NIOSH/TC/A-003

TEST PROCEDURE FOR COAL-MINE-DUST-PERSONAL-SAMPLER UNITS

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16. Abstracts The performance of coal-mine-dust-personal sampler units is specified by 30 CFR 74. Tests for filter resistance, rotameter calibration, flow against resistance capsule preweight, flow rate consistency, high and low charge rundown, and pulsation frequency are given. The tests are used as part of the determination for whether or not a unit is approved. It should be noted that simpler requirements may not have written test procedures and other procedures may be published separately.

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PREFACE

The authors express their appreciation to Nancy Rice for her effort in preparing the manuscript. The mention of a manufacturer's product in this report is not to be construed as an endorsement by NIOSH. Equivalent test equipment may be used for this test procedure and should give comparable results.

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Abstract

The performance of coal mine dust personal sampler units specified in 30 CFR 74 requires the testing of several components of the unit. In a few cases several performance tests may be done at the same time, but most of the tests are done separately. For this reason, each test procedure is listed by itself with a reference to the applicable section of 30 CFR 74. It should be noted that simpler requirements may not have written test procedures and other procedures may be published separately.

Reference to Test Requirements

The test procedures are used to test coal mine dust personal sampler units under Title 30 Part 74 of the Code of Federal Regulations.

Equipment Required

Los Alamos SIC

- Wright Dust Feeder
- Dust Chamber
- Standard Coal Dust
- 200 millicurie charge neutralizer

Bubblemeter (2 liter)

Timer (measured to the nearest 0.1 second)

Balance (Mettler M-5)

Brooks Flow Meter (capable of reading 2.00 lpm $\pm$ .01 lpm)

Power Source (Hewlett-Packard 6204B Power Supply) - two used

Hygrometer (Abbeon)

Pressure Transducer

Oscilloscope (Hewlett-Packard, Model 141B)

Electonic Digital Manometer (Barocel, Model 1174)

Needle Valve (Swagelok)

Air-tight container (Fisher Desicator)

Calibration Procedures

The following procedures are references for calibration of equipment required for this test procedure.

Bubblemeter - Alo Primary Standards Laboratory, Calibration for Bubble-O-Meter DN-013B.

Timer - Space Division, North American Rockwell Corporation, Procedure 5138, Apr. 1969.

Balance - Calibrated by manufacturer twice a year.

Brooks Flowmeter - Sandia Corporation, Procedure No. BKC-EN-025.

Power Sources - Calibrated as needed with digital voltmeters.

Hygrometer - North American Aviation, Inc., Space and Information System Division, Procedure No. 5064-8, Feb. 1966.

Pressure Transducer - Hercules Powder Company, Procedure 07-3-89, Dec. 1961.

Electronic Digital Manometer - North American Aviation Inc., Meteorology Laboratory, Procedure P-SM-017, Feb. 1967.

Operating Procedures

The operating procedures follow as separate procedures for each test.

FILTER RESISTANCE PROCEDURE (30 CFR 74.3(b)(2)(i)

I. Use the following apparatus:

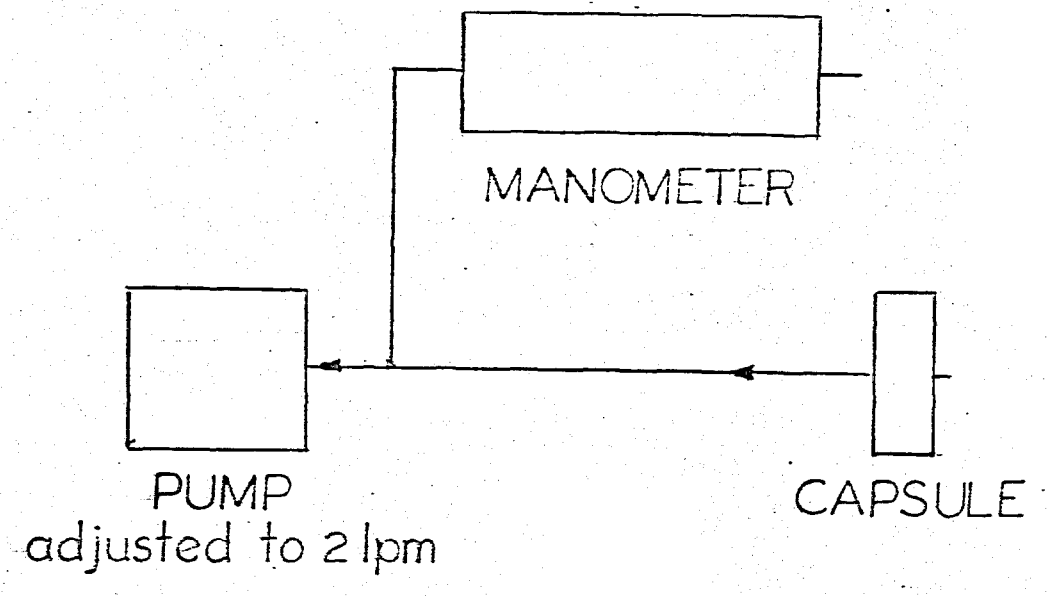

Figure 1. Filter resistance apparatus.

II. Record the data collected. Manometer reading must be less than 2.0 inches of water to pass.

ROTAMETER CALIBRATION FOR 30 CFR 74.3(a)(11) and (12)

I. Use the apparatus shown in Figure 2 with the following precautions.

A. Run the actual tubing supplied with the unit through the desicator rubber stopper.

B. Run a short piece of large diameter tubing between the bubblemeter and desicator.

C. Make sure the bubblemeter is perpendicular to a level table.

D. Run enough bubbles through the bubblemeter to thoroughly wet the walls. The bubble should be almost flat when it crosses the top mark.

E. Use a battery charged to manufacturer's specifications or operate the pump from a constant voltage source.

II. Adjust the rotameter setting to the calibration mark being checked. Start the timer when the soap film is at the lower bubblemeter calibration mark. Stop the timer when the soap film is at the upper bubblemeter calibration mark and record the timer reading to the nearest 0.1 second. Perform this measurement four (4) times for each rotameter setting being checked. Compare the average of the four (4) measurements to the chart to determine if the calibrations are within the ±5 percent requirement.

ROTAMETER SETTING	2 LITER BUBBLEMETER	
	TARGET (Sec.)	ACCEPTABLE Range (Sec)
Open full	<48.0	<48.0
2.0	60.0	57.1-63.2
1.8	66.7	63.5-70.2
1.6	75.0	71.4-78.9
Closed	>80.0	>80.0

III. Record all information. Rotameter setting, volume collected, time to collect volume, and barometric pressure and temperature.

IV. Seven of the ten pumps must have all average flow rates within the acceptable range.

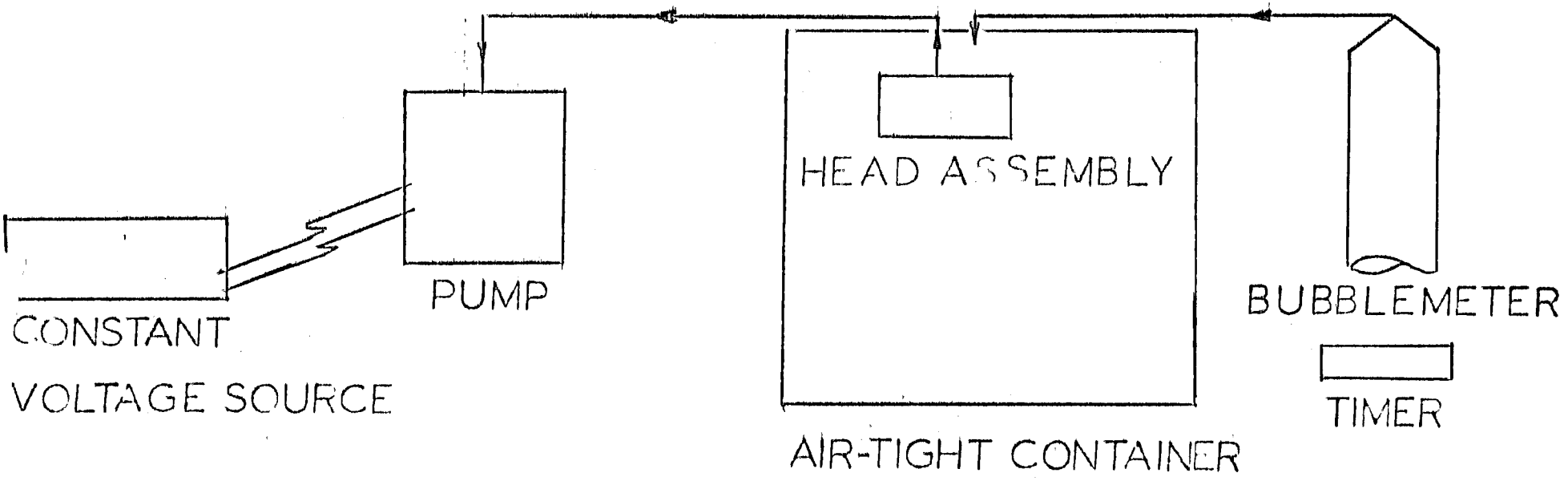

Figure 2. Rotameter calibration apparatus.

FLOW AGAINST RESISTANCE - 30 CFR 74.3(a)(14)

Test may be combined with high or low charge rundown.

I. Use the apparatus shown in Figure 3 with the following precautions.

A. Make sure the bubblemeter is perpendicular to a level table.

B. Run enough bubbles through the bubblemeter to thoroughly wet the walls. The bubble should be almost flat when it crosses the top mark.

C. Take an average of at least four (4) bubblemeter times.

D. Use a pump charged according to the manufacturers specifications.

II. Record the time the test is started.

III. Adjust the needle valve (controls the manometer) and pump until the manometer reads 3.9 to 4.1 inches of water and the actual flow rate is 2.00 $\pm$.01 lpm.

IV. Determine the actual flow rate as in Step II, Page 5 and using Table 1 in Appendix A.

V. Check test progress hourly and record time from start of test, manometer reading, actual flow rate, and pump rotameter setting. If rotameter or manometer settings are not in correct range, re-set and take another set of readings. All readings are recorded on data sheet in Appendix B.

VI. Test is complete when run eight (8) hours (pump passes) or pump rotameter cannot be adjusted to conditions in Step III.

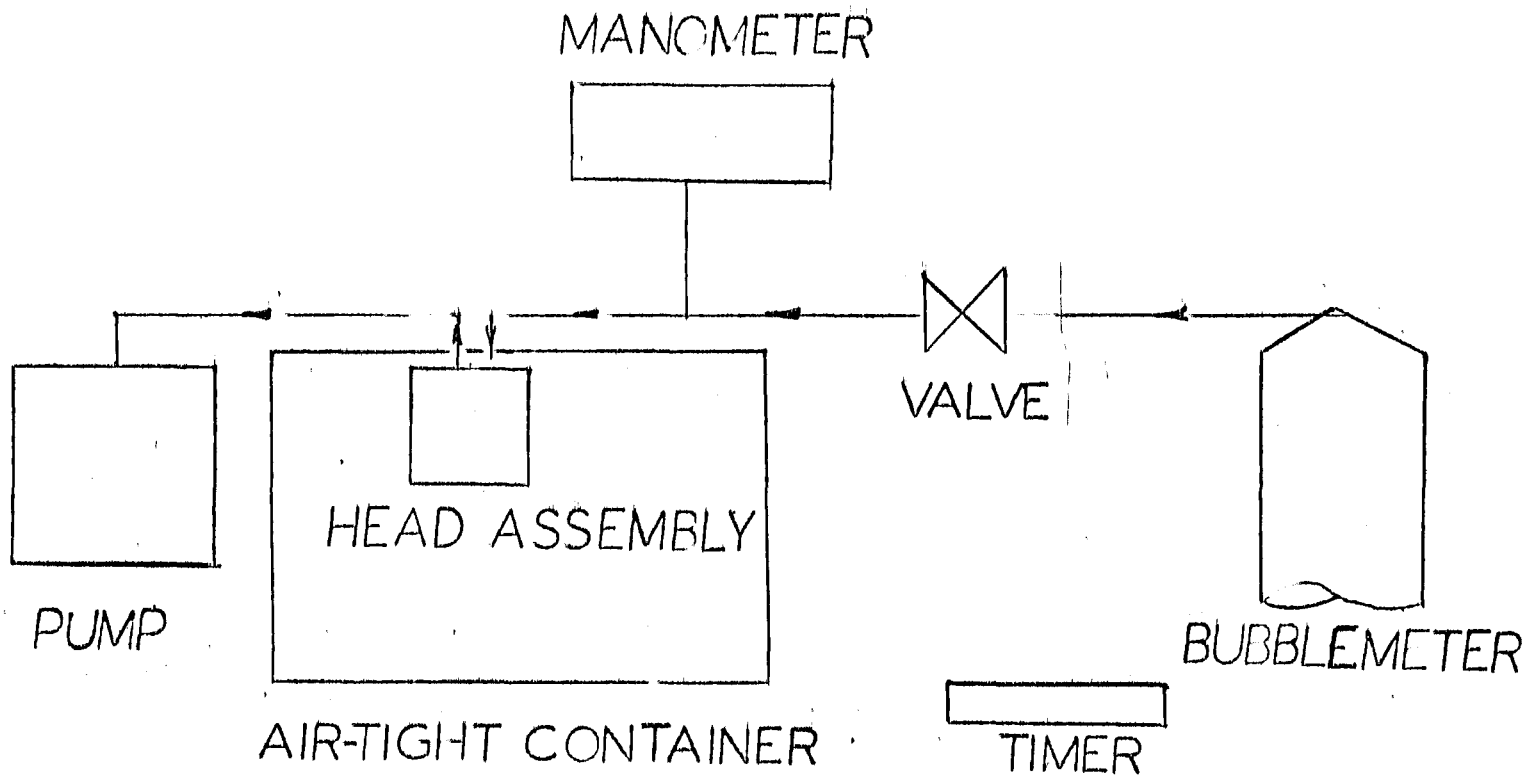

Figure 1. Flow against resistance apparatus.

CAPSULE PREWEIGHT AND TOTAL MASS PROCEDURE - 30 CFR 74.3(b)(2)(ii)

I. Weight ten (10) unused capsules to the nearest 0.01 mg and record all data. Be careful to handle them only with tweezers.

II. Treat the ten (10) capsules for 16 hours at 50°C to simulate storage and use conditions in the field.

III. Re-weigh the capsules as in Step I.

IV. Rounded off weights (nearest 0.1 mg) must be less than 5.0 grams, and the manufacturers preweight must be within 0.1 mg of this weight to pass.

V. The capsules shall be weighed in an atmosphere with 50 $\pm$ 10% relative humidity and a temperature of 20 $\pm$ 3°C.

FLOW RATE CONSISTENCY - 30 CFR 74.3(a)(13)

I. The flow rate consistency test is to be run on the Los Alamos SIC as if the CMDPSU was to be used for taking a sample concentration.

A. The gear ratio on the SIC shall be set at 2:1. Los Alamos standard coal dust packed to 1500 psi will be used. This gives 3 - 4 mg/m^3 respirable dust concentration.

B. Four pumps shall be run at the same time from their own internal batteries charged according to the manufacturers specifications.

C. Any warm-up time prescribed in the manufacturer's instructions shall be followed before setting the flowrate to 2.00 $\pm$ 0.01 lpm on all four pumps.

II. The flow rate on the pumps will be checked every hour by removing the head assembly from the sampling chamber of the SIC and attaching it to a bubblemeter (see Figure 4).

A. If the flow is between 1.90 and 2.10 lpm, no adjustment is required.

B. If the flow does not fall within the desired range, an adjustment shall be made so that the flow returns to 2.00 $\pm$0.01 lpm.

C. The number of adjustments shall be noted and no more than two required for an eight hour run on the SIC.

D. Optionally the filters may be weighed and concentrations determined to assure filter integrity. However, visual examination of the filter at the end of the run is sufficient.

III. Ten runs shall be conducted with all four pumps required to pass seven our of ten times. (see Appendix B for data sheets)

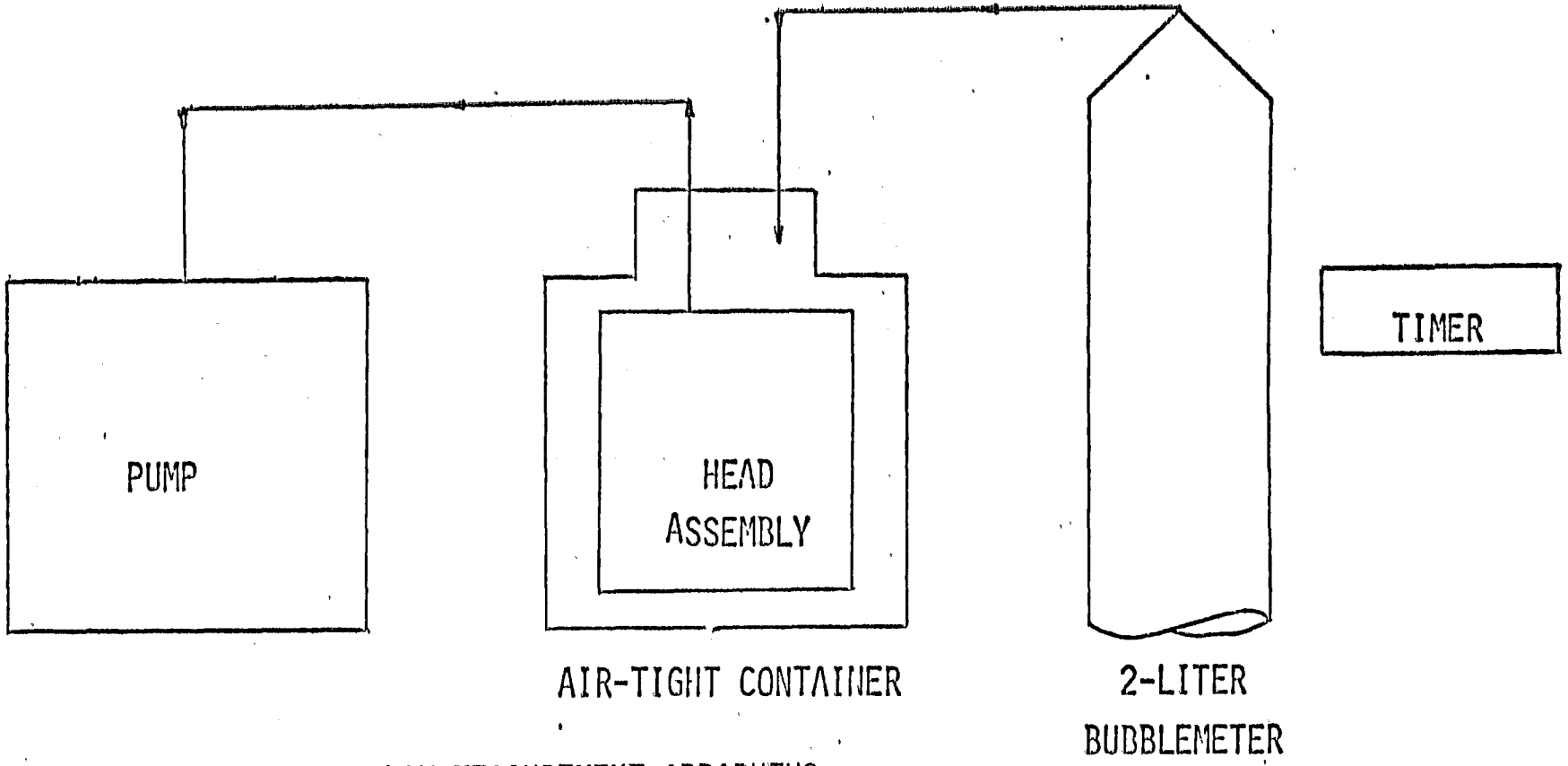

FIGURE 4- DIAGRAM OF FLOW MEASUREMENT APPARUTUS.

HIGH AND LOW CHARGE RUNDOWN PROCEDURE - 30 CFR 74.3(c)(4)

I. This test will be run in conjuntion with resistance and consistancy tests. A discharged battery is defined as one which has operated a unit for eight hours at 2 lpm.

II. A discharged battery will be charged at either the 16 hour rate for 16 hours or the 64 hour rate for 64 and 88 hours and the pump tested for flow rate consistancy or resistance.

III. The pump will again be fully discharged, recharged at the OTHER charging rate, and tested again.

IV. If one charger passes the test, other chargers are considered equivalent if they give identical wave forms and amplitudes on an oscilloscope on both high and low charge rates with the following arrangements (with the battery not fully charged).

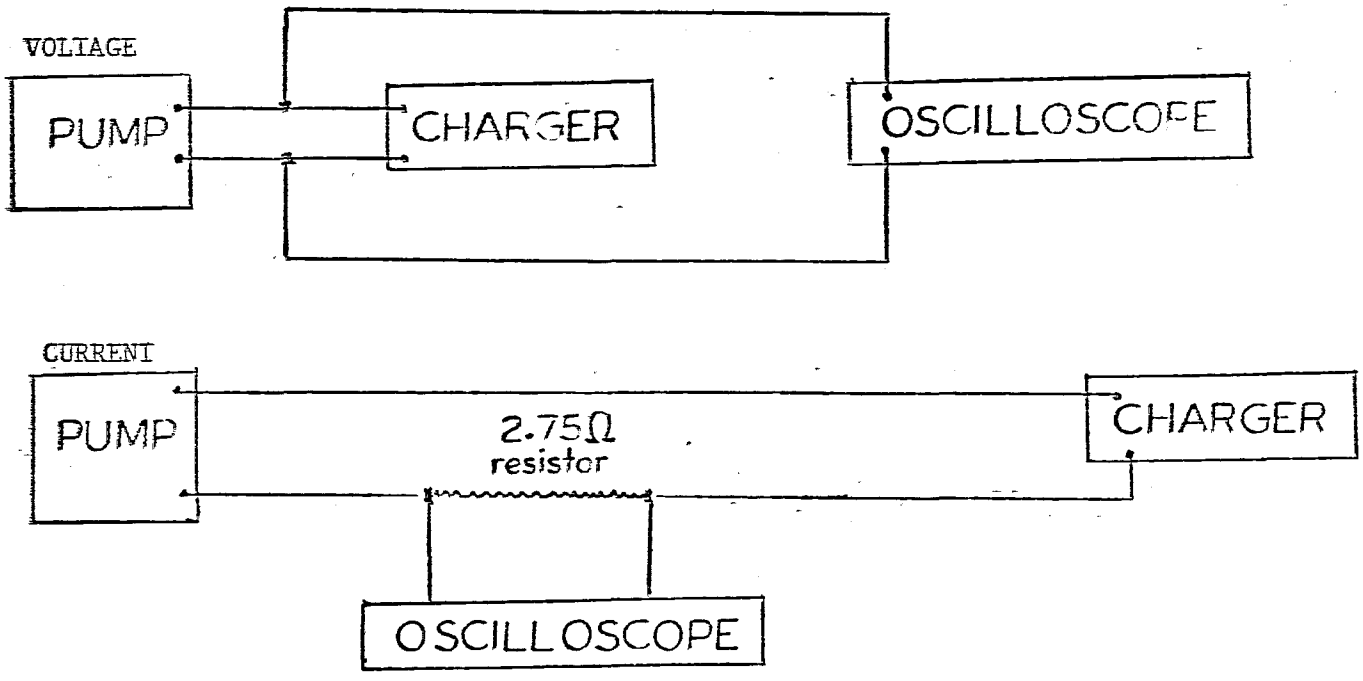

Figure 5. Charge rundown apparatus.

PULSATION FREQUENCY - 30 CFR 74.3(a)(8)(i)

I. The apparatus shown in Figure 6 will be used.

   A. For this test, a charged battery is used as the power source in pump.

   B. Proper warm-up time on the oscilloscope should be allowed. This time is noted in the manufacturer's instructions.

II. The frequency of the pulsation is determined by measuring the wavelength of the fundamental frequency which is the distance from one point on a repetitive wave form to the same point on the next repetition. The (distance/time) setting on the oscilloscope is noted and by dividing this setting by the measured distance, the fundamental frequency is calculated.

III. The frequency must be greater than 20 Hertz (cycles per second). See Appendix B for Data Sheet (Flow Rate Pulsation).

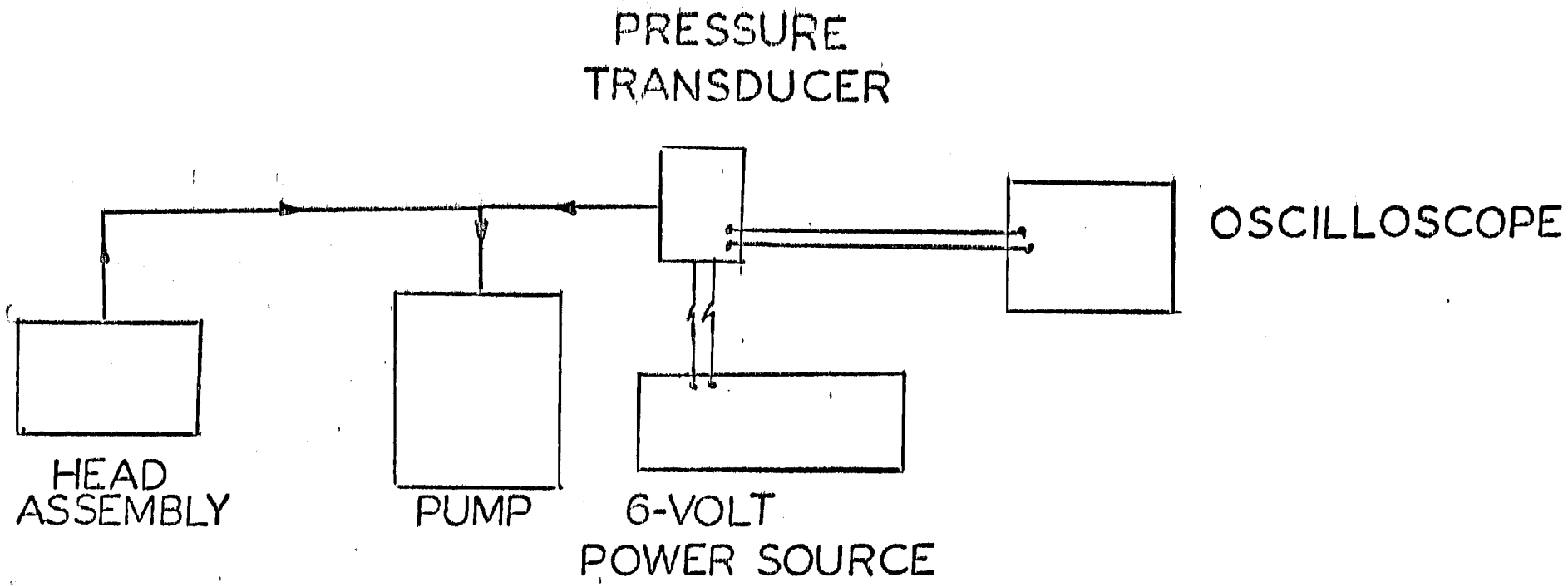

Figure 6. Pulsation frequency apparatus.

TABLE 1

Actual Flow Rate

FLOW RATE (lpm)	TIME (Sec.) TO COLLECT 2 Liters
1.90	63.2
1.91	62.8
1.92	62.5
1.93	62.2
1.94	61.9
1.95	61.5
1.96	61.2
1.97	60.9
1.98	60.6
1.99	60.3
2.00	60.0
2.01	59.7
2.02	59.4
2.03	59.1
2.04	58.8
2.05	58.5
2.06	58.3
2.07	58.0
2.08	57.7
2.09	57.4
2.10	57.1

APPENDIX B

DATA SHEETS

FLOW RATE PULSATION (TEST NO. 61)

BRAND NAME, MODEL MORGANS, MIGHTY MITE

TESTED BY MORGAN MORGAN DATE 13/13/73

OSCILLISCOPE NO PHS-4693-8122

	1.6 LPM SETTING			2.0 LPM SETTING			SETTING WIDE OPEN		
PUMP NO	CYCLE LENGTH (CM)	VELOCITY SETTING (SEC/CM)	FREQ (HZ)	CYCLE LENGTH (CM)	VELOCITY SETTING (SEC/CM)	FREQ (HZ)	CYCLE LENGTH (CM)	VELOCITY SETTING (SEC/CM)	FREQ (HZ)
M-1	3.33	.010	30	3.5	.010	28.6	3.6	.010	27.8
M-2	3.1	"	32.3	3.3	"	30.3	3.7	"	27.0
M-3	3.2	"	31.3	3.4	"	29.4	3.6	"	27.8
M-4	3.5	"	28.6	3.6	"	27.8	3.5	"	28.6
M-5	3.8	↓	26.3	4.1	↓	24.4	3.7	↓	27.0
	MANUFACTURER PASSES FREQUENCY OF PULSATIONS TEST.								
	SCOPE READINGS		CALCULATED VALUE						

HIGH AND LOW CHARGE RUNDOWN, RESISTANCE

NAME, MODEL _____

TESTED BY _____ DATE _____

PUMP NO. _____ HEAD NO. _____ CAPSULE/CASSETTE NO. _____

TIME	PUMP SETTING (LPM)	RESISTANCE (IN H_2O)	FLOW RATE ADJUSTED Yes	FLOW RATE ADJUSTED No	COMMENTS

FLOW RATE CONSISIENCY DATA SHEET

EXPERIMENT_____

RUN NUMBER_____GEAR RATIO_____START TIME_____

TOTAL RUN TIME_____

FILTER #				
PUMP #				
PORT				
INITIAL WGT				
FINAL WGT				
TIME/FLOW				

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GLOSSARY

CMDPSU - means a coal mine dust personal sampler unit, which is any unit, whether certified or not, intended for use in sampling coal dust in mine atmospheres.

SIC - means a standard instrument calibrator aerosol test system which was developed by Los Alamos Scientific Laboratory for testing of CMDPSU's.

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