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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 13 OF 1963.

REPORT ON DUST COLLECTOR TESTS AT
HIGHVELD POWER STATION, BOILER NO. 6, OCTOBER 24TH
1962.

BY:
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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

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INTRODUCTION:

The tests reported herein were carried out on behalf of Messrs. Davidson & Co. (Africa) Ltd., the suppliers of the Dust Collector plant, for the purpose of determining the efficiency of the installation.

A preliminary test was carried out on the dust collectors of No. 6 boiler, on the 24th October, 1962. A M.C.R. test only was performed. The test was carried out during a boiler trial.

PART I. DESCRIPTION OF APPARATUS AND TEST METHOD.

The operation of the dust collector was judged by weighing the total quantity of fine ashes collected by the equipment over a set period and by assessing the dust emitted from the boiler by sampling the flue gases at the dust collector outlet.

1.1 Fine Ash Collected.

Determination of the quantity of fine ashes collected, consisted of weighing all the dust caught by the primary and secondary collectors. To this effect, temporary pipes were run from the two primary and the two secondary collector outlets (after the dust valves) to within a few feet of the floor.

The dust emitted from each of these valves was collected in dust-bins, closed with a tightly fitting lid, connected by a flexible canvas sleeve to the valve outlet.

The filled bins were weighed and a sample of approximately a half pound taken from each bin.

The ashes collected at the right and left-hand sides of the boiler were weighed at regular intervals, the results being given in Tables No. 1 and 2.

1.2 Flue Dust Sampling Equipment.

Flue dust sampling was carried out iso-kinetically and in accordance with B.S. 893 : 1940. For this purpose, the sampling head illustrated in Figure 1, was used. The equipment comprises a Pitot tube, by means of which the flue gas velocity is determined and a sampling probe, through which the gas is exhausted at a velocity closely corresponding to that deduced from the Pitot tube indication. The gas then passes a miniature cyclone, in which most of the dust is precipitated, then a glass-wool filter and finally a small shaped nozzle, installed for the purpose of measuring the quantity of flue gas aspirated. For details of the construction see Figure 2.

In .../

In addition, the sampling head contains a thermocouple by means of which the flue gas temperature may be determined.

The complete assembly is supported by a thin walled steel tube of 2 in. diameter, through which the exhaust pipe, and measuring tubes and the thermocouple wires are passed.

The equipment was designed to pass through 4"x7" sampling ports in the duct. During the test, the port is closed by a heavy steel cover to which a tubular guide for the thin walled tube is welded. A clamping device ensures that the sampling head may be rigidly fixed in any desired position.

The exhaust line, measuring tubes and thermocouple leads are extended to the measuring equipment, mounted in a case. This apparatus contains -

(a) a sliding vane type exhauster with control valves;
(b) an inclined gauge (0 to 20 mm. by 0.2 mm water column), connected to the Pitot tube, indicating the flue gas velocity head;
(c) a U-tube connected to pressure taps on both sides of the orifice plate; this gauge thus indicates the pressure drop across the orifice.
(d) a U-tube, connected to the Pitot-static line and the atmosphere, indicating the draught or suction in the flue;
(e) an aneroid barometer and a clock;
(f) a spot-light galvanometer, connected by copper leads to two terminals embedded in an aluminium block upon which the thermocouple leads terminate.

The temperature of the block was measured by means of a mercury thermometer.

2. SAMPLING PROCEDURE:

In principle the test procedure is as follows:- The sampling head is inserted in the duct in a suitable position, which in this test was situated before the I.D. fan intake, and properly aligned in one of the sampling points (situated on a grid as illustrated in Figure 3).

The .../

The exhaust line and all measuring tubes are temporarily closed during insertion by means of clamps (so as to avoid an untimely flow through the cyclone and damage to the pressure gauges). The measuring tubes are opened as soon as the equipment is in position. When the apparatus has - after approximately 15 minutes - attained the flue gas temperature, sampling may start. The aspiration velocity is set at the estimated speed and the quick acting clamp on the exhaust line opened at the beginning of the sampling period. The speed is then readjusted to the correct value, corresponding to the Pitot tube indication and sampling is continued for the required period - 10 minutes in the present case. If necessary, the suction is re-adjusted from time to time; observations are recorded at 5-minute intervals. At the end of the sampling period, the exhaust is quickly closed and the sampling head transferred to another position. When all sampling points have been treated in this manner, the apparatus is finally withdrawn and opened. Any dust adhering to the interior of the apparatus is carefully transferred to the cyclone beaker (the dust collector proper) which together with the glass-wool filter is weighed after drying.

From the data thus obtained, the dust burden of the flue gas may be calculated, which in conjunction with the amount of dust recovered from the hopper, permits assessment of the collector performance.

The success of the operation therefore depends to a large extent on the accuracy with which the observer can adjust the exhaust velocity to the gas velocity in the duct. For correct isokinetic sampling, the pressure drop p_o across the nozzle, has to be adjusted in a definite relation to the velocity head p_v measured by means of the Pitot tube.

In practice, however, the operator usually has little time available for this calculation, especially when conditions are not quite steady. He is thus provided with a table or diagram giving him the ratio $p_o \div p_v$ for an

anticipated .../

anticipated average condition, and for the particular probe, in this case $\frac{3}{8}$", based on information collected during preliminary tests. This generally, adequately, covers the requirements of B.S. 893:1940, which allows the exhaust velocity to deviate by plus or minus 10% of the gas velocity.

Observations taken during the tests are presented in Tables No. 3, 5, and 6.

3. CALIBRATION OF EQUIPMENT.

The thermocouples are continuous from the hot junction to the terminals in the cold junction, which largely eliminated parasitic thermal electro-motive forces.

The thermocouples were calibrated (together with their galvanometers) by inserting them in small cavities in a copper block, previously heated to 200°C and left to cool. The temperature of the copper block was measured by means of a mercury thermometer, that of the cold junction by the thermometers installed on the apparatus. Readings, as set out in Table No. C.1 were taken at appropriate intervals.

During sampling, the flue gas temperature is thus found as the sum of cold junction temperature and galvanometer deflection, converted to degrees of temperature.

3.2 Nozzle Calibration.

(a) Introductory Remarks:

The purpose of this calibration is to establish the relationship between the volume rate of flow through the cyclone and the pressure drop occurring in the nozzle. By calculation, this relation can then be converted into that between pressure drop and linear velocity in the probe.

Though conditions during calibration differ from those during actual use, (as the calibration is carried out, using air at room temperature and pressure) these differences have usually no significant effect.

(b) Method of Calibration:

The experimental set-up during calibration is indicated in Figure 4. It will be noted that calibration

was .../

was effected on the complete sampling head, i.e., the orifice was preceded by the probe and the filter; the pressure drop during calibration does thus not differ materially from that experienced during the test.

The volume rate of flow was measured by means of a Fisher and Porter Rotameter (No.B4-21-10 with stainless steel float No. BSVT-45). According to the manufacturer's calibration data, the flow rate is proportional to the instrument reading in the range from 8% to 100% of the maximum flow, where 100% corresponds to a flow rate of 2.48 ft^3/minute of air at 70°C. and 14.7 lbs/in^2 abs. These statements were verified and found to be substantially correct. (c.f. Table C.3.) The manufacturerers further state that viscosity effects are negligible and that adjustments for other conditions are to be made on the basis of the density.*

During calibration, nozzle pressure drop, rotameter reading, pressure at rotameter intake, air pressure and temperature were recorded. (The humidity during these tests was so low that the air density was not appreciably affected).

(c) <u>Evaluation of Orifice Calibration Test Data.</u>

These test data are tabulated in Table No. C3, and are evaluated as follows:

The rotameter flow rates listed in Table C2, are those for the atmospheric conditions operative during the experiment. As, however, a slight pressure drop, p_r occurs at .../

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*In principle, the rotameter is a slightly tapered vertical tube through which the fluid is passed from bottom to top. In doing so, the medium has to force its way past the float, which then assumes such a position that the pressure difference across the annular space between float and tube wall balances the float weihgt W, hence

$$W = \frac{K \gamma}{2g} v_a^2$$

where γ is the density of the fluid, K a constant and v_a the velocity in the annulus. Hence it follows that if the density γ_1 at a particular test differs from that at the standard condition

γ_o (70°C, 14.7 psia, air), the actual volume flow rate Q_1 for a particular deflection, say 100% has to be derived from the "standard" quantity at 100% according to the equation

$$Q_1 = Q_o \sqrt{\gamma_o/\gamma_1}$$

at the rotameter point of entry, the air in the rotameter is a little lighter than at the probe entry. Consequently, the flow rate Q_1, as indicated by the rotameter is a little higher than that at the probe entry, Q, the latter following from the former according to the equation:

$$Q = Q_1 \sqrt{\frac{B - p_r}{B}}$$

where B equals the absolute air pressure, p_r the pressure drop at the rotameter, expressed in the same units. As

$$p_r \ll B \qquad Q = Q_1 \left(1 - \frac{p_r}{2B}\right)$$

Table No. C.4 then shows the corrected flow rate, expressed in terms of the linear velocity v_2 in the probe in relation to the pressure drop across the nozzle. As both ½" and ⅜" nominal bore probes may be used, data for both probes are incorporated.

(d) Use of Test Data.

In practice, during the actual sampling procedure the velocity v_2 in the probe has to be made equal - as nearly as possible to the gas velocity v_1 at the sampling point. However, v_1 is not determined directly, but by means of the dynamic pressure $p_v = \frac{\gamma}{2g} v_1^2$ generated in the Pitot tube, and thus related to v_1 by a square law.

Likewise, the probe velocity v_2 follows indirectly from the nozzle pressure drop p_o, which is related to v_2, if not exactly by a square law, by an equation closely resempling such a law.

It thus appears expedient to relate the two quantities p_o and p_v, which are observed directly, to each other, as p_o and p_v may be expected to stand to each other in a nearly, though not necessarily absolutely constant ratio.

One would thus express p_o in terms of the velocity head in the probe, i.e. one would put

$$p_o = \beta \frac{\gamma}{2g} v_2^2 = \beta p_v'$$

As already mentioned the operator is provided with a table giving him the value of p_o to be maintained in relation to the velocity head p_v.

3.3 ..../

3.3 Further Calibrations.

(a) All pressure gauges used during the test were compared with an Askania micro-manometer reading to 0.01 mm. water column. It appeared that the inclined gauges, used for measuring the velocity head were sufficiently accurate to take their indications at face value, provided they were properly levelled; theodolite type spirit levels were consequently fixed to these instruments

(b) A brief investigation was carried out for the purpose of establishing -

(i) whether the gas flow in the duct was seriously disturbed by introduction of the sampling apparatus.

(ii) whether the cyclone and filter affected the Pitot tube.

The first point was investigated by mounting a Pitot tube in a small wind tunnel (30" x 30", air speed 30 to 40 ft/sec.) and fixing the sampling head and supporting tube approximately 6" down stream in various positions. When using technical pressure gauges (i.e. instruments reading to 0.01" or 0.2 mm. water column), no disturbance could be detected.

The second point was investigated as follows:

Two Pitot tubes were mounted in the wind tunnel and their total head pressure tubes connected in opposition to a pressure detector, the Pitot tubes being so positioned that a zero pressure reading was obtained. The sampling head was then held in various positions close to one of the Pitot tubes. It appeared that no disturbance was caused as long as the static holes of the Pitot tube were not interfered with, a condition easily satisfied in practice.

4. PROVISIONAL ASSUMPTION OF FLUE GAS CONDITION.

It was assumed that a coal of the following composition would be used:

C	-	76%
H	-	5%
O	-	7%
N	-	1.5%
S	-	0.5%
H_2O	-	10%

above ..../

above data referring to the coal as fired but on an ash free basis.

Assuming 30% excess air, the composition of the wet flue gas would be:

CO_2	-	13% (on dry basis 14%)
O_2	-	4.6%
N_2+Ar	-	74.9%
H_2O	-	7.5%

(with air of 30% relative humidity at 27°C).

At 0°C and 760 mm. Hg. the (fictitious) density of such a flue gas would be 1.328 kg/m³. (0.0829 lbs/ft³).

5. TEST RESULTS:

The actual tests were performed on the lines set out in the previous paragraphs. The test results are represented in Tables 1 to 8, these being derived from the data sheets completed during the tests.

6. GAS VOLUMES AND ASH QUANTITIES:

6.1 Calculation of Gas Velocity in Duct.

This velocity follows directly from the Pitot tube readings taken at the various sampling points. Denoting the velocity head by p_v, the velocity v_1 in the duct follows from the equation:

$$v_1 = \sqrt{\frac{2g}{\gamma} p_v}$$

where γ equals the specific gravity of the flue gas under test conditions and g the acceleration due to gravity. As p_v was determined in mm H_2O, the velocity follows in m/sec. when g and γ are expressed in the appropriate metric units (m/sec². and kg/m³); conversion to feet per second requires multiplication by the factor 3.2808.

As the actual flue gas composition is not known at the present stage, a flue gas as indicated in paragraph 4, has been assumed to exist, with a fictitious density of 1.328 kg/m³ (0.0829 lbs/ft³) at 0°C and a pressure of 760 mm Hg.

The .../

The data of Tables 3 and 4 have been treated as follows:-

(a) For each sampling point, the mean value of $\sqrt{p_v}$, resulting from the three readings taken at this point, has been obtained, using the indications of the inclined gauge.

(b) The density under actual conditions, γ_1 is then calculated from the assumed figure $\gamma_0 = 1.328$ kg/m³ at 0^oC, 760 mm.Hg by means of the conversion

$$\gamma_1 = \gamma_0 \frac{B}{760} \quad \frac{273}{T}$$

6.2 Calculation of the Aspiration Velocity.

For each sampling point the average value of the three pressure drop readings across the nozzle has been determined, the readings as tabulated in Tables 3 and 4 being used for this purpose.

Using the diagrams of Figure C1, the value p_v', the velocity head in the probe may be read off for each value of p_o. The correction for the viscosity effect could be introduced at this point; it is, however, more convenient to do so in the final stage, i.e. when calculating the total quantity of gas aspirated.

From $\sqrt{p_v'}$ the velocity v' may be calculated in the same manner as in section (1), the results being shown in Tables 7 and 8.

6.3 Calculation of Flue Gas Volume and Gas Quantity Aspirated.

(a) The velocity at each of the 24 sampling points is considered to be representative for the area in the centre of which this point is situated. As it is desired to calculate only the gas volume emitted by the boiler during the actual sampling period (24 x 10 minutes), the gas volume Q follows from the equation -

$$Q = 240\ \Sigma \frac{A_i}{144} \times 60\ v_i \quad = \quad 100\ \Sigma\ A_i\ v_i$$

where v_i equals the flue gas velocity (expressed in feet per second) in the sampling point i, and A_i the area of the surface (expressed in square inches) in which point i is situated, c.f. Table 9.

The .../

The calculations are summarized in Table 10.

(b) The quantity of gas aspirated, Q_2, follows from the consideration that sampling occurred through the area of the probe for a period of 600 seconds in each of the sampling points.

Consequently, in the point i, the volume $Q_i = 600\ A_p . v_i$ is aspirated, where A_p denotes the probe area in ft^2. (c.f. Table C.4) and v_i the aspiration or probe velocity in feet per second. The total volume, exhausted during the test, thus equals $Q_2 = 600\ A_p\ \Sigma\ v_i$, where $\Sigma\ v_i$ is obtained from Tables 7 and 8.

The results of the calculation are shown in Table 11.

This table also indicates the ratio $Q : Q_2 = R$ (gas volume emitted to gas volume sampled) as well as the theoretical value R', following from the ratio of duct area to probe area, and the correction factor K, by means of which the quantity of dust, collected in the sampling equipment, has to be multiplied.

6.4 Gross Collector Efficiency and Dust Burden.

The collector efficiency follows from the equation:

$$\eta = \frac{W_1}{W_1 + W_2} 100\%$$

where W_1 equals the quantity of dust collected, W_2 the quantity of dust emitted, where both W_1 and W_2 have to be determined for identical periods. The latter may be calculated from $W = wQ/_{Q_2} K = wRK$, where w equals the weight of the dust collected in the sampling apparatus which has been indicated in Table 10. This, thus covers dust sampled in an active sampling period of 4 hours, but because of the time involved in changing the position of the probe every 10 minutes, the total sampling time t is longer than 4 hours.

As the ash deposited in the collector hoppers is being weighed without interruption, the collector ash quantity actually weighed has to be adjusted.

During .../

During the test, the periods were : L.H. side : 8.32 to 15.00, ash collected 42393.25 lb. and R.H. side: 8.32 to 17.00, ash collected 45176.50 lb.

Tables No. 12 and 13 indicates the final results.

(SIGNED) T. C. ERASMUS.
TECHNICAL OFFICER.

PRETORIA.
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TABLE NO. C 1

THERMOCOUPLE CALIBRATION.

Date: 28-8-1957

Temperature, °C			Millivolts		μV/°C	
Hot junction	Cold junction	Diff.	Couple No.1	Couple No.2	Couple No.1	Couple No.2
185.0	18.3	166.7	9.30	9.10	55.6	54.6
170.0	18.3	151.7	8.50	8.27	55.6	54.5
160.0	18.4	141.6	7.93	7.72	56.0	54.6
150.0	18.5	131.5	7.35	7.17	55.7	54.5
140.0	18.6	121.4	6.77	6.58	55.4	54.2
130.0	18.7	111.3	6.18	6.00	55.6	54.0
120.0	18.8	101.2	5.60	5.44	55.3	53.8
110.0	18.9	91.1	5.03	4.90	55.1	53.8
100.0	18.9	81.1	4.49	4.36	55.4	53.8
90.0	19.0	71.0	3.90	3.80	55.0	53.6
80.0	19.0	61.0	3.33	3.26	55.0	53.4
70.0	19.1	50.9	2.80	2.70	55.0	53.0

Average: 55.4 54.0

The thermocouples are calibrated together with the millivoltmeters (multiple reflection light spot type) with which they are to be used.

TABLE NO. C2.

ORIFICE CALIBRATION.

(Observed Data).

Test ——>		a	a	b	b
	Rotameter Reading	Pressure drop at Rotameter Inlet	Pressure drop across Orifice	Pressure drop at Rotameter Inlet	Pressure drop across Orifice.
	%	mm H_2O			
Orifice No.1, ¼"dia.	20	7	2.87	9	2.44
	30	18	5.91	20	5.60
	40	33	10.07	34	10.26
	50	52	15.21	52	15.32
	60	70	21.27	74	21.71
	70	93	28.11	96	28.57
	80	120	36.07	124	36.39
	90	149	44.72	152	45.37
	100	182	54.47	180	54.86
	Date:	7/10/57		8/10/57	
	Temp.	21.5°C		24.3°C	
	Baro.	25.7" Hg.		25.7" Hg.	
Orifice No.2, ¼"dia.	20	10	2.65	10	2.21
	30	22	5.56	21	5.58
	40	38	9.84	36	9.94
	50	56	15.42	55	15.45
	60	83	21.48	76	21.48
	70	110	28.89	100	28.72
	80	126	36.37	126	35.98
	90	150	45.79	154	45.34
	100	188	55.82	193	56.00
	Date.	7/10/57		8/10/57	
	Temp.	24.8°C		24.3°C	
	Baro.	25.6" Hg.		25.7" Hg.	

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TABLE No. C 3.

ROTAMETER MAXIMUM FLOW RATE AND AIR DENSITY UNDER CALIBRATION CONDITIONS.

Orifice No.	Orifice Dia.	Test No.	Max. Flow Rate		Velocity in ½" probe		Air Density	
			ft^3/min.	litres/min.	ft/sec.	m/sec.	lbs/ft^3	kg/m^3
1	¼"	a	2.678	75.8	31.99	9.75	0.0642	1.029
		b	2.691	76.2	32.18	9.81	0.0636	1.019
2	¼"	a	2.698	76.4	32.91	10.03	0.0633	1.014
		b	2.691	76.2	32.84	10.01	0.0636	1.019

Standard Data and Conversion Factors:

AIR DENSITY:

At 14.7 psia, 70°F (Rotameter Standard)		0.0700 lbs/ft^3
or 760 mm.Hg, 21.1°C		1.200 kg/m^3
At 760 mm.Hg, 0°C		0.0807 lbs/ft^3
		1.293 kg/m^3

Air density conversion:

$$\gamma_1 = \gamma_0 \frac{p_1}{p_0} \frac{T_0}{T_1} = 11.795 \frac{B}{T},$$

where B = air pressure in inches Hg.
T = abs. temp. in °K

ROTAMETER:

Flow rate at maximum (100%) indication

$Q_0 = 2.48\ ft^3/min.$ air of 14.7 psia, 70° F

Under other conditions $Q_1 = Q_0 \sqrt{\gamma_0/\gamma_1}$

PROBES:

No.	Diameter Nominal	Diameter Actual	Area cm^2	1/Area cm^{-2}
1	½"	1.284 cm.	1.295	0.7722
2	½"	1.274	1.270	0.7874
1	⅜"	0.955	0.7163	1.3961
2	⅜"	0.953	0.7133	1.4019

CONVERSION FACTORS:

1 ft^3 = 28.317 litres
1 kg/m^3 = 0.06243 lbs/ft^3
1 $gram/m^3$ = 0.4370 $grains/ft^3$
1 kg = 2.20462 lbs.
1 gram = 15.432 grains.

1 mm H_2O = 1 kg/m^2
1 m = 3.2808 ft.
1 cm^2 = 0.1550 in^2

TABLE NO. C4.

ORIFICE CALIBRATION.

ORIFICE NO. 1., ¼"

	Rotameter Reading	Correction	½" Probe: Velocity in Probe	½" Probe: Velocity Head p_v	Pressure drop across Orifice p_o	⅜" Probe: Velocity Head p_v	Remarks.
	%	%	m/sec.	mm.H_2O	mm.H_2O	mm.H_2O	
a	20	0	1.95	0.199	2.87	0.650	Ratio of Velocity
	30	0.1	2.93	0.450	5.91	1.471	Head ⅜" probe to ½"
	40	0.2	3.89	0.794	10.07	2.595	probe.
	50	0.3	4.87	1.245	15.21	4.069	$\left(\frac{1.284}{0.955}\right)^4 = 3.268$
	60	0.4	5.83	1.784	21.27	5.830	$\gamma = 1.029$
	70	0.5	6.80	2.427	28.11	7.931	$p_v = \frac{v^2}{19.05} = 0.0524\ v^2$
	80	0.7	7.75	3.153	36.07	10.30	
	90	0.8	8.71	3.982	44.72	13.01	
	100	0.9	9.66	4.899	54.47	16.01	
b	20	0	1.96	0.200	2.44	0.654	
	30	0.1	2.94	0.449	5.60	1.467	$\gamma = 1.019$
	40	0.2	3.91	0.795	10.26	2.598	
	50	0.3	4.90	1.249	15.32	4.082	$p_v = \frac{v^2}{19.23} = 0.0520\ v^2$
	60	0.4	5.87	1.792	21.71	5.856	
	70	0.6	6.84	2.433	28.57	7.951	
	80	0.7	7.80	3.164	36.39	10.34	
	90	0.9	8.75	3.981	45.37	13.01	
	100	1.1	9.71	4.903	54.86	16.02	

ORIFICE NO. 2, ¼".

	Rotameter Reading	Correction	½" Probe: Velocity in Probe	½" Probe: Velocity Head p_v	Pressure drop across Orifice p_o	⅜" Probe: Velocity Head p_v	Remarks.
a	20	0	2.01	0.209	2.65	0.670	Ratio of Velocity
	30	0.1	3.01	0.468	5.56	1.500	Head ⅜" probe to ½"
	40	0.2	4.00	0.827	9.84	2.651	probe.
	50	0.3	5.00	1.293	15.42	4.144	
	60	0.4	6.00	1.861	21.48	5.965	$\left(\frac{1.274}{0.953}\right)^4 = 3.205$
	70	0.6	6.98	2.519	28.89	8.073	
	80	0.7	7.96	3.276	36.37	10.50	$p_v = \frac{v^2}{19.33} = 0.0517\ v^2$
	90	0.9	8.95	4.141	45.79	13.27	$\gamma = 1.014$
	100	1.1	9.92	5.088	55.82	16.31	
b	20	0	2.00	0.208	2.21	0.666	
	30	0.1	3.00	0.468	5.58	1.500	$\gamma = \frac{v^2}{19.23} = 0.0520\ v^2$
	40	0.2	3.99	0.828	9.94	2.654	
	50	0.3	4.98	1.290	15.45	4.134	$\gamma = 1.019$
	60	0.4	5.98	1.860	21.48	5.961	
	70	0.6	6.96	2.519	28.72	8.073	
	80	0.7	7.94	3.278	35.98	10.51	
	90	0.9	8.92	4.138	45.34	13.26	
	100	1.1	9.89	5.086	56.00	16.30	

TABLE NO. 1.

DUST COLLECTED .

DUST COLLECTOR TEST AT HIGHVELD POWER STATION, BOILER NO. 6.

DATE: 24/10/62

LOAD MCR

RIGHT HAND SIDE.

TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE	TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE
8.32	155	151	306.0		138.5	124	6266.5
	99.5	100.5	506.0		78	83	6427.5
	131	139.5	776.5		87.5	86.5	6601.5
	99.5	92.5	968.5		77	73.5	6752.0
	75	70	1113.5		79.5	81	6912.5
	126	129	1368.5		102.5	90.5	7105.5
	124	99	1591.5		97.5	90	7293.0
8.45	140	156.5	1888.0	9.45	84.5	91	7468.5
	114	117	2119.0		80.0	72.5	7621.0
	99	101	2319.0		99	98	7818.0
	105	103	2527.0		63.5	60.5	7942.0
	47	55	2629.0		89.5	91.5	8123.0
	108	115	2852.0		92	84	8299.0
	90	82	3024.0		94	87	8480.0
9.00	93	91	3208.0	10.00	82.5	81.5	8644.0
	102.5	107	3417.5		94.5	79	8817.5
	89.0	82	3588.5		67.5	84.5	8969.5
	99.5	95	3783.0		94.5	84.5	9148.5
	91.5	99	3973.5		102.5	90.0	9341.0
	101	85.5	4160.0		76	88.5	9505.5
	99	97	4356.0		89	81	9675.5
	85	93	4534.0		85	85	9845.5
9.15	96	87.5	4717.5	10.15	99	93	10037.5
	115	101.5	4934.0		85	88	10210.5
	96.5	98	5128.5		84	83	10377.5
	91	105	5324.5		106.5	91	10575.0
	92	85	5501.5		58	56.5	10689.5
	96.5	90	5688.0		91.5	89.5	10870.5
	76	74	5838.0		94.5	83.0	11048.0

TABLE NO. 1 (Continued)

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION, BOILER NO. 6.

DATE: 24/10/62

LOAD: MCR.

RIGHT HAND SIDE.

TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE	TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE
9.30	84.5	81.5	6004.0	10.30	80	82.0	11210.0
	117	108	11435.0		84	72	16336.0
	77.5	67.5	11580.0		79	73.5	16488.5
	94.5	78.5	11753.0		99.5	89.5	16677.5
	68.5	61	11882.5		90	77	16844.5
	86.5	82	12051.0		71	64.5	16980.0
	88	76.5	12215.5		89	78.5	17147.5
	107	96	12418.5		91	83.5	17322.0
10.45	76	72	12566.5	11.43	83.5	60.5	17466.0
	86.5	86	12739.0		97	94	17657.0
	84	73	12896.0		81	67	17805.0
	82	79	13057.0		83.5	71.5	17960.0
	86	77	13220.0		91.5	83	18134.5
	101	70	13391.0		85	73.5	18293.0
	81.5	86.5	13559.0		99	88.5	18480.5
11.00	78	68.5	13705.5	12.00	71.5	53	18605.0
	92.5	85.5	13883.5		103	93.5	18801.5
	75.5	68	14027.0		86.5	73.5	18961.5
	93.5	88.5	14209.0		65	55	19081.5
	76	66	14351.0		95	81.5	19258.0
	89.5	80.5	14521.0		98	86	19442.0
	85.5	73.5	14680.0		69	58	19569.0
	80.5	72.0	14832.5		124	109	19802.0
11.15	97	95	15024.5	12.15	81	79	19959.0
	77	63.5	15165.0		89.5	76.5	20125.0
	90.5	78	15333.5		84.5	69	20278.5
	102	86.5	15522.0		82.5	82.5	20443.5
	62.5	54	15638.5		94	84	20621.5
	102.5	91	15832.0		95	73	20789.5
	80	73	15985.0		94.5	82	20966.0
11.30	101	94	16180.0	12.30	96	84.5	21146.5

TABLE NO. 1. (Continued)

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION, BOILER NO. 6.

DATE: 24/10/62

LOAD MCR

RIGHT HAND SIDE

TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMELATIVE	TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE
12.30	85	76	21307.5		84	72.5	26314.5
	83	62	21452.5		81.5	75.0	26471.0
	94.5	65	21612.0		90.5	75.5	26637.0
	87.5	100	21799.5		94	74.5	26805.5
	90	70	21959.5		97	75.5	26978.0
	79	72.5	22111.0		83.5	83	27144.5
	92.5	70	22273.5		134.5	137	27416.0
12.45	153	158	22584.5	13.45	79	78	27573.0
	71	78.5	22734.0		96	77.5	27746.5
	97	70	22901.0		80.5	70.5	27897.5
	97.5	104	23102.5		73.5	67.5	28038.5
	93.5	89.5	23285.5		87.5	71.5	28197.5
	85.5	76	23447.0		82	79	28358.5
	84	70.5	23601.5		78	72.5	28509.0
	90	83	23774.5	14.00	87	69.5	28665.5
13.00	47.5	38.5	23860.5		95.5	76.5	28837.5
	82	76	24018.5		78	74	28989.5
	87.5	77.5	24183.5		88.5	81	29159.0
	86	75.5	24345.0		82.5	70	29311.5
	90	82	24517.0		87	73.5	29472.0
	88.5	70	24675.5		83.5	70	29625.5
	85.5	81	24843.0		78	74	29777.5
13.15	89.5	77.5	25009.0	14.15	93	81	29951.5
	88.5	80.5	25178.0		91.5	78	30121.0
	86	74.5	25338.5		66.5	61	30248.5
	81	76	25495.5		86.5	68	30403.0
	89	76.5	25661.0		125	121.5	30649.5
	93	76.5	25830.5		144	144.5	30938.0
	86.5	80	25997.0		72	65.5	31075.5
					97	86	31258.5
13.30	85	76	26158.0				

TABLE NO. 1. (Continued)

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER No. 6.

DATE: 24/10/63

LOAD: MCR

RIGHT HAND SIDE.

TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE	TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE
14.30	88	76.5	31423.0	15.30	80	67	26371.0
	84.5	73	31580.5		77.5	71	36519.5
	87.5	78	31746.0		73	73.5	36666.0
	84	76	31906.0		94.5	73	36833.5
	91.5	77.5	32075.0		87	79	36999.5
	88	78	32241.0		86.5	79	37165.0
	86	72.5	32399.5		82	76	37323.0
14.45	86.5	77.5	32563.5	15.45	90.5	77	37490.5
	87.5	76	32727.0		86.	80	37656.5
	90.5	75	32892.5		81	75.5	37813.0
	83	76	33051.5		78.5	73	37964.5
	92	76	33219.5		75.5	67	38107.0
	92.5	81	33393.0		82.5	77.5	38267.0
	81	74	33548.0		78.5	73.5	38419.0
	89	78.5	33715.5		101	90	38610.0
15.00	84.5	78	33878.0	16.00	99.5	96	38805.5
	86	76	34040.0		97	92	38994.5
	83	73	34196.0		110	98	39203.5
	85	77	34358.0		123.5	112.5	39438.5
	83.5	72.5	34514.0		105.5	100.5	39644.5
	88	74	34676.0		105	94	39843.5
	85.5	74	34835.5		136	141.5	40121.0
					119	107.5	40347.5
15.15	77.5	73.5	34986.5				
	155	144	35285.5	16.15	110	113.5	40571.0
	98	107.5	35491.0		108	98	40777.0
	66.5	55	35612.5		110	105	40992.0
	105	70.5	35788.0		96.5	87	41175.5
	78	76	35942.0		122	114.5	41412.0
	72.5	60	36074.5		103	91	41606.0
	77	72.5	36224.0		111	98.5	41815.5

TABLE NO. 1. (Continued).

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/63

LOAD: MCR

RIGHT HAND SIDE.

TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE	TIME hr.min	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE
16.30	97	99	42011.5				
	105.5	93	42210.0				
	106.5	93	42409.5				
	152.5	149.5	42711.5				
	138	111	42960.5				
	122.5	106.5	43189.5				
	131	101	43421.5				
16.45	110	103	43634.5				
	86	71.5	43792.0				
	63.5	64	43919.5				
	77	63.5	44060.0				
	96.5	91	44247.5				
	106	98	44451.5				
	101.5	99	44652.0				
	110.5	91	44853.5				
	119.5	111	45084.0				
17.00	47	45.5	45176.5				

TABLE NO. 2.

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/62.
LOAD: MCR

LEFT HAND SIDE.

TIME hr.min	WEIGHT lbs.			TIME hr,min	WEIGHT lbs.		
	INCREMENT		CUMULATIVE		INCREMENT		CUMULATIVE
8.32	147.25	153.5	300.75		118.25	109.5	6141.0
	138.5	137.5	576.75		71	60	6272.0
	138	142.5	857.25		63.5	63	6398.5
	151.5	141	1149.75		83.5	70.5	6552.5
	97.75	89	1336.5	9.40	94.5	93.5	6740.5
	136.5	126.5	1599.5		76.5	78	6895.0
	113	114	1826.5		86.5	76.25	7057.75
	129	122.5	2078.0		65.5	54	7177.25
	105	95	2278.0		88.5	84.5	7350.25
8.50	127	100.5	2505.5	9.50	56	53.5	7459.75
8.52	97.5	88.25	2691.25		96	94.5	7650.25
8.54	41	40	2772.25		64.5	64.5	7779.25
8.56	124.5	102.5	2999.25		88.5	72.5	7940.25
8.58	95	84.5	3178.75		75.5	66.5	8082.25
9.00	101.5	92.5	3372.75	10.00	81.5	81.5	8245.25
9.02	95.5	88	3556.25		77	59.25	8381.50
9.04	91	85.5	3732.75		79.25	68	8528.75
9.06	85.5	81.5	3899.75		53.5	47	8629.25
9.08	92.5	75	4067.25		74.5	75	8778.75
9.10	75.5	70.5	4213.25	10.10	91.5	85.5	8955.75
	113.5	105	4431.75		70	62	9087.75
	74.5	65.5	4571.75		57	59	9203.75
	96	87.5	4755.25		78.5	62	9344.25
	92.5	85	4932.75		88.5	85.5	9518.25
9.20	105	88	5125.75	10.20	76.5	77.25	9672.0
	75.5	68.5	5269.75		70	72.25	9814.25
	102	86	5457.75		77	76.5	9967.75
	69	61.5	5588.25		90	67	10124.75
	79.5	71	5738.75		85.5	85.5	10295.75
9.30	92.5	82	5913.25	10.30	88.5	83.5	10467.75

TABLE NO. 2. (Continued)

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/62
LOAD: MCR

LEFT HAND SIDE.

TIME hr.min.	WEIGHT lbs. INCREMENT		WEIGHT lbs. CUMULATIVE	TIME hr.min	WEIGHT lbs. INCREMENT		WEIGHT lbs. CUMULATIVE
	88.5	88.25	10644.5		84	82	15274.75
	66.5	66.5	10777.5		63	60	15397.75
	86.5	86.5	10950.5		99	101	15597.75
	88.5	90.75	11129.75		76	69	15742.75
10.40	75.5	61	11266.25	11.40	79	82	15903.75
	81.5	81	11428.75		88	72	16063.75
	70.5	64	11563.25		61	76	16200.75
	77	75.5	11715.75		92	76	16368.75
	110.5	107	11933.25		83.5	69	16521.25
10.50	64	66.5	12063.75	11.50	79	68	16668.25
	86	74	12223.75		79	71.5	16818.75
	72.5	58	12354.25		73.5	69.5	16961.75
	74	101	12529.25		73	67	17101.75
	71	66.5	12666.75		75	78	17254.75
11.00	85	87.5	12839.25	12.00	90	70	17414.75
	82	64	12985.25		75	65	17554.75
	80	77.5	13142.75		73	74.5	17702.25
	79.5	70	13292.25		85	72	17859.25
	70.5	67	13429.75		95	89.5	18043.75
11.10	77	62	13568.75	12.10	61	56	18160.75
	85	89	13742.75		82.5	71	18314.25
	82.5	61	13886.25		78	81	18473.25
	67	63.5	14016.75		92	61.5	18626.75
	80	77	14173.75		81	77	18784.75
11.20	85	62.5	14321.25	12.20	83	83.5	18951.25
	82.5	80	14483.75		94.5	69	19114.75
	87	93	14663.75		69	71	19254.75
	79	74.5	14817.25		102.5	86	19443.25
	70	66.5	14953.75		85.5	79	19607.75
11.30	83	72	15108.75	12.30	86	70	19763.75

TABLE NO. 2. (Continued).

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/62

LOAD: MCR

LEFT HAND SIDE.

TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE	TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE
	75	66	19904.75		69	70	24405.75
	81	72	20057.75		82	78	24565.75
	78	73	20208.75		77	78	24720.75
	72	60	20340.75		92	79	24891.75
12.40	84	91	20515.75	1.40	77	79	25047.75
	62	67	20644.75		64	50	25161.75
	96	89	20829.75		82	71.5	25315.25
	84.5	69.5	20983.75		87	69	25471.25
	74	84	21141.75		89	101	25661.25
12.50	85	67	21293.75	1.50	147	123	25931.25
	76	61	21430.75		81	73	26085.25
	98	99	21627.75		58	45	26188.25
	87	78	21792.75		81	70	26339.25
	66	56	21914.75		83	67	26489.25
1.00	78	68	22060.75	2.00	77	68	26634.25
	42	43	22145.75		85	66	26785.25
	81	64	22290.75		72	66	26923.25
	73	72	22435.75		75	74.5	27072.75
	82	67	22584.75		65	52	27189.75
1.10	91	89	22764.75	2.10	64	53	27306.75
	73	60	22897.75		83	91	27480.75
	78	70	23045.75		75.5	58	27614.25
	90	89	23224.75		84	71	27769.25
	67	58	23349.75		71	72	27912.25
1.20	77	85	23511.75	2.20	81	74	28067.25
	72	60	23643.75		87	64	28218.25
	77	68	23788.75		79	77	28374.25
	86	87	23961.75		87	74	28535.25
	74	60	24095.75		99	81.5	28715.75
1.30	90	81	24266.75	2.30	70	69	28854.75

TABLE NO. 2. (Continued).

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6

DATE: 24/10/62

LOAD: MCR

LEFT HAND SIDE.

TUME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE	TIME hr.min.	WEIGHT, lbs. INCREMENT		WEIGHT, lbs. CUMULATIVE
	90	72	29016.75		70	68	33760.25
	79	74	29169.75		83	75	33918.25
	85	79	29333.75		68	66	34052.25
	78	75	29486.75		64	63	34179.25
2.40	85	75	29646.75	3.40	104	76	34359.25
	74	64	29784.75		64	65	34488.25
	82	70	29936.75		84	70	34642.25
	81	77	30094.75		85	82	34809.25
	76	66	30236.75		86	87	34982.25
2.50	78	64	30378.75	3.50	84	73	35139.25
	91	87	30556.75		74	60	35273.25
	80	69	30705.75		76	74	35423.25
	110	122	30937.75		82	78	35583.25
	148	131	31216.75		70	73	35726.25
3.00	79	57	31352.75	4.00	102	83	35911.25
	62	54	31468.75		106	110	36127.25
	77	80	31625.75		96	93	36316.25
	60	47	31732.75		98	75	36489.25
	68	68.5	31869.25		97	96	36682.25
3.10	89	76	32034.25	4.10	99	95	36876.25
	77	68	32179.25		85	73	37034.25
	72	69	32320.25		125	124	37283.25
	86	75	32481.25		126	96	37505.25
	147	135	32763.25		98	88	37691.25
3.20	92	92.5	32947.75	4.20	128	135	37954.25
	62.5	55	33065.25		122	98	38174.25
	75.5	70	33210.75		98	110	38382.25
	65	55	33330.75		128	106	38616.25
	76	75.5	33482.25		115	88	38819.25
3.30	72	68	33622.25	4.30	82	80	38981.25

TABLE NO. 2. (Continued).

DUST COLLECTED.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/62

LOAD: MCR.

LEFT HAND SIDE.

TIME hr.min.	WEIGHT, lbs.			TIME hr.min.	WEIGHT, lbs.		
	INCREMENT		CUMULATIVE		INCREMENT		CUMULATIVE
	118	99	39198.25				
	99	89	39386.25				
	112	113	39611.25				
	117	104	39832.25				
4.40	116	92	40040.25				
	142	132	40314.25				
	144	142	40600.25				
	150	148	40898.25				
4.47½	115	110	41123.25				
4.49	60	46	41229.25				
4.50½	84	74	41387.25				
4.52	74	69	41530.25				
4.54	102	85	41717.25				
4.56	94	78	41889.25				
4.58	110	120	42119.25				
5.00	104	76	42299.25				
	48	46	42393.25				

TABLE NO. 3.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/62
LOAD: MCR.

APPARATUS NO. 1.
CYCLONE BEAKER NO. 3.
FILTER NO. 3.

LEFT HAND SIDE.

SAMPLING POINT	TIME	VELOC. HEAD	ORIFICE P. DROP	STATIC PR.	FLUE GAS TEMP.	AMB. TEMP.	BARO.
	hr.min.	mm H_2O	mm H_2O	mm Hg.	mV	°C	in. Hg.
A.1	09.45	7.5	26.5	28.00	5.2	25.5	$25\frac{1}{4}$
	09.50	7.5	26.5	28.00	5.2	25.5	
	09.55	7.6	26.5	30.00	5.2	25.6	
A.2	09.56	8.0	28.00	36.00	5.2	25.6	
	10.01	8.2	28.00	40.00	5.2	25.8	
	10.06	8.6	30.00	48.00	5.15	25.8	
A.3	10.07	6.5	23.5	40.00	5.20	25.8	
	10.12	7.0	25.0	50.00	5.20	25.9	
	10.17	7.2	25.0	54.00	5.20	25.8	
B.1	10.21	6.8	23.5	48.00	5.10	26.0	
	10.26	7.2	25.0	58.00	5.12	26.0	
	10.31	7.6	26.5	68.00	5.20	26.0	
B.2	10.32	7.8	28.0	64.00	5.20	26.0	
	10.37	8.0	28.0	68.00	5.20	26.1	
	10.42	7.8	28.0	68.00	5.20	26.2	
B.3	10.43	8.8	32.0	70.00	2.21	26.3	
	10.48	7.8	28.0	64.00	5.21	26.3	
	10.53	8.2	28.0	70.00	5.21	26.4	
C.1	11.00	6.4	23.5	66.00	5.05	26.7	
	11.05	6.6	23.5	76.00	5.05	26.9	
	11.10	6.4	23.5	76.00	5.00	26.9	
C.2	11.11	7.0	25.0	72.00	5.00	27.1	
	11.16	6.8	25.0	68.00	5.00	27.4	
	11.21	7.2	25.0	68.00	5.00	27.5	
C.3	11.22	9.2	32.0	84.00	5.10	27.8	
	11.27	8.2	28.0	82.00	5.10	28.1	
	11.32	8.6	30.0	92.00	5.10	28.4	

TABLE NO. 3. (Continued).

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/62
LOAD: MCR

APPARATUS NO. 1.
CYCLONE BEAKER NO. 3 up to D3/No.4
FILTER NO. 3 upper D3/No.4 →

LEFT HAND SIDE.

SAMPLING POINT	TIME	VELOC. HEAD	ORIFICE P. DROP	STATIC PR.	FLUE GAS TEMP.	AMB. TEMP.	BARO.
	hr.min.	mm H_2O	mm H_2O	mm Hg	mV	^{o}C	in Hg.
D.1	11.38	9.40	33.50	92.0	4.90	28.2	25¼
	11.43	9.60	33.50	102.0	5.00	28.3	
	11.48	9.60	33.50	106.0	5.00	28.3	
D.2	11.51	9.60	33.50	110.0	5.05	28.5	
	11.56	9.50	33.50	114.0	5.05	28.6	
	12.02	9.50	33.50	118.0	5.05	28.9	
D.3	12.03	9.00	32.00	125.0	5.10	29.0	
	12.08	9.00	32.00	154.0	5.10	29.0	
	12.13	8.90	32.00	145.0	5.10	29.10	
E.1	12.55	10.00	35.00	38.0	5.10	29.00	
	01.00	10.00	35.00	25.0	5.10	28.90	
	01.05	9.80	35.00	22.0	5.10	28.50	
E.2	01.10	9.20	32.00	22.00	5.15	28.40	
	01.15	9.50	33.50	24.00	5.15	28.30	
	01.20	9.40	33.50	24.00	5.20	28.00	
E.3	01.21	9.20	32.00	22.00	5.25	27.80	
	01.26	9.00	32.00	26.00	5.25	27.50	
	01.31	9.02	32.00	25.00	5.30	27.50	
F.1	01.42	9.00	32.00	24.00	5.05	27.40	
	01.47	9.02	32.00	28.00	5.05	27.40	
	01.52	8.90	32.00	28.00	5.05	27.50	
F.2	01.53	8.50	30.00	28.00	5.10	27.40	
	01.58	8.40	30.00	30.00	5.10	27.20	
	02.03	8.50	30.00	32.00	5.10	27.20	
F.3	02.04	9.00	32.00	34.00	5.10	27.30	
	02.09	8.90	32.00	35.00	5.10	27.40	
	02.14	9.00	32.00	34.00	5.10	27.50	

TABLE NO. 3 (Continued.)

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6

DATE: 24/10/62
LOAD: MCR

APPARATUS NO. 1.
CYCLONE BEAKER: NO. 4.
FILTER NO. 4.

LEFT HAND SIDE.

SAMPLING POINT	TIME	VELOC. HEAD	ORIFICE P. DROP	STATIC PR.	FLUE GAS TEMP.	AMB. TEMP.	BARO.
	hr.min.	mm H_2O	mm H_2O	mm Hg.	mV	^oC	in. Hg
G.1	02.20	10.20	35.00	28.00	5.00	27.70	$25\frac{1}{4}$
	02.25	10.00	35.00	32.00	5.05	27.80	
	02.30	9.85	35.00	34.00	5.10	27.80	
G.2	02.31	8.90	32.00	32.00	5.10	27.80	
	02.36	9.20	32.00	34.00	5.15	27.90	
	02.41	9.20	32.00	33.00	5.20	27.90	
G.3	02.42	9.10	32.00	36.00	5.20	27.80	
	02.47	9.00	32.00	36.00	5.20	27.60	
	02.52	8.90	32.00	34.00	5.20	27.50	
H.1	02.55	9.40	33.50	32.00	5.05	27.50	
	03.00	9.80	35.00	32.00	5.10	27.30	
	03.05	9.50	33.50	32.00	5.10	27.20	
H.2	03.06	9.00	32.00	30.00	5.10	27.20	
	03.11	8.90	32.00	34.00	5.10	27.10	
	03.16	8.95	32.00	35.00	5.10	27.10	
H.3	03.17	9.00	32.00	34.00	5.10	27.10	
	03.22	8.90	32.00	36.00	5.12	27.10	
	03.27	8.90	32.00	36.00	5.22	27.20	

TABLE NO. 4.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/62 APPARATUS NO. 2
LOAD: MCR CYCLONE BEAKER NO. 1
FILTER NO. 7.

RIGHT HAND SIDE.

SAMPLING POINT	TIME	VELOC. HEAD	ORIFICE P. DROP	STATIC PR.	FLUE GAS TEMP.	AMB. TEMP.	BARO.
	hr.min.	mm H_2O	mm H_2O	mm Hg.	mV	^oC	in Hg.
A.1	9.39	7.0	25.0	20.0	6.65	26.0	25 5/16
	9.44	7.7	26.5	20.0	6.65	26.3	
	9.49	8.0	28.5	20.0	6.65	26.5	
A.2	9.50	6.4	23.5	22.0	6.60	26.5	
	9.55	6.7	23.5	22.0	6.50	26.6	
	10.00	7.0	25.0	24.0	6.50	26.6	
A.3	10.01	6.2	22.0	24.0	6.50	26.7	
	10.06	6.2	22.0	25.0	6.45	26.8	
	10.11	6.4	23.5	28.0	6.45	27.0	
B.1	10.12	8.3	30.0	30.0	6.45	27.0	
	10.17	8.5	30.0	29.0	6.55	27.0	
	10.22	8.5	30.0	36.0	6.55	27.2	
B.2	10.23	7.4	26.5	35.0	6.50	27.2	
	10.28	8.0	28.5	43.0	6.53	27.2	
	10.33	8.0	28.5	43.0	6.55	27.2	
B.3	10.34	7.5	26.5	42.0	6.50	27.3	
	10.39	7.5	26.5	46.0	6.50	27.4	
	10.44	7.5	26.5	46.0	6.50	27.5	
C.1	10.46	7.5	26.5	35.0	6.55	27.5	
	10.51	7.5	26.5	46.0	6.60	27.5	
	10.56	7.5	26.5	48.0	6.55	27.5	
C.2	10.57	6.2	22.0	44.0	6.55	27.4	
	11.02	6.5	23.5	52.0	6.55	27.4	
	11.07	6.4	23.5	55.0	6.55	27.4	
C.3	11.08	7.0	25.0	58.0	6.50	27.4	
	11.13	7.0	25.0	54.0	6.50	27.3	
	11.18	7.0	25.0	63.0	6.50	27.3	

TABLE NO. 4 (Continued).

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6

DATE; 24/10/62
LOAD: MCR

APPARATUS NO. 2.
CYCLONE BEAKER: NO. 1.
FILTER NO. 7.

RIGHT HAND SIDE.

SAMPLING POINT	TIME	VELOC. HEAD	ORIFICE P. DROP	STATIC PR.	FLUE GAS TEMP.	AMB. TEMP.	BARO.
	hr.min.	mm H_2O	mm H_2O	mm Hg	mV	^oC	in. Hg
D.1	11.19	8.5	30.0	39.0	6.55	27.2	25 5/16
	11.24	8.8	31.5	52.0	6.60	27.3	
	11.29	9.0	31.5	60.0	6.60	27.5	
D.2	11.30	8.6	30.0	40.0	6.60	27.5	
	11.35	8.6	30.0	57.0	6.60	27.5	
	11.40	9.0	31.5	66.0	6.60	27.5	
D.3	11.41	9.0	31.5	59.0	6.65	27.3	
	11.46	8.5	30.0	60.0	6.50	27.3	
	11.51	8.5	30.0	67.0	6.50	27.3	
E.1	12.12	9.5	33.5	24.0	6.55	27.7	
	12.17	9.5	33.5	24.0	6.60	27.8	
	12.22	9.7	33.5	30.0	6.65	27.8	
E.2	11.23	9.5	33.5	27.0	6.70	27.8	
	11.28	9.4	33.5	33.0	6.70	27.8	
	11.33	9.0	31.5	35.0	6.70	27.8	
E.3	11.34	9.0	31.5	33.0	6.60	27.8	
	11.39	9.4	33.5	43.0	6.60	27.9	
	11.44	9.5	33.5	45.0	6.55	27.8	
F.1	11.48	8.2	28.5	24.0	6.65	27.9	
	11.53	8.3	30.0	43.0	6.65	28.0	
	11.58	8.5	30.0	45.0	6.65	28.0	
F.2	11.59	8.0	28.5	39.0	6.70	27.9	
	1.04	8.0	28.5	57.0	6.70	27.7	
	1.09	8.0	28.5	60.0	6.65	27.6	
F.3	1.10	9.0	31.5	49.0	6.60	27.6	
	1.15	9.0	31.5	63.0	6.60	27.6	
	1.20	9.0	31.5	50.0	6.65	27.2	

TABLE NO. 4 (Continued).

DUST COLLECTOR TEST AT HIGHVELD POWER STATION. BOILER NO. 6.

DATE: 24/10/62

LOAD: MCR.

APPARATUS NO. 2.

CYCLONE BEAKER NO. 2.

FILTER NO. 5.

RIGHT HAND TEST.

SAMPLING POINT.	TIME	VELOC. HEAD	ORIFICE P.DROP	STATIC PR.	FLUE GAS TEMP.	AMB. TEMP.	BARO.
	hr.min.	mm H_2O	mm H_2O	mm Hg	mV	^oC	in.Hg
G.1	1.36	9.0	31.5	31.0	6.7	27.0	25 1/16
	1.41	9.0	31.5	58.0	6.7	27.0	
	1.46	9.0	31.5	63.0	6.7	27.0	
G.2	1.48	8.4	30.0	58.0	6.7	27.0	
	1.53	8.5	30.0	62.0	6.7	26.8	
	1.58	8.5	30.0	69.0	6.7	26.8	
G.3	1.59	8.0	28.5	64.0	6.65	26.8	
	3.04	8.0	28.5	67.0	6.60	26.8	
	3.09	7.5	26.5	69.0	6.60	26.8	
H.1	3.11	8.5	30.0	43.0	6.60	27.0	
	3.16	8.5	30.0	65.0	6.60	27.0	
	3.21	9.0	31.5	68.0	6.65	27.2	
H.2	3.22	9.0	31.5	65.0	6.65	27.2	
	3.27	9.4	33.5	70.0	6.70	27.2	
	3.32	9.0	31.5	70.0	6.70	27.2	
H.3	3.33	9.0	31.5	45.0	6.70	27.2	
	3.38	9.0	31.5	73.0	6.70	27.4	
	3.43	9.0	31.5	78.0	6.70	27.3	

TABLE NO. 5.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION,BOILER NO.6.

LEFT HAND SIDE:	Oven for 24 Hours.
Container No. 3.	
89.6740	89.5941
65.9583	65.9583
23.7157	23.6358
Filter No. 3.	
57.0521	57.0454
42.3020	42.3020
14.7501	14.7434
Filter No. 4 + Spider	
67.0639	67.0603
	Spider 19.0573
	48.0030
	45.6079
	2.3951
Container No. 4 (Dust from thread).	
66.1088	66.0693
65.7676	65.7676
.3412	.3017
Container No. 5 (In Probe)	
66.6779	66.6099
65.7311	65.7311
.9468	.8788
LEFT HAND SIDE:	
Total weight of Dust	23.6358
	14.7434
	2.3951
	.3017
	.8788
	41.9548

TABLE NO. 6.

DUST COLLECTOR TEST AT HIGHVELD POWER STATION, BOILER NO. 6.		
RIGHT HAND SIDE: Cyclone Beaker and All Loose Dust.		
Container No. 1	Desiccator 3 days	Oven for 24 hours
106.0301	105.9939	105.9708
67.5231	67.5231	67.5231
38.5070	38.4708	38.4477
Filter No. 5.		
59.8186	59.8183	59.8138
51.3902	51.3902	51.3902
8.4284	8.4281	8.4236
Filter No. 7.		
56.6283	56.6282	56.6254
51.7567	51.7567	51.7567
4.8716	4.8715	4.8687
Container No. 2 (Probe) = 0.0515		
Total Weight of Dust.		38.4477
		8.4236
		4.8687
		0.0515
		51.7915

TABLE NO. 7.

VELOCITIES IN DUCT AND PROBE.

LOAD: MCR DATE: 24/10/62 RIGHT HAND SIDE.

Sampling Point	Average Temperature	Mean Velocity Head	Mean Velocity in Samp. Point V_1	Mean Orifice Pressure Drop	Mean Velocity in Probe V_2
No.	^oA	mm H_2O	m/Sec.	mm H_2O	m/Sec.
A.1	423.7	7.56	14.34	26.66	13.86
A.2	421.6	6.70	13.47	24.00	13.06
A.3	421.8	6.26	13.03	22.50	12.48
B.1	423.1	8.43	15.14	30.00	14.75
B.2	422.2	7.80	14.55	27.83	13.86
B.3	422.9	7.50	14.27	26.50	13.79
C.1	423.5	7.50	14.29	26.50	13.80
C.2	423.4	6.36	13.16	23.00	12.79
C.3	422.3	7.00	13.78	25.00	13.38
D.1	423.8	8.76	15.45	31.00	15.01
D.2	425.0	8.73	15.44	30.50	14.96
D.3	423.3	8.66	15.35	30.50	14.93
E.1	424.7	9.56	16.15	33.50	15.69
E.2	425.9	9.30	15.94	32.83	15.59
E.3	424.8	9.30	15.93	32.83	15.58
F.1	425.9	8.33	15.10	29.50	15.16
F.2	426.7	8.00	14.81	28.50	14.35
F.3	424.5	9.00	15.67	31.50	15.22
G.1	426.0	9.00	15.69	31.50	15.28
G.2	425.9	8.46	15.21	30.00	14.98
G.3	423.3	7.83	14.59	27.83	14.23
H.1	424.1	8.66	15.36	30.50	14.90
H.2	425.2	9.13	15.79	32.16	15.33
H.3	426.3	9.00	15.70	31.50	15.48

TABLE NO. 8.

VELOCITIES IN DUCT AND PROBE.

LOAD: MCR. DATE: 24/10/62 LEFT HAND SIDE.

Sampling Point	Average Temperature	Mean Velocity Head	Mean Velocity in Samp. Point V_1	Mean Orifice Pressure Drop	Mean Velocity in Probe V_2
No.	^{o}A	mm H_2O	m/Sec.	mm H_2O	m/Sec.
A.1	426.5	7.53	14.37	26.50	13.81
A.2	425.7	8.26	15.03	28.66	14.42
A.3	426.8	6.90	13.76	24.50	13.25
B.1	424.2	7.20	14.01	25.00	13.41
B.2	427.6	7.86	14.69	28.00	14.26
B.3	403.3	8.26	14.63	29.33	14.17
C.1	424.5	6.46	13.27	23.50	13.11
C.2	423.3	7.00	13.80	25.00	13.40
C.3	426.2	8.66	15.40	30.00	14.80
D.1	423.8	9.53	16.11	33.50	15.66
D.2	426.7	9.53	16.16	33.50	15.71
D.3	427.2	8.96	15.68	32.00	15.32
E.1	427.0	9.93	16.50	35.00	16.06
E.2	428.7	9.36	16.05	33.00	15.57
E.3	430.4	9.07	15.84	32.00	15.38
F.1	425.4	8.97	15.66	32.00	15.29
F.2	425.4	8.46	15.21	30.00	14.79
F.3	425.5	8.96	15.65	32.00	15.29
G.1	425.8	10.01	16.55	35.00	16.04
G.2	427.9	9.10	15.82	32.00	15.37
G.3	428.9	9.00	15.75	32.00	15.39
H.1	425.5	9.56	16.17	34.00	15.90
H.2	425.2	8.95	15.64	32.00	15.33
H.3	425.4	8.93	15.62	32.00	15.33

TABLE NO. 9.

DUCT AREA.

POSITIONS.		DIMENSIONS.	AREA (Each) $in.^2$
A.1,A.2,A.3, C.1,C.2,C.3, G.1,G.2,G.3.	B.1, B.2, B.3, F.1,F.2,F.3, H.1,H.2,H.3.	$20" \times 15\frac{7}{8}"$	317.50
	D.1, D.2, D.3. E.1, E.2, E.3.	$20\frac{1}{2}" \times 15\frac{7}{8}"$	325.44

TABLE NO. 10.

FLUE GAS VOLUME

	SAMPLING POINT	AREA EACH	RIGHT HAND SIDE		LEFT HAND SIDE.	
	Number	in.^{2}	Σ Vi m/sec.	Vol.Q 10,000 ft.^{3} in 4 hours	Σ Vi m/sec.	Vol.Q 10,000 ft.^{3} in 4 hours.
M. C. R.	A.1, A.2, A.3, B.1, B.2,B.3 C.1, C.2, C.3, F.1, F.2,F.3 G.1, G.2, G.3, H.1, H.2,H.3	317.50	263.95 m/sec. 865.97ft/sec.	2749.45	271.03 m/sec. 889.19ft/sec.	2823.18
	D.1, D.2, D.3 E.1, E.2, E.3	325.44	94.26 m/sec. 309.25ft/sec.	1006.42	96.34 m/sec. 316.07ft/sec.	1028.62
	TOTAL:		358.21 m/sec. 1175.21ft/sec.	3755.87	367.37 m/sec. 1205.27ft/sec.	3851.80

TABLE NO. 11.

VOLUME ASPIRATED.

	Side	Probe Area (Ap)	Σ Vl	Volume Sampled (Q_2)	Ratio Volume Emitted to Volume Sampled.		Correction Factor
		$X10^{-3}$ Ft^2	M/sec.	$Ft.^3$	Actual (R)	Theoretical (R)	K
M. C. R.	R.H.	0.767	348.46 m/sec.) 1143.23ft/sec.)	526.11	71380	69420	1.03
	L.H.	0.767	357.06 m/sec.) 1171.44ft/sec.)	539.10	71440	69420	1.03

TABLE NO. 12.

DUST EMISSION.

		Unit	R. H.	L. H.	Total
M. C. R.	Weight of ash Sampled (W)	Gram	51.7915	41.9548	93.7463
	Weight of ash Emitted (E)	lb.	8394.77	6806.00	15200.77
	Weight of ash collected in 4 hours.	lb.	21259.8	19950.15	41209.9

TABLE NO. 13.

RIGHT HAND

Grain Size	Emitted Ash Analysis	Mass of Ash Emitted	Collected Ash Analysis	Mass of Ash Collected	Fractional Efficiency
(Microns)	(%)	(lbs.)	(%)	(lbs.)	(%)
0 - 1.4	12.05	1011.57	1.28	272.12	21.20
1.4 - 3.4	32.07	2692.20	3.50	744.09	21.65
3.4 - 5.0	31.28	2625.88	7.64	1624.25	38.22
5.0 - 7.5	16.80	1410.32	10.68	2270.55	61.68
7.5 -11.6	5.65	474.30	15.58	3312.28	87.47
11.6 -19.2	2.15	180.48	16.22	3448.34	95.03
19.2 -23.8	0	0	7.33	1558.34	100
23.8 -26.7	0	0	3.25	690.94	100
> 26.7	0	0	34.56	7347.39	100
TOTAL	100.00	8394.75	100.04	21268.30	71.7

LEFT HAND.

Grain Size	Emitted Ash Analysis	Mass of Ash Emitted	Collected Ash Analysis	Mass of Ash Collected	Fractional Efficiency
(Microns)	(%)	(lbs.)	(%)	(lbs.)	(%)
0 - 1.4	12.59	856.87	1.39	277.31	24.45
1.4 - 3.4	32.39	2204.46	4.12	821.95	27.16
3.4 - 5.0	30.32	2063.58	7.19	1434.42	41.01
5.0 - 7.5	16.52	1124.35	10.27	2048.88	64.57
7.5 -11.6	5.83	396.79	14.97	2986.54	88.27
11.6 -19.2	2.35	159.95	16.23	3237.91	95.29
19.2 -23.8	0	0	7.33	1462.34	100
23.8 -26.7	0	0	3.21	640.40	100
> 26.7	0	0	35.31	7044.40	100
TOTAL	100.00	6806.00	100.02	19954.15	74.5

SOUTH AFRICAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

NATIONAL MECHANICAL ENGINEERING RESEARCH INSTITUTE.

PARTICLE SIZE ANALYSIS ON FOUR SAMPLES OF FLY-ASH

FOR: FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

Description of Samples.

The four samples were designated as follows:-

(a) Right hand probe sample
(b) Left hand probe sample
(c) Dust caught by dust collector, right hand
(d) Dust caught by dust collector, left hand.

Method of Analysis.

As requested, the analysis was performed in a Bahco Centrifugal Dust Classifier.

The two probe samples (a) and (b) weighed about 38 grams and 25 grams respectively upon receipt. These were each split into two parts and each part was analysed as a whole.

The samples from the dust collectors, (c) and (d) were supplied in quantities of several pounds. From each of these a portion weighing about 15 grams was collected by means of a sampling tube, and the analysis performed on these smaller samples.

In order to calibrate the Bahco Centrifugal Dust Classifier a further analysis was performed on a sample of standardised dust of known particle size distribution. From this information the following formula was derived for the actual grain size limits:-

$$d = \frac{d'}{1.5\sqrt{\rho}}$$

where d = actual particle diameter in microns

d' = ideal particle diameter in microns, as supplied by the manufacturers of the instrument

ρ = particle density.

In this connection attention should be drawn to the following recommendation by the manufacturers:

"When handling dust samples originally having more than 30 per cent of their particles below 6 microns, the accuracy of fractionation should be attested by examination of the fractions under a microscope".

For this purpose a portion of each fraction of the probe samples was collected and handed over to the Fuel Research Institute.

Results: .../

Results:

(a) Right hand probe sample

Particle Density: $\rho = 2.17$ g/cc

	1st Analysis	2nd Analysis
Sample Weight, G_u grams	18.1769	20.3724
Residue on Screen, G_f grams	0.0020	0

Spacing Piece No.	Grain Size Limit, microns		Residue, grams				Cumulative weight % above grain size limit	
	Ideal Particle diameter, d'	Actual Particle diameter, $d = \frac{d'}{1.5\sqrt{\rho}}$	1st Analysis		2nd Analysis		1st Analysis	2nd Analysis
			G_a	$G_a + G_f$	G_a	$G_a + G_f$		
18.5	3.2	1.4	16.0291	16.0311	17.8745	17.8745	88.2	87.7
17	7.4	3.4	10.4800	10.4820	11.0602	11.0602	57.7	54.3
16	11.0	5.0	4.6282	4.6302	4.8547	4.8547	25.5	23.8
14	16.5	7.5	1.4309	1.4329	1.5757	1.5757	7.9	7.7
12	25.7	11.6	0.3905	0.3925	0.4372	0.4372	2.2	2.2

(b) Left hand probe sample

Particle Density: $\rho = 2.17$ g/cc

	1st Analysis	2nd Analysis
Sample Weight, G_u grams	16.2630	8.7233
Residue on Screen, G_f grams	0	0

Spacing Piece No.	Grain Size Limit, microns		Residue, grams				Cumulative Weight % above grain size limit	
	Ideal Particle diameter, d'	Actual Particle diameter, $d = \frac{d'}{1.5\sqrt{\rho}}$	1st Analysis		2nd Analysis		1st Analysis	2nd Analysis
			G_a	$G_a + G_f$	G_a	$G_a + G_f$		
18.5	3.2	1.4	14.1943	14.1943	7.6458	7.6458	87.3	87.6
17	7.4	3.4	9.0809	9.0809	4.6649	4.6649	55.8	53.2
16	11.0	5.0	4.1009	4.1009	2.0698	2.0698	25.2	23.7
14	16.5	7.5	1.3547	1.3547	0.6892	0.6892	8.3	7.9
12	25.7	11.6	0.3941	0.3941	0.1940	0.1940	2.4	2.2

(c) Dust caught by dust collector, right hand

Particle Density, ρ = 2.17 g/a
Sample Weight, G_u = 18.0120 grams
Residue on Screen, G_f = 0.0074 grams

Spacing Piece No.	Grain Size Limit, microns		Residue, grams		Cumulative weight % above grain size limit
	Ideal Particle diameter, d'	Actual Particle diameter, $d = \frac{d'}{1.5\sqrt{\rho}}$	G_a	$G_a + G_f$	
18.5	3.2	1.4	17.7817	17.7891	98.8
17	7.4	3.4	17.1513	17.1587	95.3
16	11.0	5.0	15.7752	15.7826	87.6
14	16.5	7.5	13.8515	13.8587	76.9
12	25.7	11.6	11.0450	11.0524	61.4
8	42.5	19.2	8.1238	8.1312	45.1
4	52.5	23.8	6.8029	6.8103	37.8
0	59.0	26.7	6.2170	6.2244	34.6

(d) Dust caught by dust collector, left hand

Particle Density, ρ = 2.17 g/cc
Sample Weight G_u 15.1915 grams
Residue on Screen, G_f 0.0047 grams

Spacing Piece No.	Grain Size Limit, microns		Residue, grams		Cumulative weight % above grain limit
	Ideal Particle diameter, d'	Actual Particle diameter, $d = \frac{d'}{1.5\sqrt{\rho}}$	G_a	$G_a + G_f$	
18.5	3.2	1.4	14.9798	14.9845	98.6
17	7.4	3.4	14.3543	14.3590	94.5
16	11.0	5.0	13.2623	13.2670	87.3
14	16.5	7.5	11.7025	11.7072	77.1
12	25.7	11.6	9.4282	9.4329	62.1
8	42.5	19.2	6.9619	6.9666	45.9
4	52.5	23.8	5.8479	5.8526	38.5
0	59.0	26.7	5.3595	5.3642	35.3

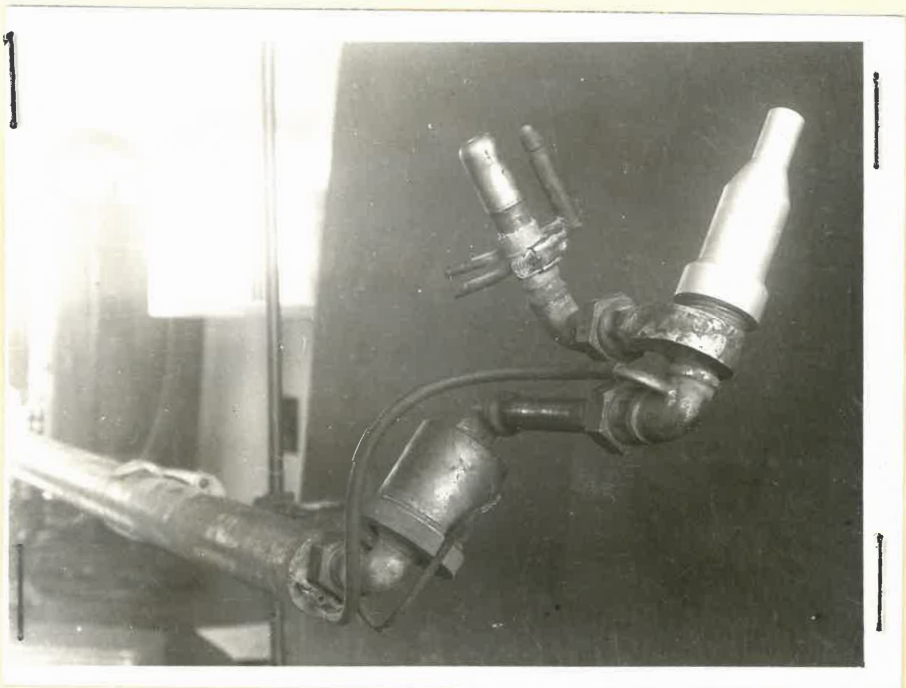


FIGURE: 1.

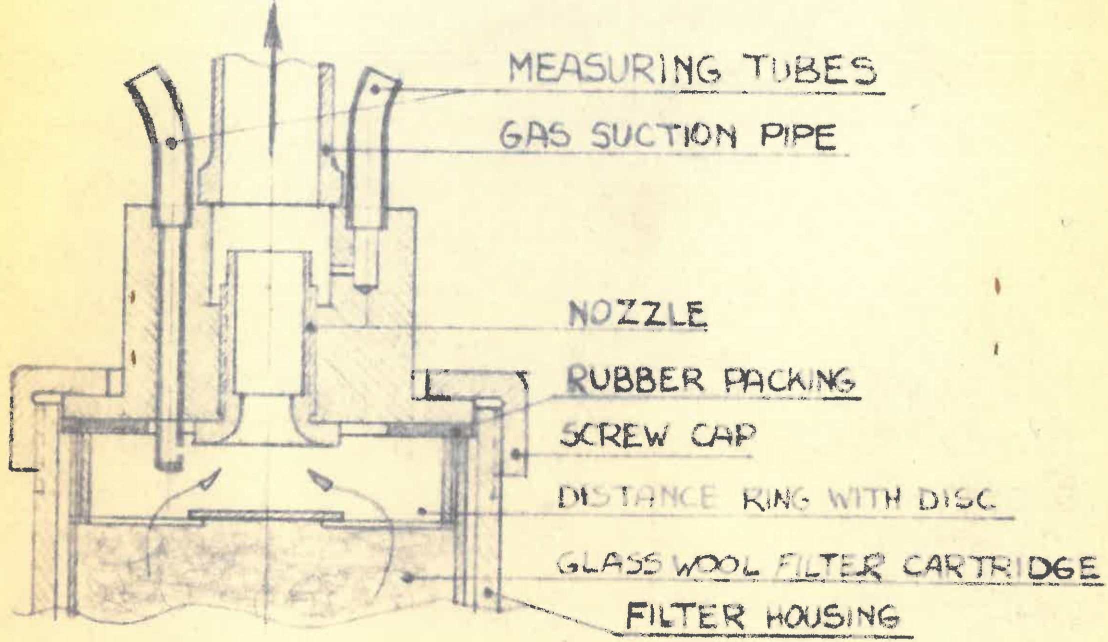


FIG. 2

FILTER HEAD AND NOZZLE

HIGHVELD POWER STATION
BOILER No 6

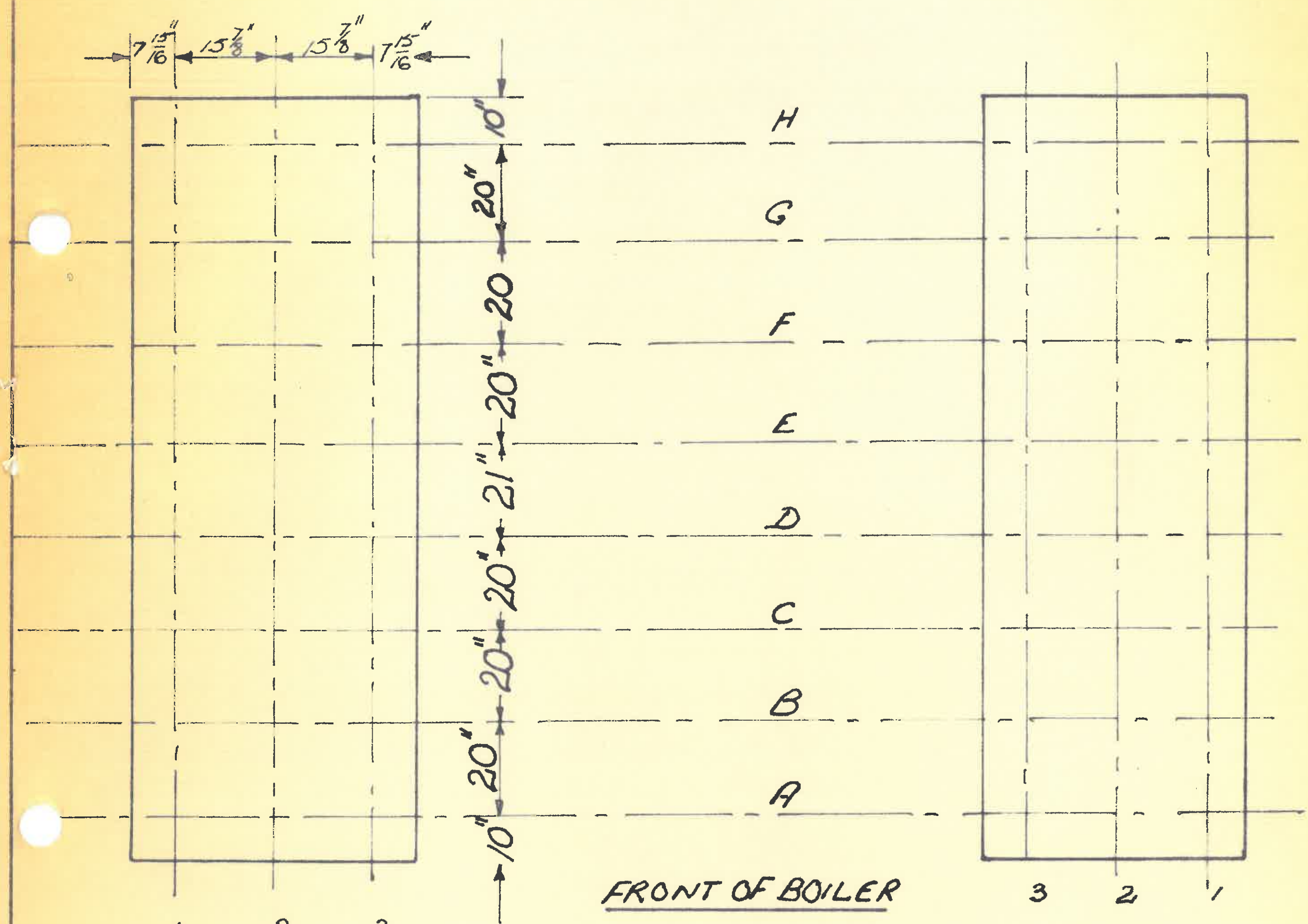


FIG. 3

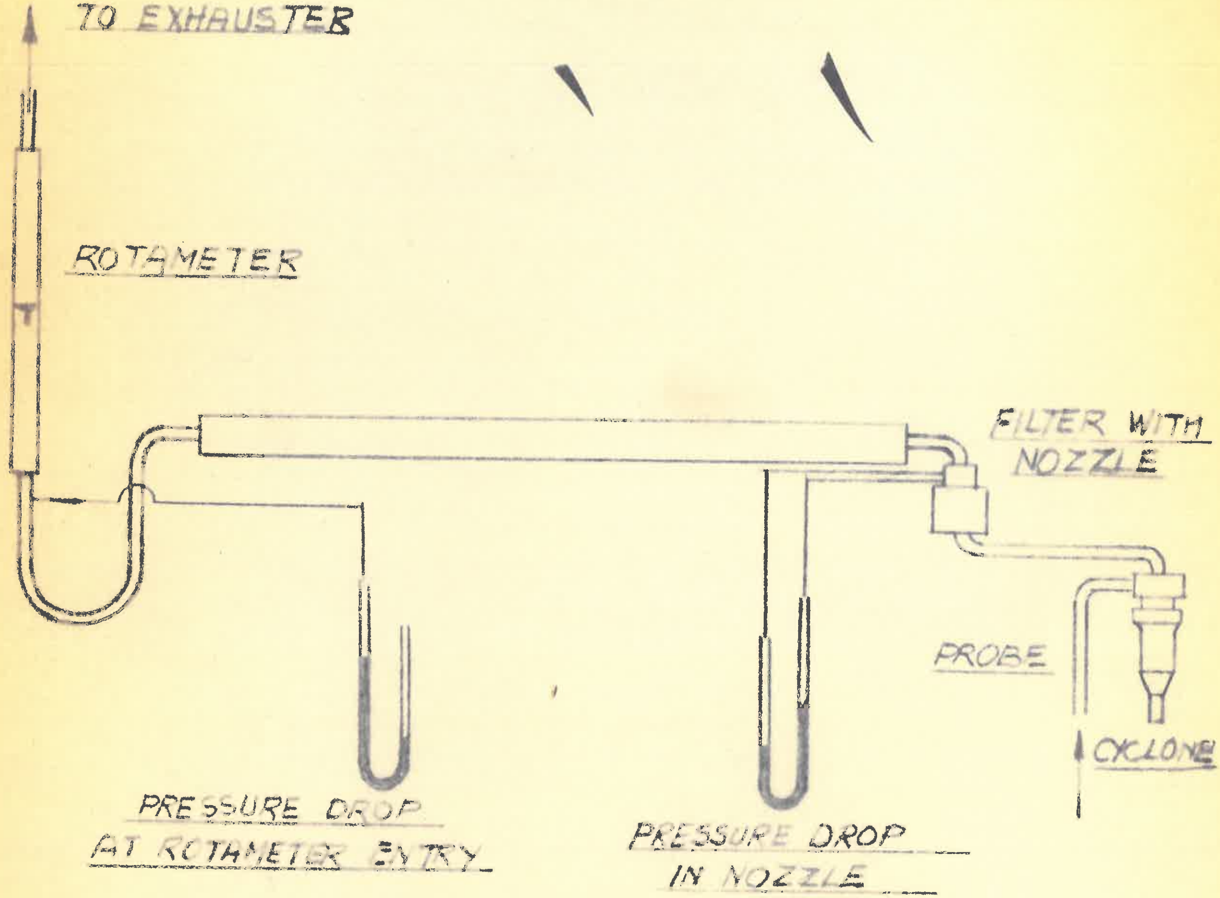
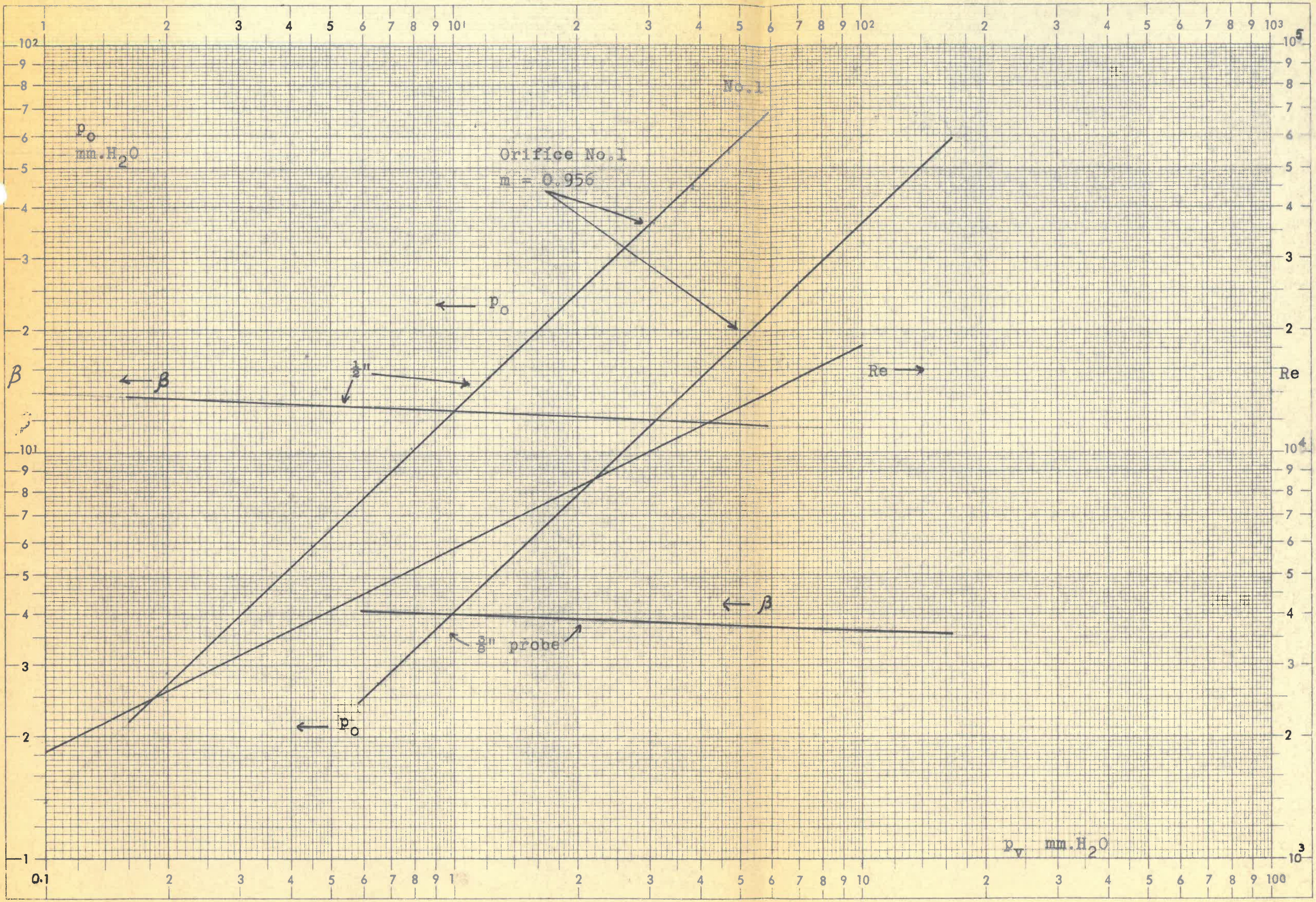


FIG. 4 : SET-UP FOR CALIBRATION OF NOZZLE



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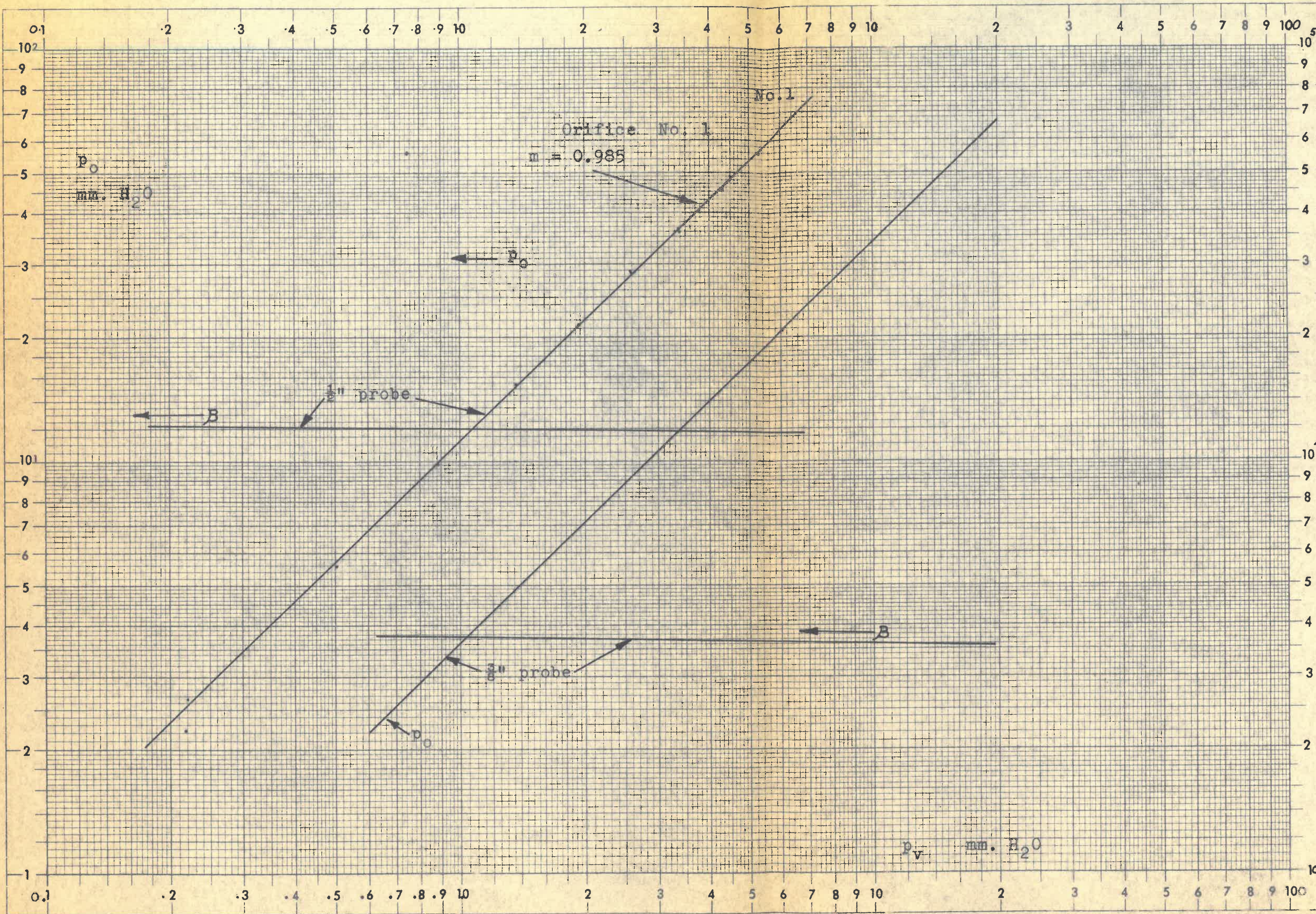
Beide Achsen logar. geteilt, eine von 1 bis 100, die andere bis 1000, Einheit 100 mm.

FIGURE C 1 a

Calibration Curves for Apparatus No. 1.

Note: This figure is for the purpose of illustration only and of reduced size compared with the diagram from which the ratio p_c + p_v is determined.



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Beide Achsen logar. geteilt, eine von 1 bis 100, die andere bis 1000, Einheit 100 mm.

FIGURE C 1b

Calibration Curves of Apparatus No. 2.

Note: This figure is for the purpose of illustration only and of reduced size compared with the diagram from which the ratio $p_o \div p_v$ is determined.