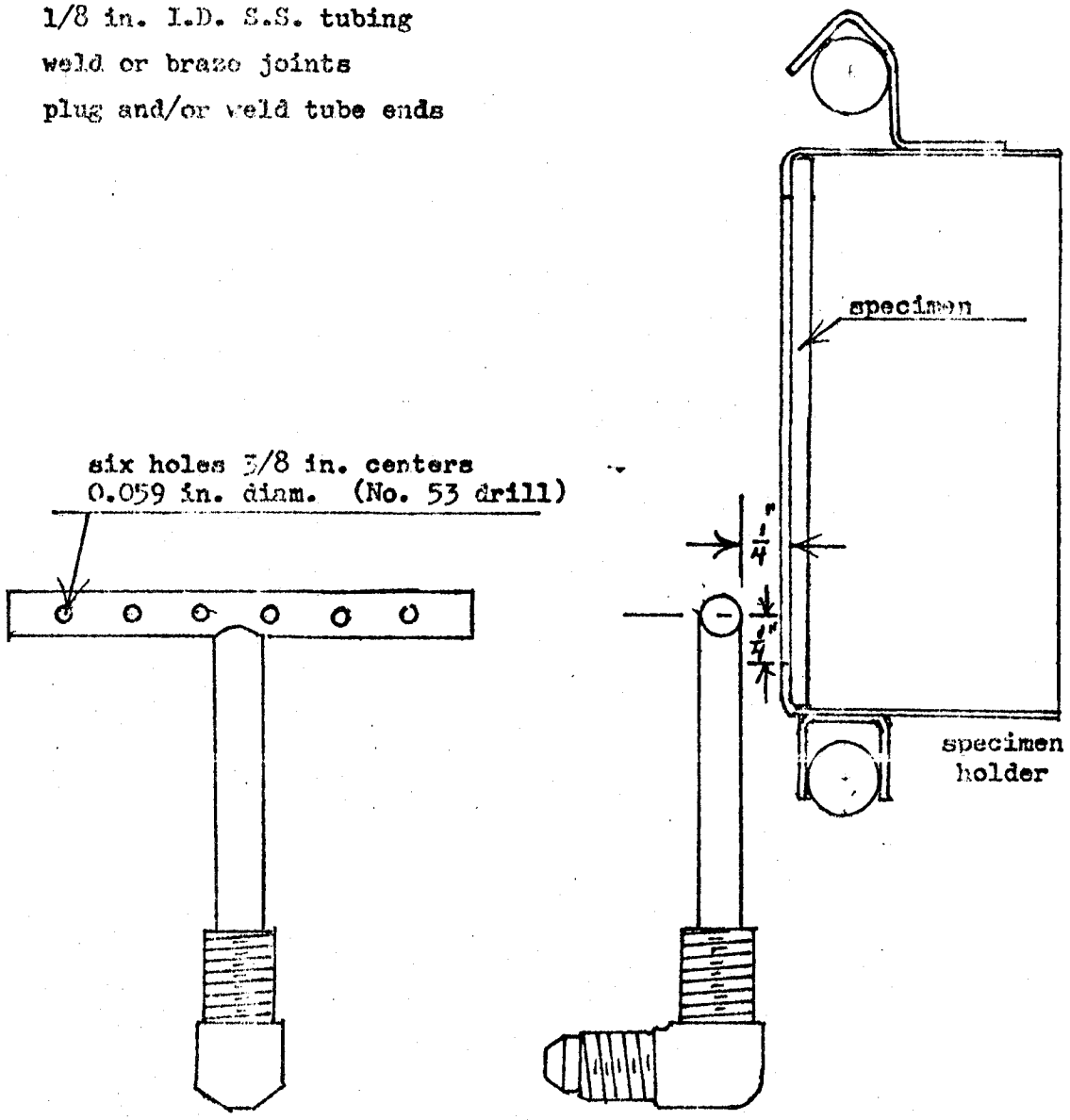


RADIOMETER MOUNT

FIGURE 8

(Sheet 2 of 2)

1/8 in. I.D. S.S. tubing
weld or braze joints
plug and/or weld tube ends



Front View, Facing Specimen

Side View, indicating critical spacing

Pilot Flame Burner

Figure 9

NBS SMOKE CHAMBER DATA SHEET

OPERATOR _____ DATE _____ RUN NO. _____

MATERIAL:

CATEGORY

APPLICATION

BASIC (CHEMICAL)

MANUFACTURER

VENDOR DESIGNATION

BOEING CALL-OUT

CONDITIONS:

SPECIMEN	1		2		3		4		5	
TIME MIN.	%T	Ds	%T	Ds	%T	Ds	%T	Ds	%T	Ds
.25										
.50										
.75										
1.00										
1.25										
1.50										
2.0										
3.0										
4.0										
5.0										
TIME TO EXTINCTION										
TIME TO IGNITION										
BURN TIME										
D_M @										
SOI_4										
$SOI_{1\frac{1}{2}}$										

FIGURE 10

CONVERSION TABLE

% Transmission To Specific Optical Density (D_S)

$$D_s = \frac{18\ ft^3}{.0456\ ft^2 \times 3\ ft} \times \text{Log}_{10}\left(\frac{100}{\%\ T}\right)$$

% T	D_S	% T	D_S	% T	D_S	% T	D_S	% T	D_S
100.0	0	81.5	12	63.5	26	45.5	45	27.5	74
99.5	0	81.0	12	63.0	26	45.0	46	27.0	75
99.0	0	80.5	12	62.5	27	44.5	46	26.5	76
98.5	1	80.0	13	62.0	27	44.0	47	26.0	77
98.0	1	79.5	13	61.5	28	43.5	48	25.5	78
97.5	1	79.0	13	61.0	28	43.0	48	25.0	79
97.0	2	78.5	14	60.5	29	42.5	49	24.5	80
96.5	2	78.0	14	60.0	29	42.0	50	24.0	82
96.0	2	77.5	15	59.5	30	41.5	50	23.5	83
95.5	3	77.0	15	59.0	30	41.0	51	23.0	84
95.0	3	76.5	15	58.5	30	40.5	52	22.5	85
94.5	3	76.0	16	58.0	31	40.0	52	22.0	87
94.0	3	75.5	16	57.5	32	39.5	53	21.5	88
93.5	4	75.0	16	57.0	32	39.0	54	21.0	89
93.0	4	74.5	17	56.5	32	38.5	55	20.5	91
92.5	5	74.0	17	56.0	33	38.0	55	20.0	92
92.0	5	73.5	18	55.5	33	37.5	56	19.5	94
91.5	5	73.0	18	55.0	34	37.0	57	19.0	95
91.0	5	72.5	18	54.5	34	36.5	58	18.5	97
90.5	6	72.0	19	54.0	34	36.0	58	18.0	98
90.0	6	71.5	19	53.5	35	35.5	59	17.5	100
89.5	6	71.0	20	53.0	36	35.0	60	17.0	102
89.0	7	70.5	20	52.5	36	34.5	61	16.5	103
88.5	7	70.0	20	52.0	37	34.0	62	16.0	105
88.0	7	69.5	21	51.5	38	33.5	63	15.5	107
87.5	8	69.0	21	51.0	39	33.0	63	15.0	109
87.0	8	68.5	22	50.5	39	32.5	64	14.5	111
86.5	8	68.0	22	50.0	40	32.0	65	14.0	113
86.0	9	67.5	22	49.5	40	31.5	66	13.5	115
85.5	9	67.0	23	49.0	41	31.0	67	13.0	117
85.0	9	66.5	23	48.5	41	30.5	68	12.5	119
84.5	10	66.0	24	48.0	42	30.0	69	12.0	122
84.0	10	65.5	24	47.5	43	29.5	70	11.5	124
83.5	10	65.0	25	47.0	43	29.0	71	11.0	127
83.0	11	64.5	25	46.5	44	28.5	72	10.5	129
82.5	11	64.0	26	46.0	44	28.0	73	10.0	132
82.0	11								

TABLE 1

%T	D_s	%T	D_s	%T	D_s	%T	D_s	%T	D_s
10.00	132	8.15	144	6.35	158	4.55	177	2.75	206
9.95	132	8.10	144	6.30	159	4.50	178	2.70	207
9.90	133	8.05	145	6.25	159	4.45	178	2.65	208
9.85	133	8.00	145	6.20	160	4.40	179	2.60	209
9.80	133	7.95	145	6.15	160	4.35	180	2.55	210
9.75	133	7.90	145	6.10	160	4.30	180	2.50	211
9.70	134	7.85	146	6.05	161	4.25	181	2.45	213
9.65	134	7.80	146	6.00	161	4.20	182	2.40	214
9.60	134	7.75	147	5.95	162	4.15	182	2.35	215
9.55	134	7.70	147	5.90	162	4.10	183	2.30	216
9.50	135	7.65	147	5.85	163	4.05	184	2.25	217
9.45	135	7.60	148	5.80	163	4.00	185	2.20	219
9.40	135	7.55	148	5.75	164	3.95	185	2.15	220
9.35	136	7.50	148	5.70	164	3.90	186	2.10	221
9.30	136	7.45	149	5.65	165	3.85	187	2.05	223
9.25	136	7.40	149	5.60	165	3.80	188	2.00	224
9.20	137	7.35	150	5.55	166	3.75	188	1.95	226
9.15	137	7.30	150	5.50	166	3.70	189	1.90	227
9.10	137	7.25	150	5.45	167	3.65	190	1.85	228
9.05	138	7.20	151	5.40	167	3.60	191	1.80	230
9.00	138	7.15	151	5.35	168	3.55	192	1.75	232
8.95	138	7.10	152	5.30	168	3.50	192	1.70	233
8.90	138	7.05	152	5.25	169	3.45	193	1.65	235
8.85	139	7.00	152	5.20	169	3.40	194	1.60	237
8.80	139	6.95	153	5.15	170	3.35	195	1.55	239
8.75	139	6.90	153	5.00	171	3.30	196	1.50	241
8.70	140	6.85	154	5.05	171	3.25	197	1.45	243
8.65	140	6.80	154	5.00	172	3.20	197	1.40	245
8.60	140	6.75	155	4.95	172	3.15	198	1.35	247
8.55	141	6.70	155	4.90	173	3.10	199	1.30	249
8.50	141	6.65	156	4.85	174	3.05	200	1.25	251
8.45	141	6.60	156	4.80	174	3.00	201	1.20	253
8.40	142	6.55	156	4.75	175	2.95	202	1.15	256
8.35	142	6.50	157	4.70	175	2.90	203	1.10	258
8.30	143	6.45	157	4.65	176	2.85	204	1.05	261
8.25	143	6.40	158	4.60	177	2.80	205	1.00	264
8.20	143								

TABLE 1 (Cont'd)

CONVERSION TABLE (cont'd)

%T	D_s	%T	D_s	%T	D_s	%T	D_s	%T	D_s
1.000	264	0.815	276	0.635	290	0.455	310	0.275	339
0.995	264	0.810	276	0.630	291	0.450	310	0.270	340
0.990	265	0.805	277	0.625	291	0.445	311	0.265	341
0.985	265	0.800	277	0.620	292	0.440	312	0.260	342
0.980	265	0.795	277	0.615	292	0.435	312	0.255	343
0.975	266	0.790	278	0.610	293	0.430	313	0.250	344
0.970	266	0.785	278	0.605	293	0.425	314	0.245	345
0.965	266	0.780	278	0.600	294	0.420	314	0.240	346
0.960	266	0.775	279	0.595	294	0.415	315	0.235	347
0.955	267	0.770	279	0.590	295	0.410	316	0.230	349
0.950	267	0.765	280	0.585	295	0.405	316	0.225	350
0.945	267	0.760	280	0.580	296	0.400	317	0.220	351
0.940	267	0.755	280	0.575	296	0.395	318	0.215	352
0.935	268	0.750	281	0.570	297	0.390	318	0.210	354
0.930	268	0.745	281	0.565	297	0.385	319	0.205	355
0.925	269	0.740	291	0.560	298	0.380	320	0.200	357
0.920	269	0.735	282	0.555	298	0.375	321	0.195	358
0.915	269	0.730	282	0.550	299	0.370	322	0.190	359
0.910	269	0.725	283	0.545	299	0.365	322	0.185	361
0.905	270	0.720	283	0.540	300	0.360	323	0.180	362
0.900	270	0.715	284	0.535	300	0.355	324	0.175	364
0.895	270	0.710	284	0.530	301	0.350	325	0.170	366
0.890	271	0.705	284	0.525	301	0.345	326	0.165	367
0.885	271	0.700	285	0.520	302	0.340	326	0.160	369
0.880	271	0.695	285	0.515	303	0.335	437	0.155	371
0.875	272	0.690	286	0.510	303	0.330	328	0.150	373
0.870	272	0.685	286	0.505	304	0.325	329	0.145	375
0.865	272	0.680	286	0.500	304	0.320	330	0.140	377
0.860	273	0.675	287	0.495	305	0.315	331	0.135	379
0.855	273	0.670	287	0.490	305	0.310	332	0.130	381
0.850	273	0.665	288	0.485	306	0.305	333	0.125	383
0.845	274	0.660	288	0.480	307	0.300	334	0.120	386
0.840	274	0.655	289	0.475	307	0.295	335	0.115	388
0.835	275	0.650	289	0.470	308	0.290	336	0.110	391
0.830	275	0.645	290	0.465	308	0.285	337	0.105	393
0.825	275	0.640	290	0.460	309	0.280	337	0.100	396
0.820	276								

TABLE 1 (Cont'd)