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CR# 116820 (NASA CR OR TMX OR AD NUMBER)	12 (CATEGORY)

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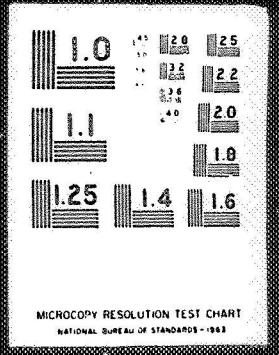
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To AEC-NASA Space Nuclear Propulsion Office

WATER DROPLET SIZE DETERMINATION FOR BREAK UP OF LARGE DIAMETER JETS

NERVA Program, Contract SNP-1

May 1970

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FAC-FTR01-W224-3

WATER DROPLET SIZE DETERMINATION FOR BREAK UP OF LARGE DIAMETER JETS

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I. SUMMARY

A series of nozzle tests in a wind tunnel has improved the understanding of how water from spray and penetration nozzles is distributed in a cross flow of gas, and how water-droplet sizes are generated.

The drops generated by the break up of water jets from nozzles ranging in diameter from 0.25 to 1.5 in. were photographed in a series of wind-tunnel tests. The volume mean drop size generated in these tests compared favorably with that calculated using the following empirical equation generated by Ingebo for nozzles of from 0.01 to 0.04-in. in diameter.

$$D_{30}/D_o = 3.9\ (We/Re)^{0.25} \qquad \text{(Eq. 1)}$$

The maximum droplet diameter was nominally 30% smaller than the droplets measured with the Ingebo method as correlated by the equation:

$$\frac{D_{max}}{D_o} = 22.3\ (We/Re)^{0.29} \qquad \text{(Eq. 2)}$$

A series of mass-distribution measurements has resulted in a new understanding of the quantity of water removed from the water jet as it penetrates a cross flow of gas. An empirical expression is presented that characterizes the water-jet mass distribution in a cross flow of gas. The correlation is a modification of the expression generated by Clark (Ref. 1).

$$q/q_o = [a(\epsilon_M - 1)^n + 1]^{-1.0} \qquad \text{(Eq. 3)}$$

A series of tests of flat-spray nozzles indicates that the penetration is decreased to 50 or 60% of that attained with a penetration or fire-hose nozzle.

II. INTRODUCTION

The NERVA Altitude Simulation System (NASS) for ETS-1 is an exhaust-duct system designed to simulate a high-altitude operational environment for a nuclear engine. One feature of this exhaust-duct design is a wet-elbow; a point in the duct where the exhaust gases are cooled by the direct injection of water and subsequently turned. The direct injection of water is used to cool the gases; obviating the need for secondary cooling of the duct walls or other components that are exposed to the exhaust gases downstream of the point of water injection.

To evaluate the effectiveness of such a cooling system, it is necessary to predict the manner in which streams of water injected into a cross flow of gas break up and evaporate.

In the design concepts of the water-injector system, different size water jets are specified to achieve varying degrees of penetration into the exhaust-gas stream, such that the entire gas-flow field, insofar as possible, interacts with the injected water flow. As the water jets penetrate the gas flow, they are disintegrated into droplets that evaporate, cooling the gas stream. Because the rate of evaporation is a direct function of the droplet size, the spectrum of droplet sizes generated is of primary interest.

Scale-model and other laboratory tests have established the jet penetration characteristics and jet-break-up rates. In addition, a volume mean droplet size has been predicted by using empirical correlations based on tests of small-diameter nozzles. Since the droplet evaporation calculation is dependent on the surface area exposed to the hot gases, confirmation regarding the droplet sizes generated by large water jets, as well as the jet-break-up rate, was deemed necessary.

A test program, consequently, was devised and completed to determine the mass distribution and the water-droplet sizes generated by the break up

of the water jets from a series of water nozzles ranging from 0.25 to 1.5 in. in diameter. The water pressures in these tests ranged from 37 to 137 psig, with flow rates of from 9.3 to 650 gpm. The tests were conducted in the Icing Research Tunnel at the Lewis Research Center.

Several investigators have studied the drop sizes generated by air atomization of liquid jets. Ingebo and Foster (Ref 2) performed experiments in a small wind tunnel and generated empirical correlations relating the drop sizes to the Reynolds number, the Weber number, and the nozzle diameter. The experimental technique developed in Ref 2 was used as a model for this droplet study, and the results are compared with the correlations in Ref 2.

Because different size nozzles are required for water penetration of a gas stream, the mass distribution of water will differ with each change in the nozzle size. Also, as a stream of water enters a cross flow of gas, the dynamic pressure of the gas flow causes the water jet to bend and spread. Ultimately the water jet is disintegrated into droplets. The designers of the NASS water injection system need to know how the water mass is distributed along the jet. To determine this, water-mass-distribution measurements were made in this test program.

The experimental data from this program do not compare well with the distribution predicted with a previous analytical model; consequently, new test data have been used to upgrade and improve the analytical model.

In addition to the other tests, a special series of tests was conducted to determine the penetration characteristics of a small, flat-spray nozzle. It is currently planned that this particular type of nozzle will be used in the NASS water-injection system in addition to the fire-hose type of nozzles. The small nozzles are needed to insure gas-water interaction in the near-wall region.

A few tests were conducted in which a long-chain polymer material (Polyox*) was introduced into the water flow. The addition of such a polymer to a flow of water has reduced the frictional loss in flow lines and could be beneficial for systems where pressure heads are limited and flow rates must be increased without hardware changes.

Because of constraints imposed by the test installation, the method of mixing the polymer into the water was inhibited and was, perhaps, inadequate. Consequently, no conclusions as to its effect could be positively ascertained; however, visual observations indicated that although the water flow rates were increased, the changes in penetration were not significant. It also appeared that bigger water droplets formed during the tests with Polyox added.

*Union Carbide Corporation, Chemicals and Plastics Development Division.

III. DESIGN OF EXPERIMENT

A. WATER-DROPLET STUDY

A jet of fluid injected into a cross-current air stream will penetrate the air stream and break-up into small droplets. Much experimental and analytical work has gone into the problem of measuring drop sizes and determining the distribution in such a system to permit a more fundamental analysis of the particular heat- or mass-transfer process.

The various techniques for measuring drop sizes include the following:

1. Collection - drops are collected on slides or in cells and measured and counted. Effective in a diffused, low-velocity gas stream.

2. Freezing - drops are solidifed, collected, and sized by using sieves. Requires a fairly long heat-transfer path to effect cooling.

3. Photographic - droplets are microphotographed. Requires high-speed photography. The depth of focus is small, which makes measurements difficult. Data reduction is tedious.

4. Optical - back scattering or diffractive scattering and transparency measurements are suitable for particles of a uniform size but are less effective for nonuniform-sized particles such as water sprays.

5. Electrical - droplet sizes of electrically conducting fluids are measured by pulse counter across an arc gap. Statistical methods are used for determining droplet sizes.

6. Electrostatic - electrostatic-charge measurements can be related to the size of particles.

7. Cascade Impactors - particles less than 100μ in diameter can be fractioned into groups. Require careful calibration. These are particularly good for smoke or aerosols.

In general, the methods of obtaining such quantities as number and mass concentration, drop size, and drop distribution data are either by taking samples and examining the collected particles or by direct observation of the dispersed mass. Because accurate and representative sampling is always difficult, it is generally preferred wherever possible to make direct observations. Commonly, the techniques for collecting liquid-drop samples are the same as for gas-borne-dust particles. The sample is collected by impingement or filtration, weighed, counted for number, and scaled for size. The technique used for the collection of samples is generally the direct capture of droplets on a slide or in an immiscible fluid. Counting or scaling may be performed from either photographs or the original specimen. An alternative technique is to treat a slide with a coating that will leave an impression that can be measured; however, this technique is dependent on a good calibration so that adequate size measurements can be obtained.

Sprays can be frozen to permit sieving and weighing of the collected spray to determine size and distribution. The technique of sampling by means of a jet or cascade impactor is an established method developed for the routine determination of cumulative volume distribution of a spray. It is recommended for drop sizes up to 100μ. Direct optical methods include: (1) unmagnified or microscopic observation of sedimentation rates, (2) intensity of transmitted light, and (3) measurement of intensity or polarization of scattered light. Each of these methods require suitable optical systems, and each method suffers from specific limitations.

Ingebo and Foster (Ref 2), and Bittker (Ref 3) utilized a high-speed camera to photograph fast-moving droplets in an air stream to obtain size measurements and a probe to determine droplet concentration. Bittker, in addition, analyzed these photographs by using an electronic counter, which

counted and sized only those drops greater than 200μ in diameter. Wiess and Worsham (Ref 4), and Nelson and Stevens (Ref 5) used a freezing technique to permit the collection of drops and the ultimate measurement of sizes. Weiss and Worsham used a hot wax as a simulating liquid and sized the dispersion by using a Micromerograph (a commercial sedimentation-in-air analyzer). Nelson and Stevens used a technique that froze the droplets from a spray nozzle in a liquid-nitrogen bath and found that it was possible to actually screen and weigh the droplets.

Optical techniques based on transmissivity or diffraction are generally unsatisfactory but Dobbins, Crocco, and Glassman (Ref 6) were able experimentally to show agreement between the volume-to-surface mean diameter for solid spheres as measured both by a microscope and by a light-scattering experiment.

Wicks and Dukler (Ref 7) reviewed the techniques used for measuring drop-size distributions and developed a new method for a direct measurement. The principle is simple, droplets of a conducting fluid flowing past two needle points of a dc circuit produce current pulses that can be totaled electronically. By varying the needle spacing, an average-count-rate curve is obtained from which the drop distribution can be calculated. Experimental data presented do not permit a full evaluation of this technique.

A sampling technique where droplets are captured on slides has been used by numerous investigators. Griffen and Nuraszew (Ref 8) counted droplets deposited from a spray on microscope slides coated with magnesium oxide, and then simplified the system by spraying a dyed fuel through the nozzle and collecting samples at varying distances from the nozzle. By comparing the samples colorimetrically, it was possible to infer mass distribution and the corresponding volume.

All of the previously mentioned methods require a unique collector system to be mounted in the gas-flow field with the exception of the direct

observation or optical system. Perturbations of the flow field would effect the sizes of droplets generated by the action of this high-velocity gas on the water stream, consequently, producing an erroneous environment. Results of laboratory investigations on similar subjects utilizing a high-speed shadowgraph system influenced the ultimate selection of a photographic technique as being a system that could fulfill the test objectives, and could be readily assembled with laboratory evaluation assuring its feasibility. This select area, High-Speed Shadowgraph Viewing System was used for determining droplet sizes.

This technique was patterned after the technique used by Ingebo and Foster (Ref 2) and consists of high-speed photography of the moving stream and subsequent determination of drop sizes from the photographs. The unique feature of the current study is the size of the water jet. The wind tunnel at the point where the jet plume was evaluated is six-feet high and nine-feet wide. The water nozzle was located in the tunnel three feet from the side windows, consequently, it was necessary to use a telephoto lens to achieve the proper depth of focus with a large iris to obtain a shallow depth of field. Several lenses were evaluated before a suitable system was found. Figure 1 is a sketch showing the camera location. Photography of moving droplets requires the use of either a short-duration light source or a fast shutter with a high-intensity light. A short-duration, high-intensity light source was used to shadowgraph the droplets in the flow field and relaxed the requirement for a high-speed shutter system on the camera. Figure 2 is a view of the camera and lens installation, and Figure 3 is a view of the high-intensity light installation. Figure 4 is one of the droplet photographs of a 0.25-in.-dia nozzle taken by this photographic system.

B. WATER MASS DISTRIBUTION STUDY

An ideal water injection system is one in which the water is uniformly distributed throughout the gas stream. A designer must, therefore, have some knowledge of the mass distribution in the water plume.

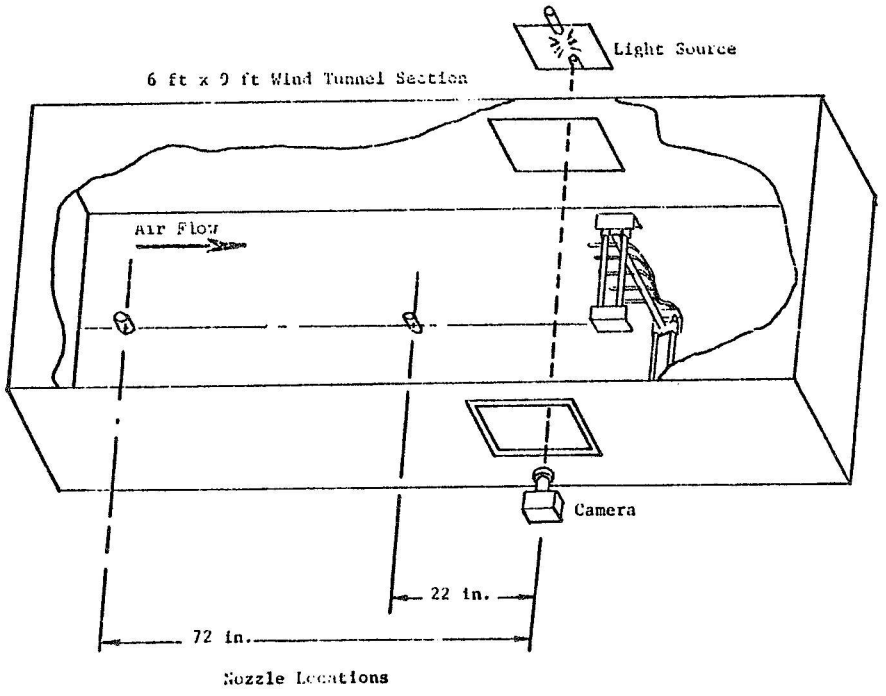

Figure 1 - Test Installation at Lewis Research Center Icing Tunnel

Figure 2 - Camera and Telephoto Lens Installation

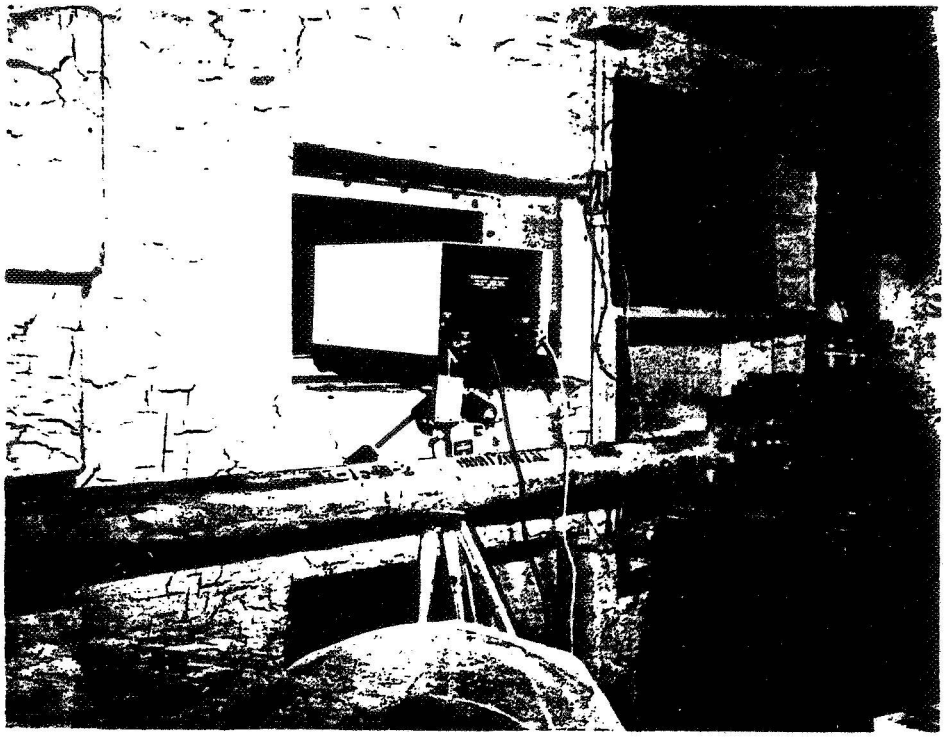

Figure 3 - High-Intensity Light Installation

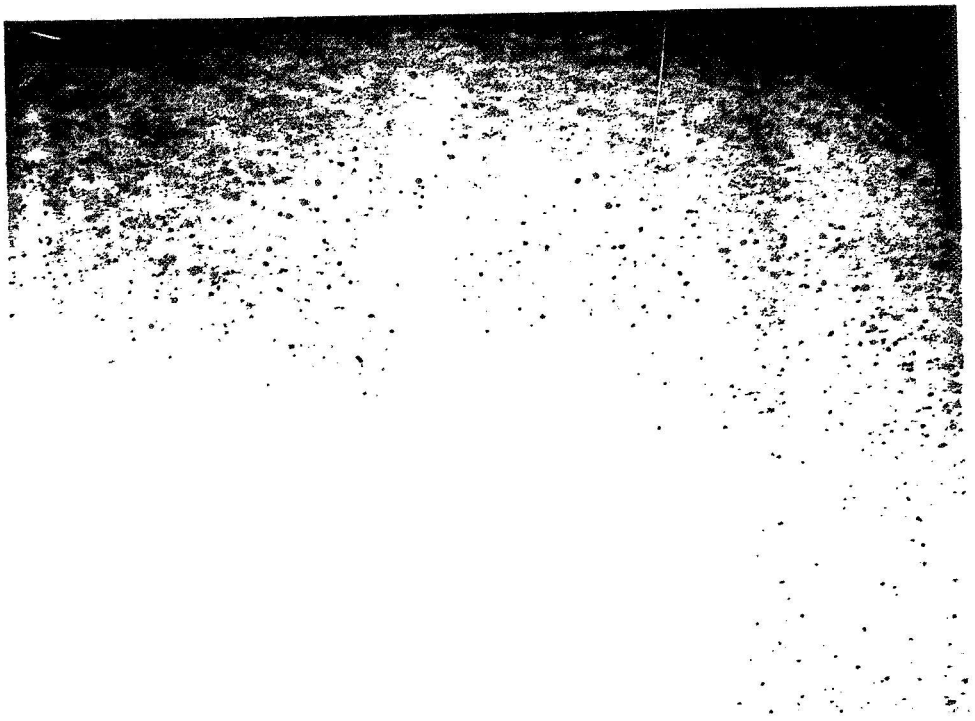

Figure 4 - Photograph of Water Droplets

A mass-distribution study was, therefore, incorporated into the test program, by using a sampling probe to collect a gas-water sample. The water was removed from the air by a Cyclone Separator* and collected and measured in graduated cylinders. A time-lapse camera recorded the water collection rate from each probe. Figure 5 is a schematic of the water-collection system. A rake with five probes was selected for sampling the air-water stream. A rake support was designed that was sufficiently rigid yet permitted the rake to be moved laterally away from the plume center line and rtically upward above the floor of the tunnel. By repositioning the sampling rake between tests, complete mapping of the plume from the water jet was possible. The entire plume could not be transversed during any one test, but, by repeating the test conditions of water flow and wind-tunnel speed, and repositioning the probe after each test, a complete pattern was obtained. AGC Drawing 1136457 defines the rake supports that were positioned on the floor and ceiling of the wind tunnel. The rake configuration is shown in AGC Drawing 1136456.

The sampling rake consisted of five probes located parallel to each other at a center line spacing of 4 in. The probe itself was a piece of 1/2-in. pipe about 11-in. long. The probes were supported by a 1-1/2-in. pipe. Each probe extended some four support pipe diameters upstream of the probe support to preclude any disturbance of the subsonic-flow field at or upstream from the probe inlet due to the probe itself. Good sampling of the flow field can be ensured if the static pressure both inside and outside of the probe is balanced. Consequently, the probes were instrumented with static ressure taps to permit measuring of static pressure in the probe. The entral probe on the rake contained three such static pressure taps. By recording the static pressure at each of the three tap locations, one could infer the static pressure at the probe inlet for comparing with the tunnel

*The Cyclone Separator was designed for the anticipated test flow rates and tested under laboratory conditions to evaluate its effectiveness. The action of the Cyclone Separator proved to be ideal with no detectable moisture in its exhaust.

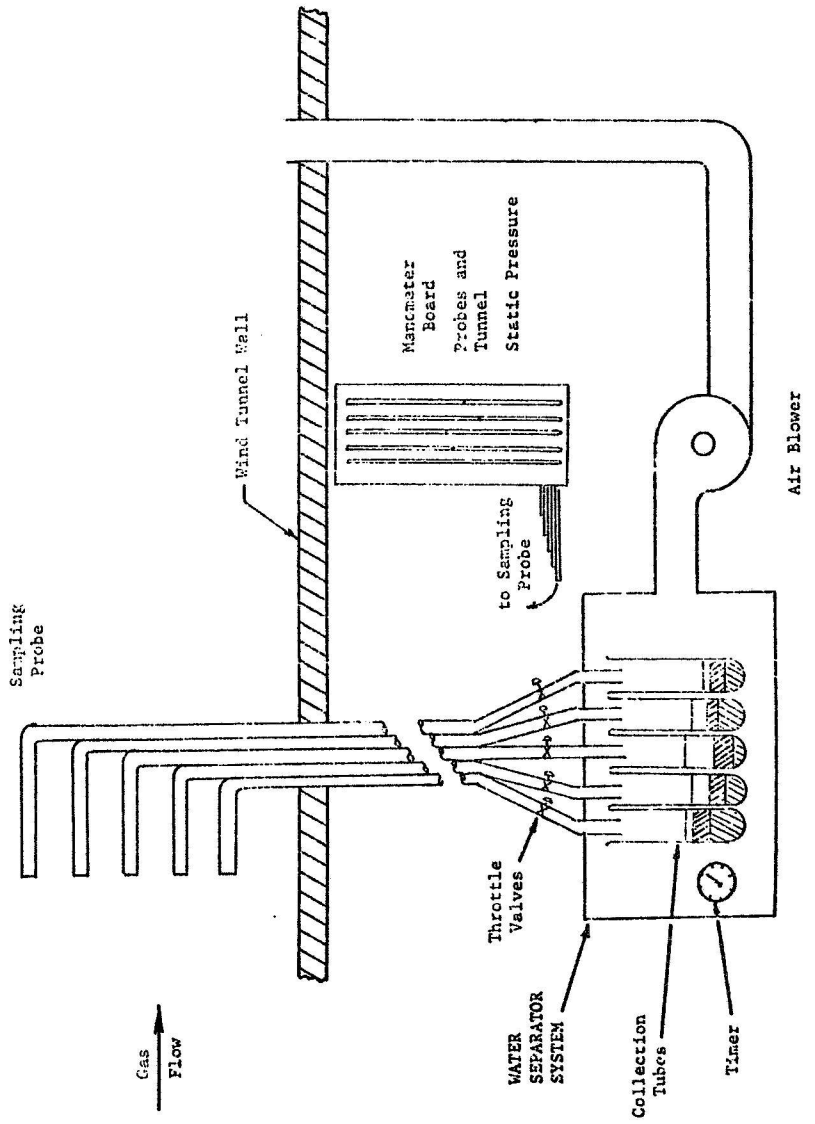

Figure 5 - Schematic of Sampling Probe Water-Collection System

static pressure. Figure 6 is a schematic of the sampling probe design, with the three static-pressure ports indicated.

A water separation and collection system located outside of the wind tunnel was connected to the probe by clear, plastic tubing. The static pressure taps were connected to a unity-oil-filled manometer board, and the probes were connected to cylindrical, lucite cyclone water separators. Water collected by each separator drained into collection tubes, as illustrated in Figure 7. To achieve isokinetic sampling, the static pressure both inside and outside of the probe should be balanced. This is achieved by making the gas velocity flowing through the probe the same as the gas velocity outside the probe. A pump was added, as shown, to the discharge side of the water separators to overcome the pressure losses in the water separator and lines.

The addition of a clock timer and a camera completed the water sampling installation. Figure 8 is a view of the sampling probe located in the wind tunnel, and Figure 9 is a view of the water collection system, installed below the wind-tunnel floor.

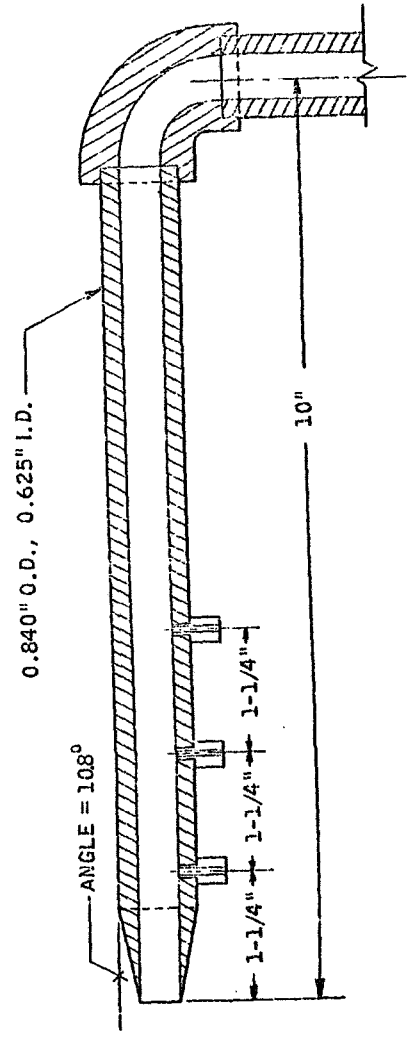

Figure 6 - Schematic of Experimental Null Type Sampling Probe

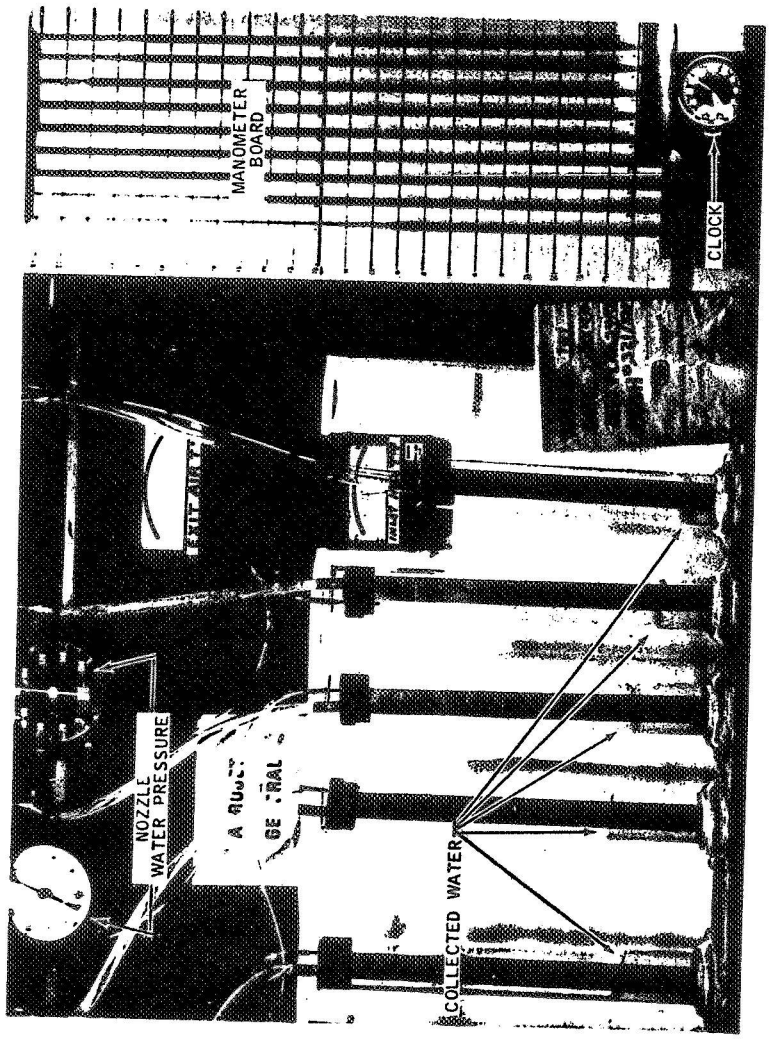

Figure 7 - Typical View of Water Collection System

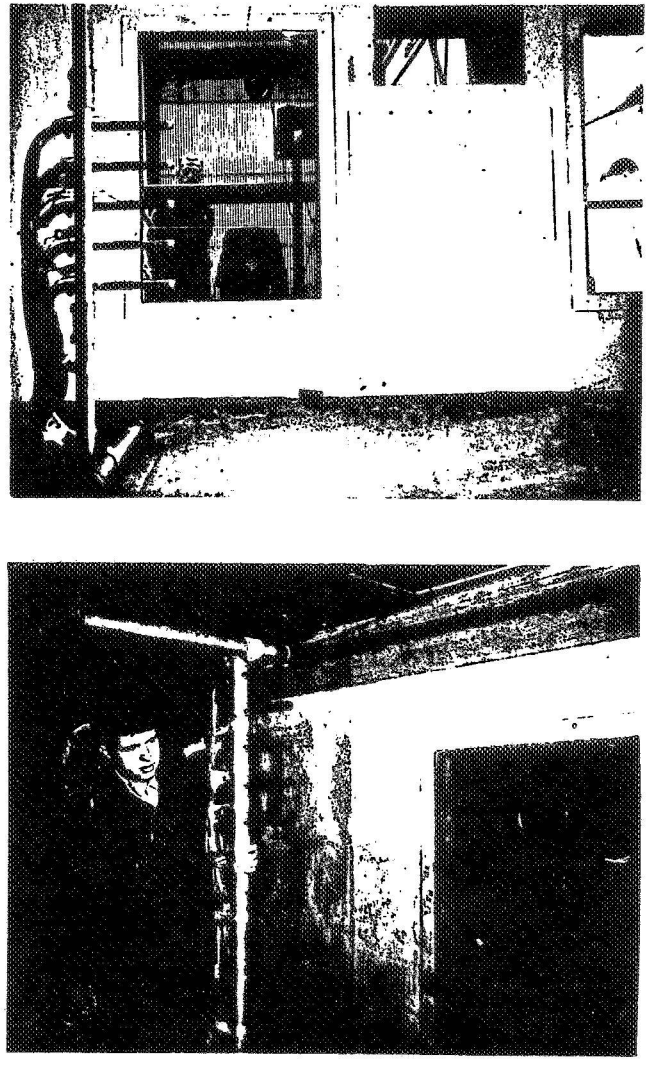

Figure 8 - Water-Sampling Probe Installation

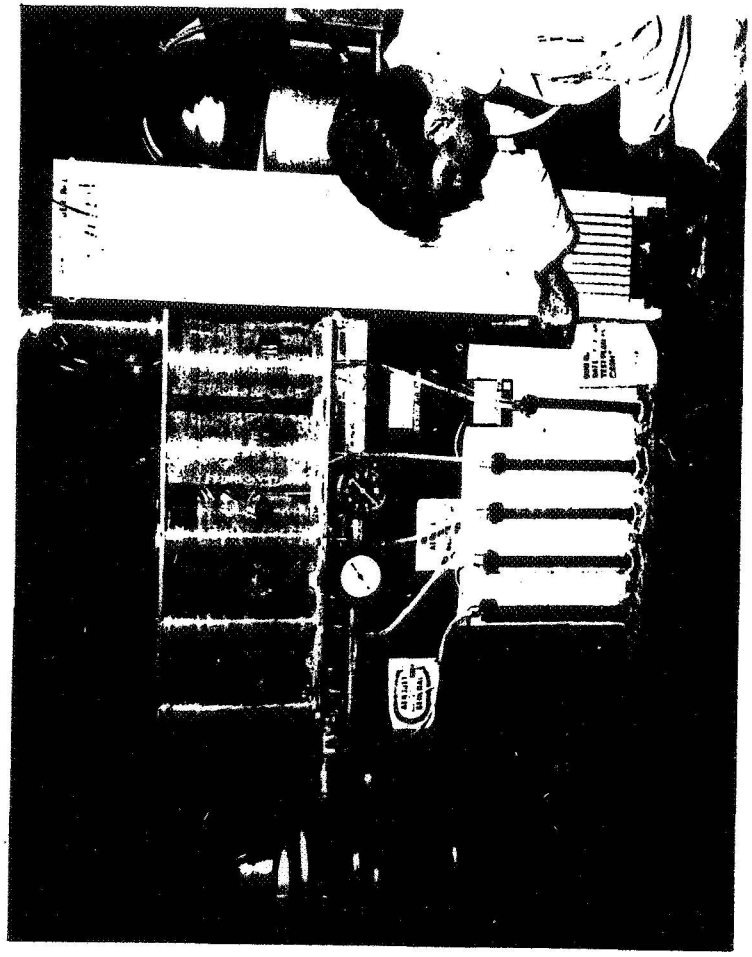

Figure 9 - Water Separator and Collector Installation

IV. EXPERIMENTAL PROGRAM

A total of 147 tests were conducted over a six-week period in the Lewis Research Center icing tunnel at Cleveland, Ohio. Each test consisted of tactical placement of the sampling probe and arrangement of the photo graphic system to obtain the best water jet plume coverage for the water pressure setting and wind tunnel velocities selected. Five different nozzles were tested; three penetration nozzles were used for the water droplet, mass-distribution study and two flat-spray nozzles were tested to determine their penetration characteristics into a cross flow of gas.

The variables in the test program aside from the nozzles themselves were: rake position, water-droplet camera position, the water manifold pressure (water flow rate). The variable most easily changed was the water flow rate; consequently, three tests were run (one at each of three water pressures) for each probe and camera location. In a few tests the air velocity in the wind tunnel was also changed (particularly true in the tests of the flat-spray nozzles.)

Complete analysis of the water-jet plume required up to four positions of the probe rake in the vertical plane, and four horizontal locations, one of which is in line with the nozzle. Only one-half of the plume was actually measured because photographs of the plume have shown that the flow was symmetrical about the center line. Consequently, in order to completely evaluate one nozzle at one flow rate it required as few as 4 and as many as 16 test runs, depending on the distance the jet penetrated into the tunnel. To evaluate three nozzles and three water manifold pressures means that a maximum test program of 144 test runs is required for the water collection phase at any one axial-probe location. The smaller plume sizes for the small nozzle required fewer probe settings for mapping and, the largest diameter nozzle could only be tested at two water pressures, hence, resulted in a reduction in the aforementioned number of tests.

To effectively utilize the wind-tunnel facility, the experimentation and adjustments required to obtain shadowgraphs of the water droplets were performed as part of the 144 tests required for the mass-distribution mapping.

The shadowgraph system (even though set up and checked out under laboratory conditions prior to these tests) still required adjustments and establishment of test procedures to obtain usable data. The type and speed of film used were dependent on the distances and inherent transmissivities of the wind-tunnel view ports. Experimentation with the film development and the enlarging procedures was also required to obtain maximum contrast in the film and reliability in enlarging and measuring procedures. Recirculation of the water injected into the tunnel rapidly decayed the transmissivity of the illumination system to a point where shadowgraphs could be obtained only during the first 15 sec. It was also found that the first five seconds of the test were required to permit the water jet to stabilize.

In most tests the plume-droplet photographs were made near the center line of the plume, i.e., at a location 36 in. from the center line of the plume to the wind-tunnel wall. A typical plume droplet photograph is shown in Figure 4.

A. TEST PROCEDURE

The photographs of the water droplet were taken and mass-distribution test data were collected simultaneously during each test run. The camera and the water collection system were positioned for a particular series of test runs, and the position of the water collection probe and camera in relation to the water nozzle were noted in accordance with the code sheet shown in Figure 10.

Data from each test were recorded photographically and logged by operators on data sheets. Test conditions noted by the operators were: (1) tunnel air temperature, (2) barometric pressure, and (3) water manifold pressure. Static and air total pressures in the wind tunnel were indicated on a manometer board, which was recorded photographically during each run at steady-state conditions. The water-collection system was photographed at

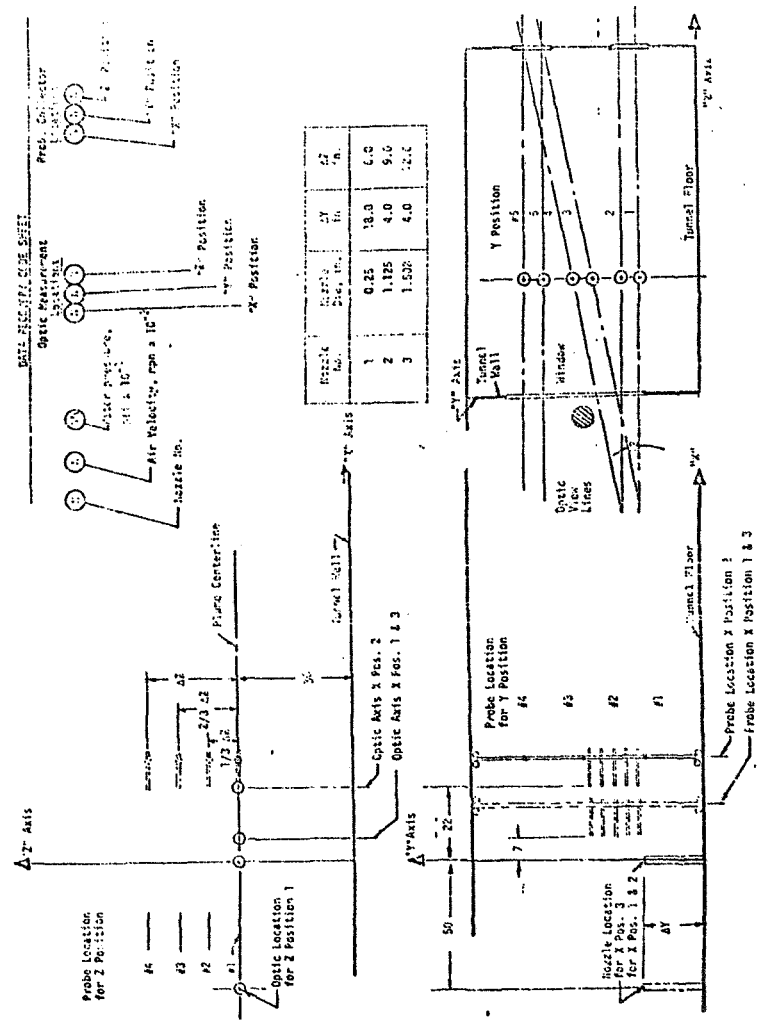

Figure 10 - Data Recovery Locations Code Sheet

intervals of from 5 to 10 sec in duration, and several photographs were also taken of the water droplets in the plume during each steady-state condition.

The same water supply system was used as that described in Ref 8. The water supply pressure was preset by a hand operated throttle valve. Once the throttle valve in the water supply system was set, the tunnel operator regulated the tunnel air velocity and water flow was initiated. Pressure of the water supply line was used with known flow calibrations to determine the flow rate for each nozzle.

Photographs of the water collection system and of the droplets in the jet plume were taken the first 1 to 2 minutes after initiation of water flow, after which recirculation of water vapor obstructs vision. Satisfactory water-droplet photographs were obtained during the first 5 to 15 seconds of a test run. The throttle valve was adjusted to a predetermined position for the next test.

After data had been recorded for the desired water manifold pressures, the water collection rake was repositioned for the next test run. Simultaneously the camera for photographing the plume was also repositioned. This procedure was repeated for the three penetration nozzles until the plume had been completely mapped for two or three water flow rates. Table 1 shows the range of test conditions and the number of mapping test runs conducted for each nozzle.

B. SPECIAL TESTS

A series of special tests was performed with the droplet test program to evaluate the penetration characteristics of the two flat-spray nozzles. Prior to this time all penetration data have been restricted to penetration or fire-fighting type nozzles. The design of the water injection system for the NASS wet-elbow requires that a small-diameter water jet, which will break up

TABLE 1

SUMMARY OF TEST CONDITIONS

Nominal Nozzle Diameter, in.	Nominal Water Velocity, ft/sec	Nominal Wind Tunnel Air Velocity, ft/sec	Number of Test Runs
0.25	57-105	400	17
0.75	100	400	2
1.0	60	220	4
1.0	55	330	1
1.0	57-105	400	53
1.5	57-105	400	29
1.5	57	220	2
1.5	57-100	420-430	9
F*-0.3-80**	60-120	220	10
F -0.3-80	130	430	1
F -0.3-40	60-120	220	3
F -0.3-40	120	430	1
		Total	132

SPECIAL TESTS

WATER JET PENETRATION TESTS

Nominal Nozzle Diameter, in.	Nominal Water Velocity, ft/sec	Nominal Wind Tunnel Air Velocity, ft/sec	Number of Test Runs
F-0.3-80	60-120	220-430	3
F-0.3-40	60-120	220-430	2

WATER POLYMER EVALUATION

Nominal Nozzle Diameter, in.	Nominal Water Velocity, ft/sec	Nominal Wind Tunnel Air Velocity, ft/sec	Number of Test Runs
0.75	60	200	2
1.0	28	400	1

*Flat Spray Nozzle
**Nozzle Spray Angle, degrees

rapidly, be incorporated into the system for interaction with the near-wall gas flow. Because the penetration characteristics of such nozzles were in question, special tests were deemed necessary. These tests were conducted in the same manner as the Phase II tests reported in Ref 9. Six tests were performed at two wind-tunnel speeds and three water pressures.

The last four tests in the wind tunnel were performed to qualitatively evaluate the influence of a high-molecular-weight organic polymer of hylene oxide on the penetration characteristics of a nozzle. The polymer evaluated was Polyox, a product of Union Carbide, Plastics and Chemical Division. The polymer is water soluble and when added to water in concentrations as low as 20 ppm, acts to reduce by as much as 80% the turbulent frictional drag of the water. The quoted effectiveness of this polymer on friction, on the basis of torque reduction tests, is more than a 40% reduction in torque at a concentration of 20 ppm and more than 60% at a concentration of 50 ppm.

C. METHOD OF DATA REDUCTION

1. Water Droplet Study

The photographic negatives from the water-droplet-size study were identified and enlarged to 8 x 10 in. for printing. This resulted in approximately a 3:1 enlargement of the droplets themselves based on photographs that included a view of the probe as shown in Figure 4. The actual field of view was approximately 2.5 in. on a side with a depth of focus of 0.25 in. Any droplets not within ± 0.125 in. of the focal plane appeared as gray spots. As the gray spot approaches the focal plane it first assumes a dark center that increases in size until the gray area is all dark. At this point the droplet is in the focal plane of the lens. The gray area can be thought of as a penumbra and the dark center as the umbra of the backlighted droplet. In interpreting the actual size of the drops those in which a

significant fraction of the surface was a gray penumbra were not counted, i.e., only those in which the width of the penumbra was equal to or less than the diameter of the umbra were counted. In sizing these particular drops, one-half of the width of the penumbra regions was added to the radius of the umbra region and this was reported as the droplet diameter. Data reduction then consisted of reading drop sizes and tabulating them from each photograph. Each photograph was divided into a 1 x 1 in. grid, and droplets in randomly selected grid squares were sized and counted until approximately 200 droplets were counted. A comparator magnifying glass was used to size the droplets to the nearest 0.005-in., by means of a graduated scale with markings at 0.005-in. intervals. Using this comparator a 0.005-in.-dia droplet on the photograph has an actual diameter of approximately 35 to 40 μ. From the tabulated droplet data several numbers describing the droplets were calculated as follows:

1. The mean droplet diameter $\bar{d}$ was found by summing the diameters and dividing by the number of particles.

2. The sample mass mean diameter or the representative diameter based on the total weight of the droplets divided by the number of particles.

3. The mass median particle size $\bar{d}$ median or that drop diameter at which half of the volume of the spray is from drops having diameters smaller than $\bar{d}$, and half is from drops larger than $\bar{d}$.

Early in the data reduction phase it became apparent that the task of tabulating the number and size of all droplets for each test would be extremely time consuming, consequently, a check was made on the consequences of random sampling each photograph. For one test a total of 1314 particles were counted and sized. Mass distribution curves and mass mean drop sizes were calculated for each tabulation. Figure 11 is a plot of the cumulative weight of the droplets as a function of drop diameter for an early test. In the data reduction of the droplet photographs, then, one aim was to achieve a sample size of approximately 200 droplets.

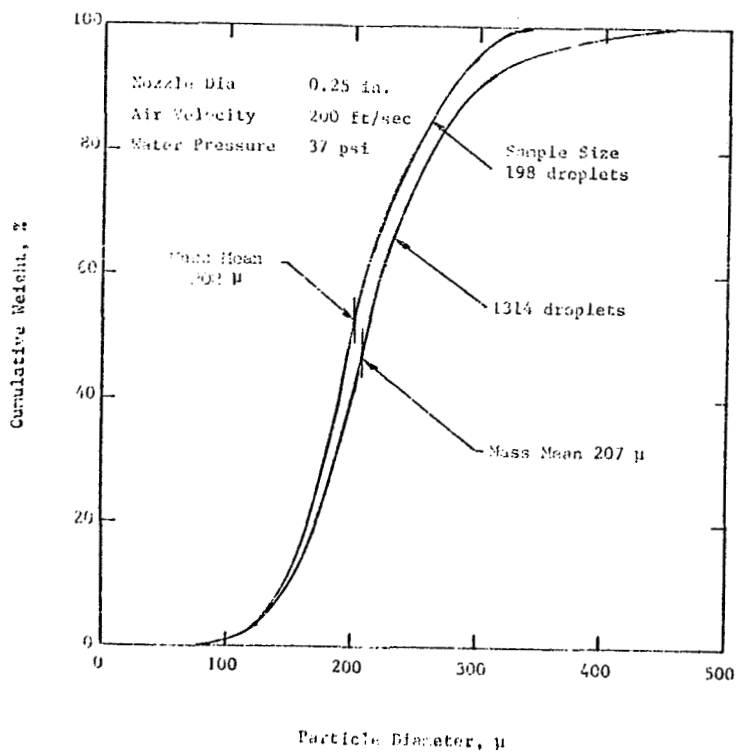

Figure 11 - Effects of Random Sampling on Cumulative Weight and Mean Droplet Diameters for Test Run 4

2. Mass Distribution Study

The reduction of the water-mass-distribution data consisted of interpreting the time sequence photographs of the water-collection system. Each photograph contained the time at which the measurement was made and the quantity of water in the graduated cylinders. This information was tabulated and the time average rate of fluid collection was calculated. Since some time was required for the collection system to stabilize, the first few readings were deleted from the rate determination. These rates of water collection were then plotted in relation to the nozzle exit plane for each test.

V. DATA ANALYSIS

A. WATER-DROPLET-SIZE DETERMINATION

The water-droplet sizes were statistically reduced and arranged according to nozzle size, water flow rate, and location in the water jet plume.

Photographs of the jet plume were taken at three distances downstream of the nozzle and from one to three points in the plume above the nozzle exit at each axial location. The focal plane of the camera was generally along the axis of the jet.

Not all photographs were interpretable for one or more of the following reasons:

1. Poor contrast between droplet and background developed rapidly due to recirculation of water (fog) in the wind tunnel. Also, the transmissivity of the tunnel varied with prescribed test conditions.

2. Spray was not uniform with time and varied in a random manner, particularly during the first few seconds of a test run.

3. Water mass concentration due to lack of stream breakup obliterated the high-intensity light.

4. Experimentation with different types of film, lighting intensities, and development processes produced some unusable negatives.

The points in the water plume where the droplets and the mass mean droplet diameters were measured have been plotted in Figures 12, 13, and 14 for the three penetration-nozzles tested. In these figures the location of the jet plume is noted as well as the test conditions. Droplet measurements

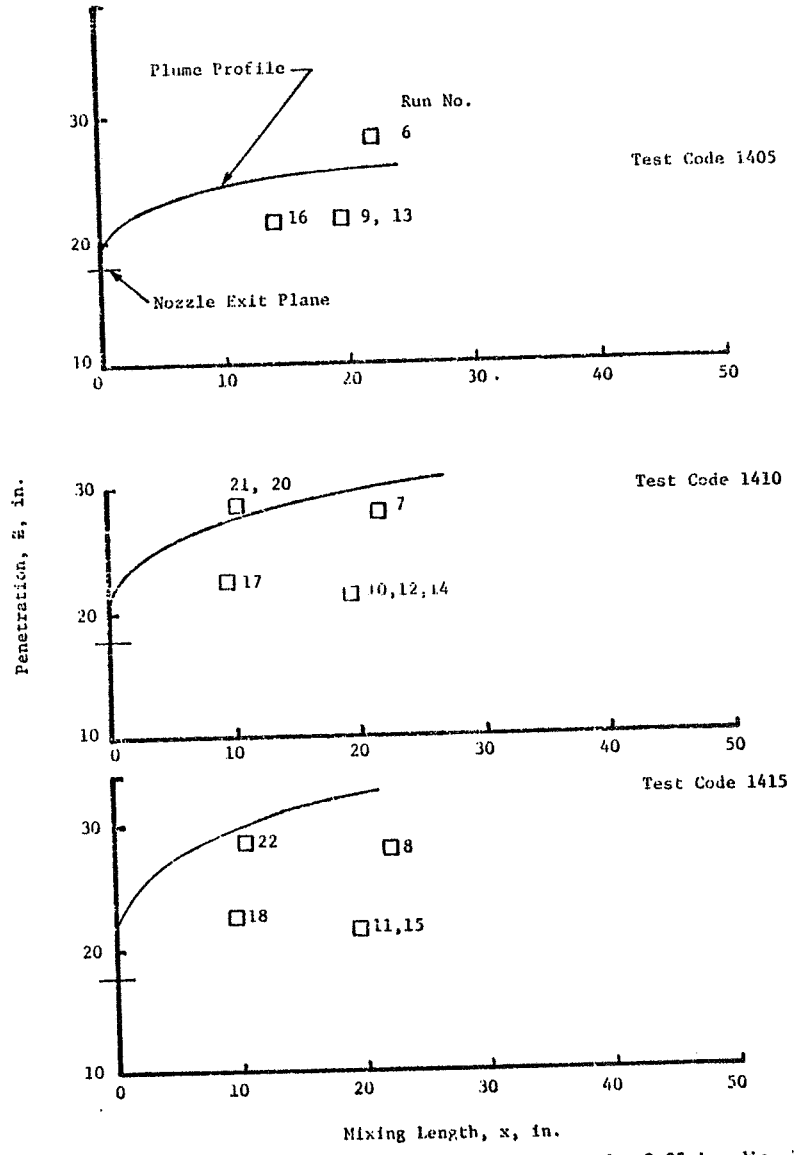

Figure 12 - Location of Water Droplet-Size Measurements for 0.25-in.-dia Nozzle

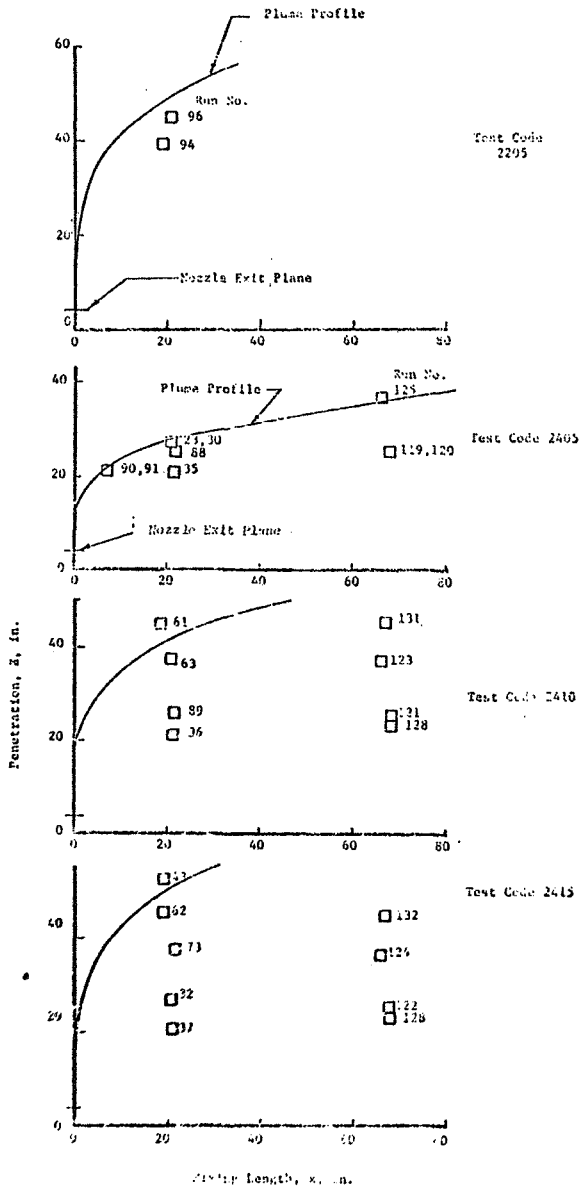

Figure 13 - Location of Water Droplet-Size Measurements for 1.125-in.-dia Nozzle

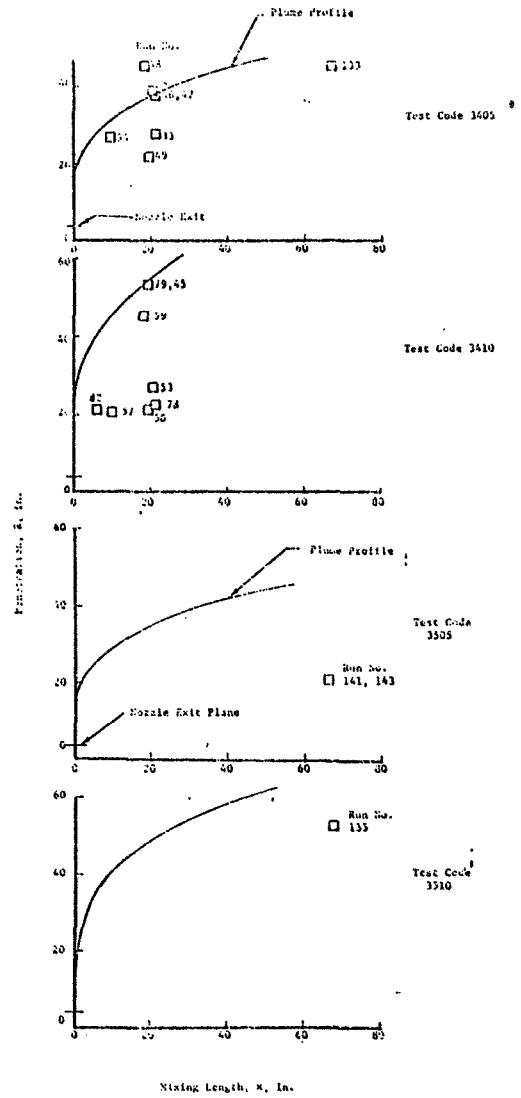

Figure 14 - Location of Water Droplet-Size Measurements for 1.5-in.-dia Nozzle

were made at three planes downstream of the nozzle, 7, 21, and 67 in., and from two to four points above the exit plane of the nozzle. Data from tests that could be interpreted and, therefore, included in the analysis, are tabulated in Table 2. Test data were obtained for three penetration and one flat-spray nozzle with two or three water-jet velocities for each at a wind-tunnel air velocity of 400 ft/sec. The 1.125 (nominally 1-in.) penetration nozzle was also tested at a wind-tunnel air velocity of 200 ft/sec. In general, the data from the small nozzles at low water velocities resulted in the best photographs. The high density of water in the gas stream resulted in either completely or partially opaque photographs in tests of large-diameter nozzles. Where the droplets were visible, they were sized; consequently, in those cases where parts of the print were opaque the true mean diameter is questionable because of the minimum sample.

1. Mean Droplet Size

The mean droplet size for each interpreted test photograph was calculated on the basis of the equation:

$$\bar{d} = \frac{\Sigma n d}{N} \qquad \text{(Eq 4)}$$

where:

$\bar{d}$ = average droplet size

n = number of droplets of a given size

d = droplet diameter

N = total number of droplets counted

This number is strongly influenced by the sample size and the range of diameters in the sample.

A diameter more commonly used in evaporation calculations is the mass mean (or volume mean) diameter defined by the equation:

TABLE 2

WATER DROPLET STUDY TEST CONDITIONS

Test Run No.	Nozzle Dia, In.	Jet Velocity, ft/sec	Gas Stream Velocity, ft/sec	Air Pressure, in. Hg	Air Temp., °F	No. Droplets Counted	Comments
6	0.25	59.8	430.0	25.82	53	239	Intermittent Spray
9	"	56.4	430.8	25.79	46	225	
16	"	54.3	423.5	26.17	43	267	
7	0.25	82.8	430.2	25.79	45	201	
10	"	87.9	430.0	25.79	50	201	
12	"	85.6	431.3	25.80	49	104	Focal plane 2 in fwd of plume centerline
8	0.25	105.0	428.4	25.78	47	196	
94	1.125	60.2	199.0	28.64	45	37	Droplets interspersed between opaque zones
96	"	61.4	202.2	28.65	45	251	
23	1.125	59.8	427.3	26.31	50	242	Droplets top of photo bottom opaque
30	"	62.8	428.6	26.34	51	213	Droplets interspersed between opaque zones
88	"	61.7	425.8	26.32	48	257	Droplets top of photo bottom opaque
119	"	66.1	428.4	26.46	60	40	Droplets interspersed between opaque zones
125	"	62.2	426.8	26.42	46	228	Droplets bottom of photo top of photo opaque
63	1.125	97.4	427.6	26.44	51	351	Droplets top of photo bottom opaque
128	"	101.3	428.9	26.36	57	66	Droplets interspersed between opaque zones
43	1.125	107.7	433.0	27.00	40	97	Droplets at top of photo bottom opaque
73	"	114.6	434.2	27.04	45	245	Large opaque zones· poor atomization
124	"	118.1	376.8	26.80	48	15	Small number of large drops evident

TABLE 2 (cont.)

Test Run No.	Nozzle Dia, in.	Jet Velocity, ft/sec	Gas Stream Velocity, ft/sec	Air Pressure, in. Hg	Air Temp., °F	No. Droplets Counted	Comments
133	1.502	63.8	396.3	26.42	45	208	Few drops visible
	1.502	95.3	371.8	27.22	44	146	Small zone of droplets surrounded by opaque zon
59	"	99.2	370.6	26.69	50	57	Small zone of droplets surrounded by opaque zon
78	"	95.8	385.1	26.90	46	216	Voids interspersed by droplets
82	"	94.6	366.2	26.90	51	17	Few drops visible
135	"	95.8	351.6	26.92	49	93	Light zone near top - balance dark
141	1.502	66.4	382.6	26.5	46	52	Opaque except for light zone near top
143	"	68.7	386.8	26.42	49	209	
98	0.3F80	65.1	222.4	28.57	45	231	
107	"	64.6	218.4	28.56	45	214	
116	"	120.5	223.3	28.51	43	253	

$$\bar{d}_{mean} = \left(\frac{\Sigma\, n\, d^3}{N}\right)^{1/3} \qquad \text{(Eq. 5)}$$

where: $\bar{d}_{mean}$ = mass mean particle diameter

A third diameter is also calculated for each sample termed the droplet mass median drop size. This drop size refers to that particle size for which the cumulative mass of all particles smaller (and larger) than that size equal one-half of the mass of those particles in the sample. This median diameter is expressed by the equation:

$$\frac{\int_0^{\bar{d}_{mass}} \xi^3 f(\xi)\, d\xi}{\int_0^{\bar{d}_{max}} \xi^3 f(\xi)\, d\xi} = 1/2 \qquad \text{(Eq. 6)}$$

where:

d_{max} = maximum droplet size in sample

d_{mass} = mass median diameter

ξ = a dummy function

$f(\xi)$ = the frequency function of the particle number distribution

These three mean diameters were calculated for each test in which the photographs could be interpreted. The droplet sizes calculated for these tests are tabulated in Table 3.

Comparing these data, it will be seen that very little significance can be attributed to the liquid velocity. There are differences to be noted because of changes in either the air velocity or in the nozzle size. This is reasonable since the water jet is normal to the airflow and at a velocity very much less than the air velocity, and thus the water jet velocity should have little influence on the drop size and only the size of the jet and the air velocity are significant variables.

TABLE 3

MEAN DROP SIZE AND DIMENSIONLESS FORCE RATIOS

Run No.	$\bar{D}_{mean}$ μ	D_{max} μ	Weber No.	Reynolds No.	We/Re	$(We/Re)^{0.25}$	D_{30}/D_o	D_{max}/D_o
6	160.27	246	5.316×10^{-4}	10.4×10^{5}	$.0511 \times 10^{-8}$	.00475	.0252	.0387
9	166.2	246	5.296	11.68	.0453	.00461	.0262	.0387
16	179.26	450	5.479	12.06	.0455	.00462	.0282	.0708
	160.8	205	5.310	11.86	.0448	.00460	.0253	.0323
10	162.6	205	5.316	10.88	.0488	.00470	.0256	.0323
12	151.5	205	5.283	11.11	.0476	.00467	.0238	.0323
8	150.5	205	5.355	11.42	.0469	.00465	.0237	.0323
94	330.5	614	4.341	28.74	.0151	.00350	.0115	.0215
6	299.0	491	4.285	28.47	.0150	.00350	.0105	.0172
23	204.9	368	1.196	51.27	.0023	.00219	.0072	.0128
30	230.9	614	1.188	50.56	.0023	.00220	.0080	.0215
88	129.2	205	1.204	51.96	.0023	.00219	.0045	.0072
119	277.7	470	1.190	43.26	.0027	.00229	.0097	.0164
125	160.6	290	1.198	53.83	.0022	.00217	.0056	.0101
63	184.6	327	1.194	48.69	.0024	.00222	.0064	.0114
	124.3	181	1.187	44.69	.0026	.00227	.0044	.0063
43	177.1	286	1.165	60.68	.0019	.00209	.0062	.0100
73	680	2165	1.158	52.99	.0022	.00216	.0238	.0757
124	236.4	326	1.187	51.46	.0023	.00219	.0082	.0114
133	139.2	253	0.869	74.19	.0012	.00185	.0036	.0066

TABLE 3 (cont.)

Run No.	$\bar{D}_{mean}$ μ	D_{max} μ	Weber No.	Reynolds No.	We/Re	$(We/Re)^{0.25}$	D_{30}/D_o	D_{max}/D_o
45	209.8	450	1.184×10^{-4}	62.52×10^{5}	$.0019 \times 10^{-8}$	.00208	.0055	.011
59	182.2	246	0.908	64.46	.0014	.00194	.0047	.006
78	178.2	368	1.104	62.66	.0018	.00205	.0046	.009
82	260.8	410	0.874	65.74	.0013	.00190	.0068	.010
135	209.4	398	0.892	69.74	.0013	.00189	.0055	.010
141	250.8	470	0.900	70.57	.0013	.00189	.0066	.012
143	141.7	253	0.898	66.01	.0014	.00192	.0037	.006
98	227.2	450	16.74	7.16	.2338	.00695	.0302	.059
107	127.2	217	17.35	7.15	.2426	.00702	.0169	.028
116	170.2	326	16.59	7.55	.2196	.00685	.0226	.043

Ingebo (Ref 2) studied the effects of variables in liquid properties and airstream conditions and with the aid of dimensional analysis obtained a grouping of dimensionless ratios that characterized his data. He reported that the following empirical equation correlated with his data.

$$\frac{D_{30}}{D_o} = 3.9\ (We/Re)^{0.25} \qquad \text{(Eq. 7)}$$

where:

D_{30} = volume mean diameter

D_o = orifice diameter

We = Weber number $\left(\frac{\sigma_w}{D_o\ \rho_s\ V_s^2}\right)$

Re = Reynolds number $\left(\frac{D_o\ V_s\ \rho_w}{\mu_w}\right)$

σ = liquid surface tension, lbm/ft

V = Velocity, ft/sec

ρ = Density, lb/ft^3

μ = Viscosity, lb/ft sec

Subscript s refers to gas stream,
w refers to liquid

Because the gas stream variables were limited principally to velocity, the influence of gas viscosity is undefined, and the Reynolds number is in essence a liquid-film Reynolds number. The characteristic length in both cases was assumed to be the orifice diameter D_o. The gas stream velocity is assumed to be the relative velocity, which for cross-stream injection is essentially the gas velocity since the velocity of the liquid is less than the velocity of the air.

Figure 15 is a plot of the mass mean droplet diameter, nozzle diameter ratio vs a function of the Weber-Reynolds ratio. Included in this figure is data of and correlating equation recommended by Ingebo. Table 3 is a tabulation of the dimensionless force ratios for each droplet test analyzed.

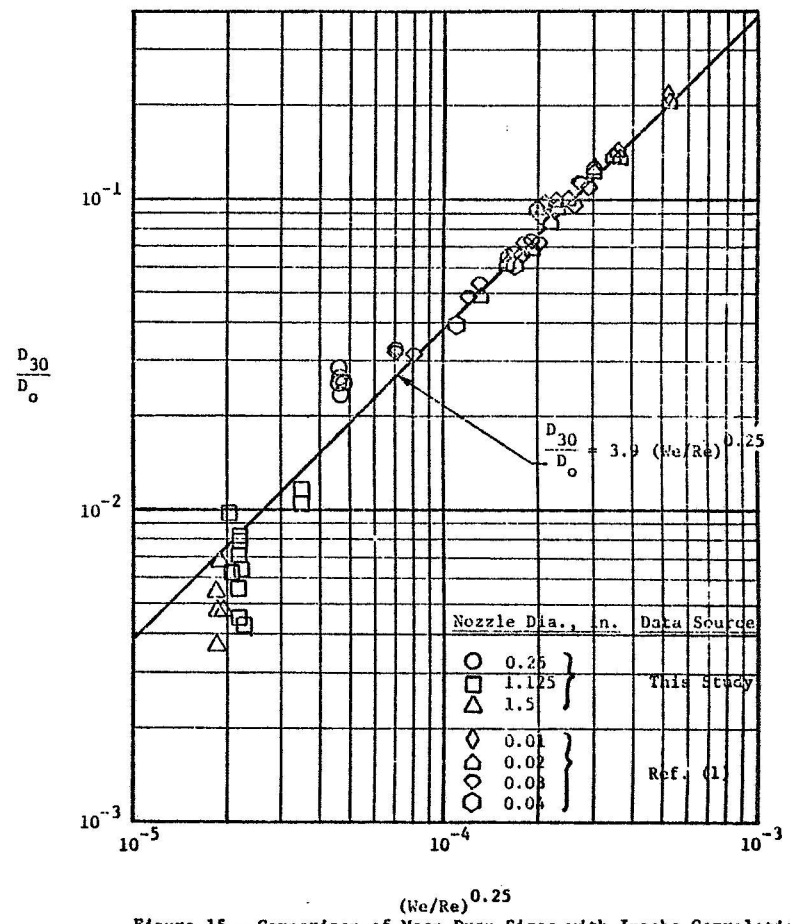

Figure 15 - Comparison of Mean Drop Sizes with Ingebo Correlation

2. Maximum Droplet Size

Ingebo assumed that the maximum observed drop size was also a function of the dimensionless properties ratio and from examination of the data found that the following equation best represented the data.

$$\frac{D_{max}}{D_o} = 22.3\ (We/Re)^{0.29} \qquad \text{(Eq. 8)}$$

This relationship was used as a basis for comparison with the maximum observed droplets in this study with the results indicated in Figure 16. The maximum observed droplet diameters are also tabulated in Table 3.

3. Droplet Distribution Data

Each photograph of the droplet tests analyzed yielded a number of drops of various sizes. These drops were grouped according to diameter in intervals of 40 μ. The smallest droplet size measured was placed in a range of from 40 to 60 μ and the other drops grouped accordingly. The cumulative mass percent of the drops in the sample was then calculated and is plotted in Figures 17, 18, and 19 for the 0.25, 1.125, and 1.502-in.-dia nozzles, respectively.

B. WATER DISTRIBUTION STUDIES

The water sampling measurements were assembled together for each nozzle and compared graphically for each probe location relative to the nozzle exit plane. These graphs are included in Appendix A as part of the water-sampling test data. The water-distribution curves were all graphically integrated to obtain a figure representative of the total water flow rate. The flow curves were integrated in sections normal to the direction of water flow (layers parallel to the gas flow) with the result that one can determine the fraction of the total flow remaining in (or removed from) the water jet as a

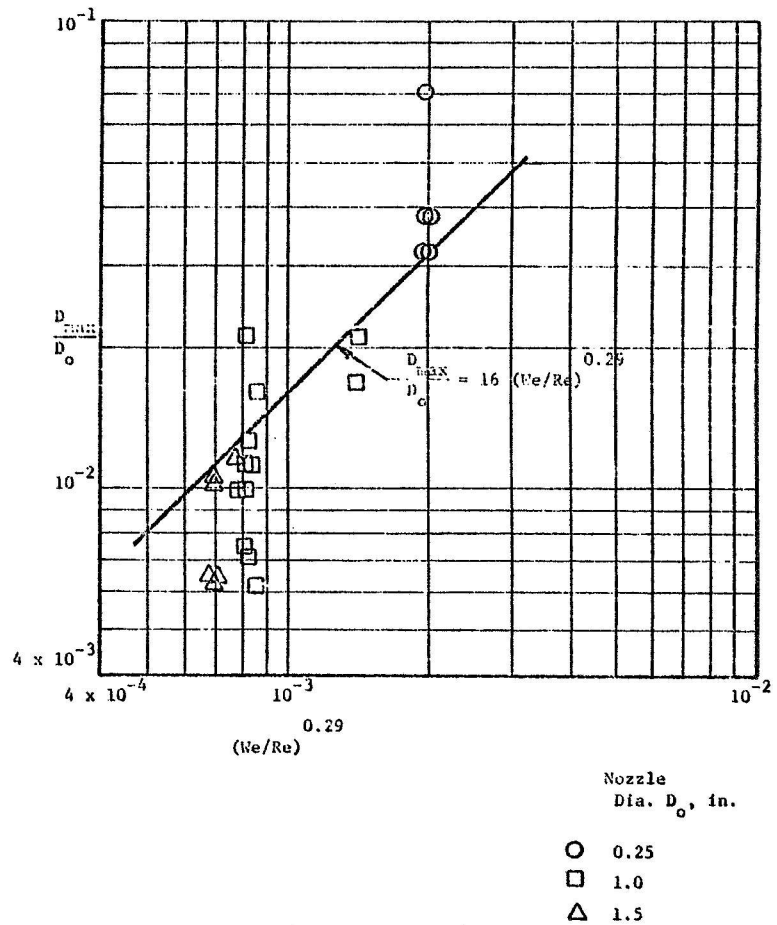

Figure 16 - Correlation of Maximum Drop Size with Dimensionless Ratios

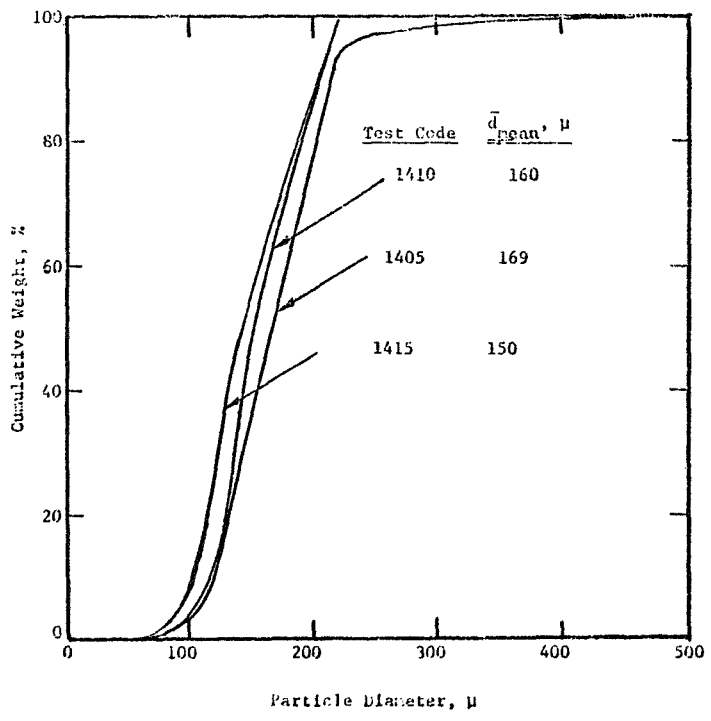

Figure 17 - Droplet-Size Distributions for 0.25-in.-dia Nozzle

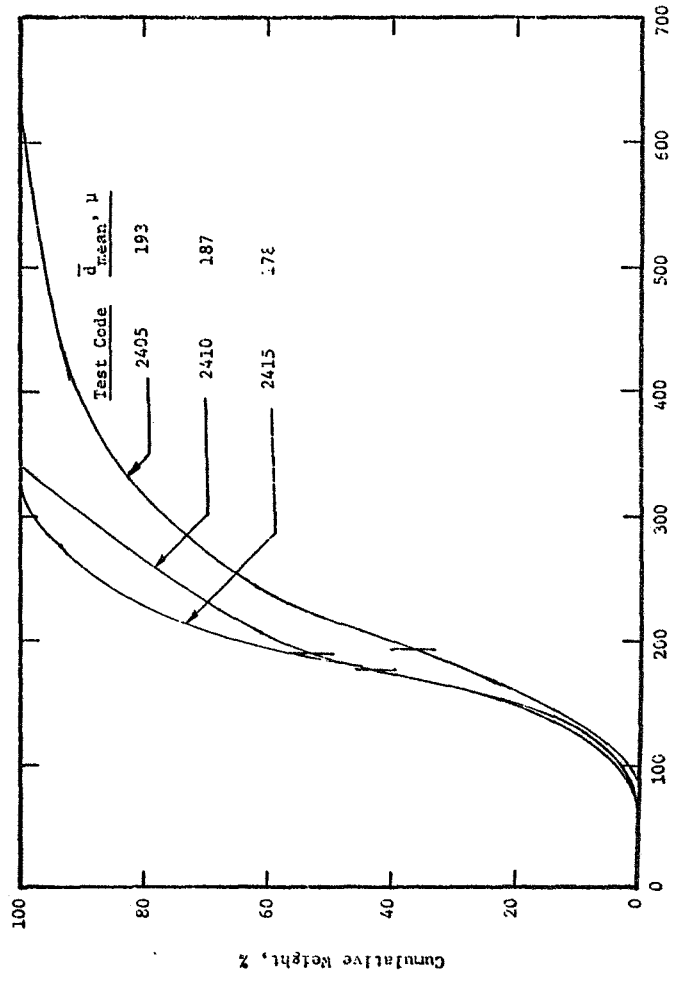

Figure 18 - Droplet-Size Distributions for 1.125-in.-dia Nozzle

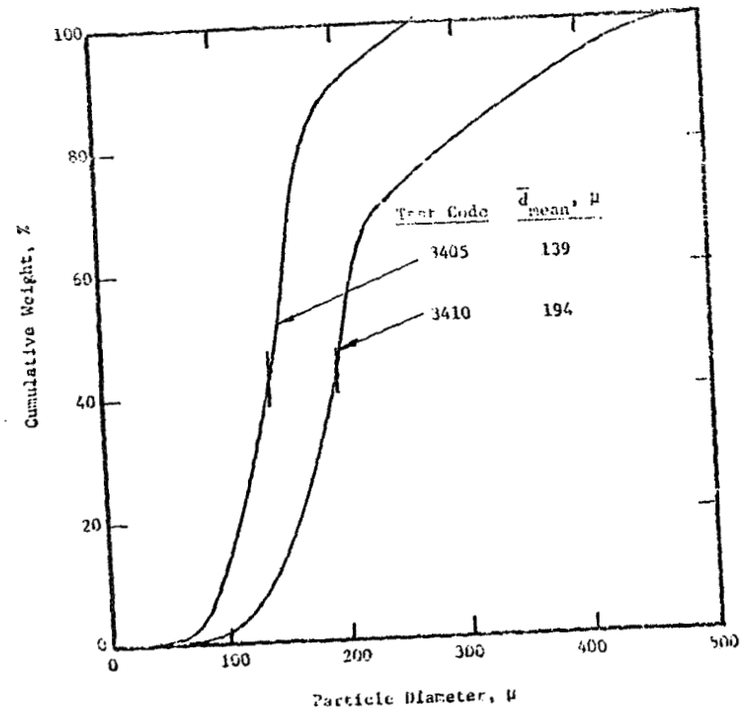

Figure 19 - Droplet-Size Distributions for 1.5-in.-dia Nozzle

function of distance away from the nozzle exit plane. Figures 20 through 27 show the results of these integration calculations for each of the penetration nozzles. Mass-distribution calculations made using the water-break-up model proposed by Clark (Ref 1) did not compare with these curves, as shown in Figures 28 through 30. Clark was able, in his prediction, to determine the rate of water-jet break-up but did not, however, directly determine mass distribution in the gas stream. In an attempt to nondimensionalize the test data, the point of maximum penetration for each nozzle was calculated using the correlation in Ref 8.

$$Z = 2d_o \left(\frac{X}{d_o}\right)^{0.2} \left(\frac{q_w}{q_s}\right)^{0.5} \qquad \text{(Eq. 9)}$$

where:

Z = penetration distance
X = mixing length downstream of the nozzle
q = dynamic pressure
d_o = nozzle diameter
Subscripts: w - water or liquid
s - gas stream

The point of maximum penetration is that point where $Z = X$. Figures 31, 32, and 33 show the mass-distribution curves for the three nozzles in terms of penetration distance for the different water-driving forces. The large-nozzle curves are of the same general shape varying little from each other. The small-diameter nozzle deposited more water near the point of maximum penetration than did the other two.

There was no attempt to see if the total integrated flow rate equaled the actual flow rate from each nozzle; however, the integrated flow rates from two different nozzles at the same pressure did vary as the square of the nozzle diameters. This would be true if the discharge coefficients of

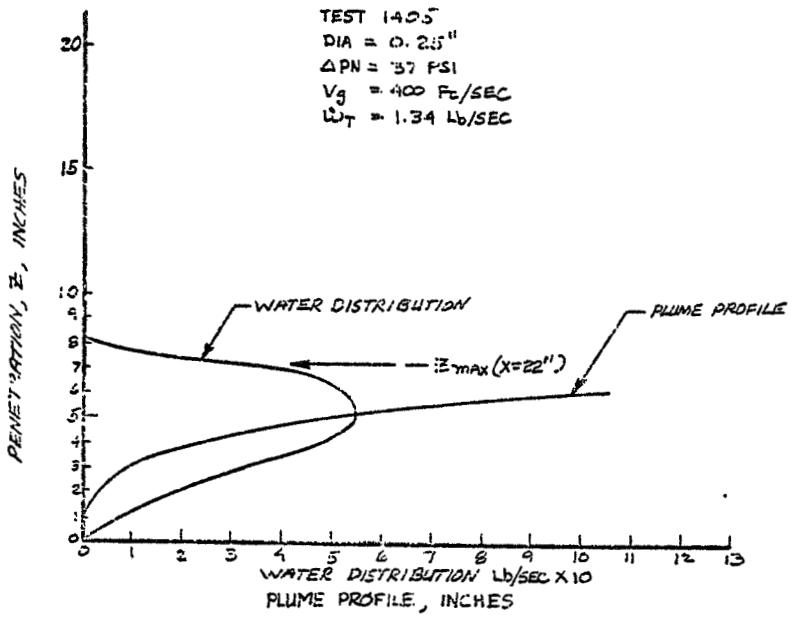

Figure 20 - Water Jet Break Up for 0.25-in.-dia Nozzle at 37 psi

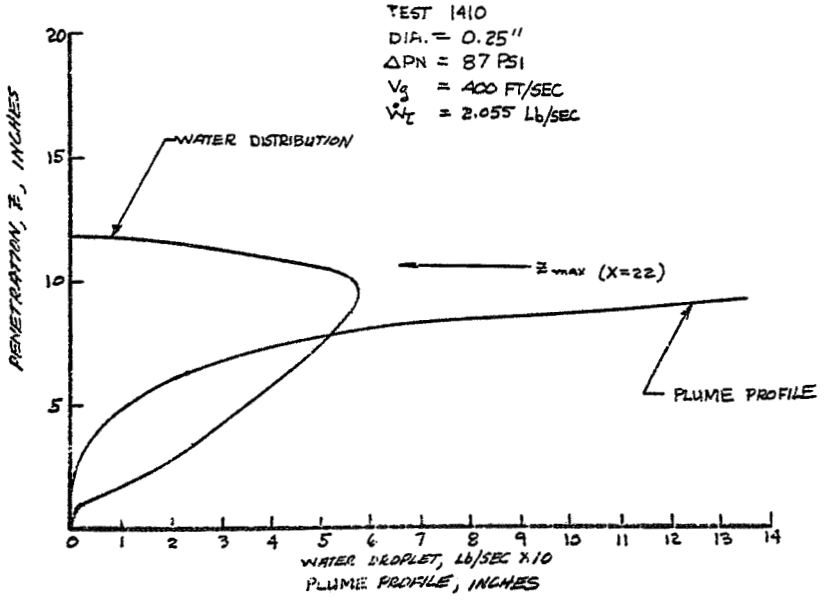

Figure 21 - Water-Jet Break Up for 0.25-in.-dia Nozzle at 87 psi

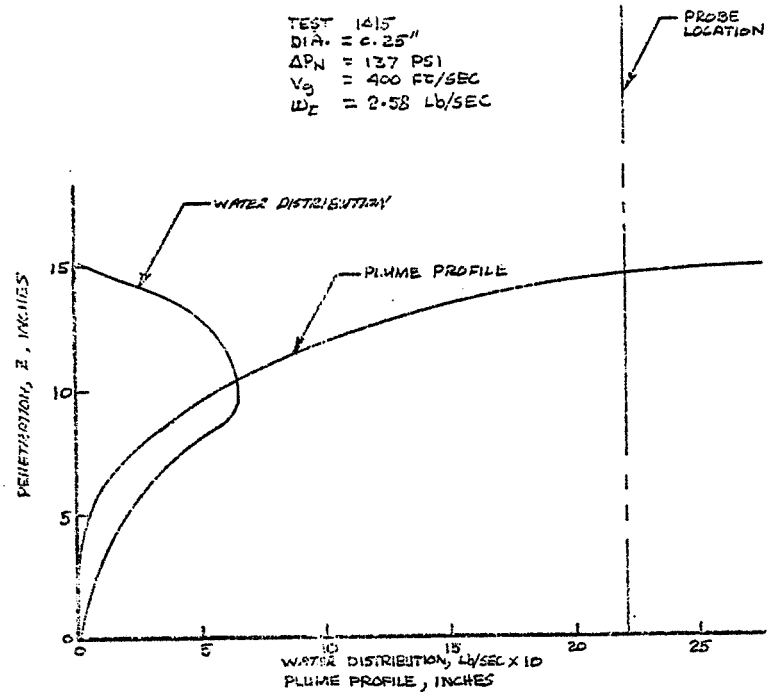

Figure 22 - Water-Jet Break Up for 0.25-in.-dia Nozzle at 137 psi

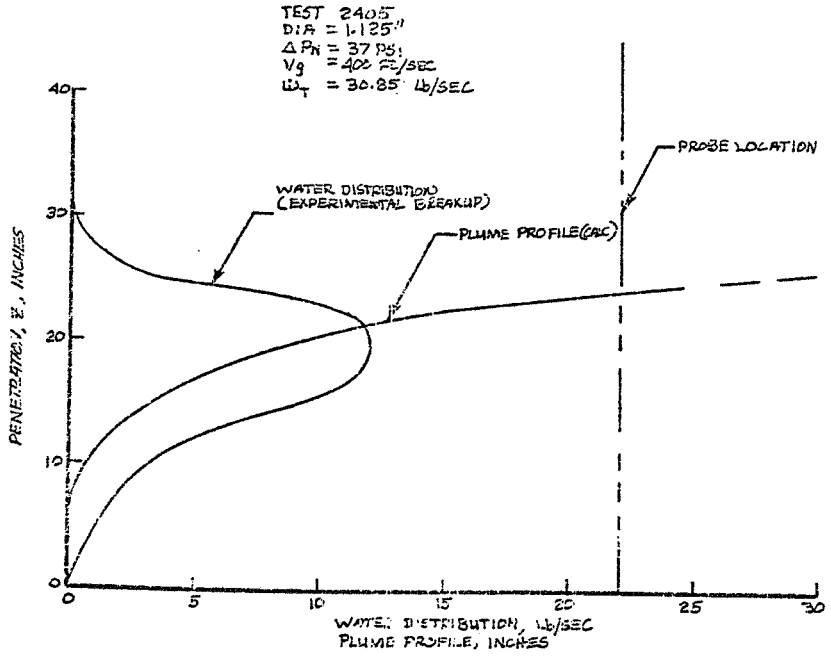

Figure 23 - Water-Jet Break Up for 1.125-in.-dia Nozzle at 37 psi

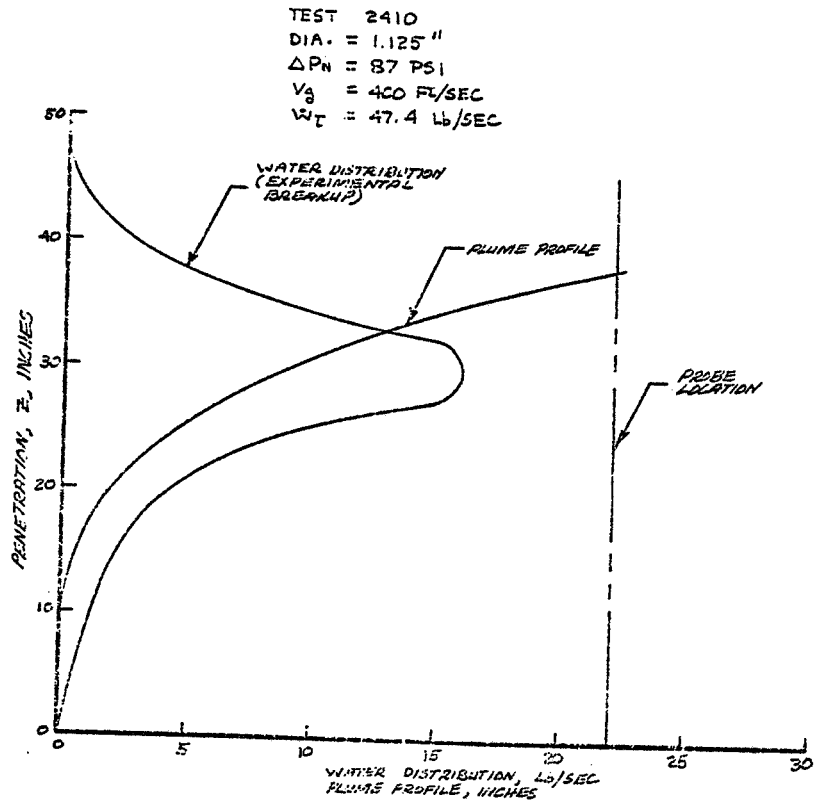

Figure 24 - Water-Jet Break Up for 1.125-in.-dia Nozzle at 87 psi

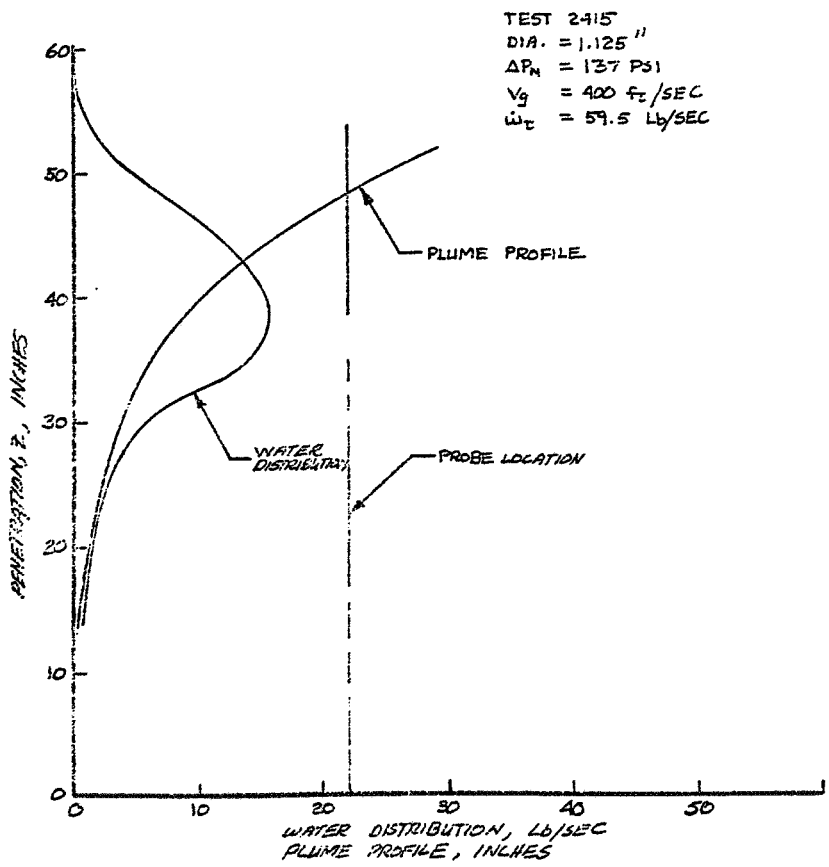

Figure 25 - Water-Jet Break Up for 1.125-in.-dia Nozzle at 137 psi

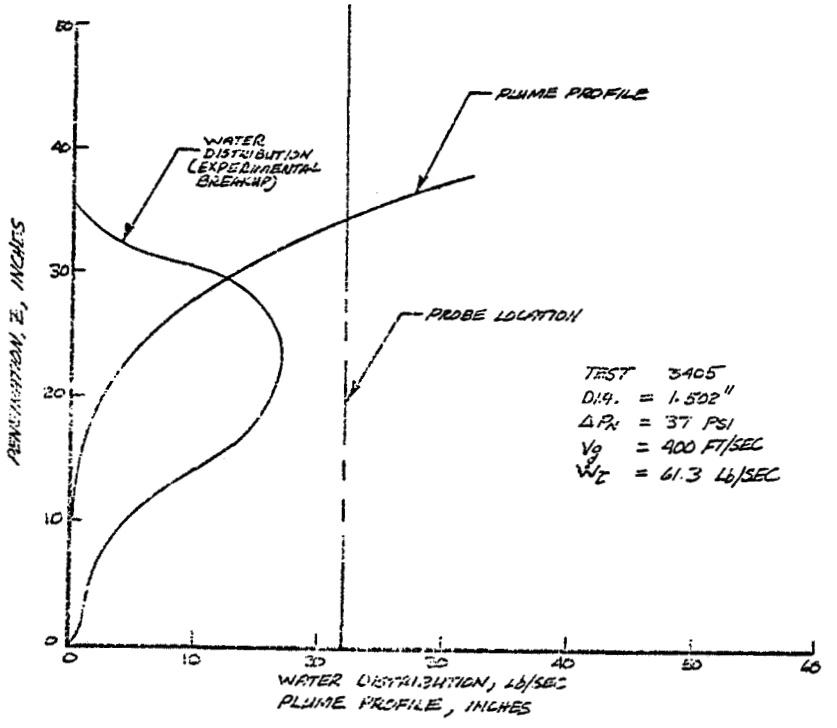

Figure 26 - Water-Jet Break Up for 1.5-in.-dia Nozzle at 87 psi

[redacted]

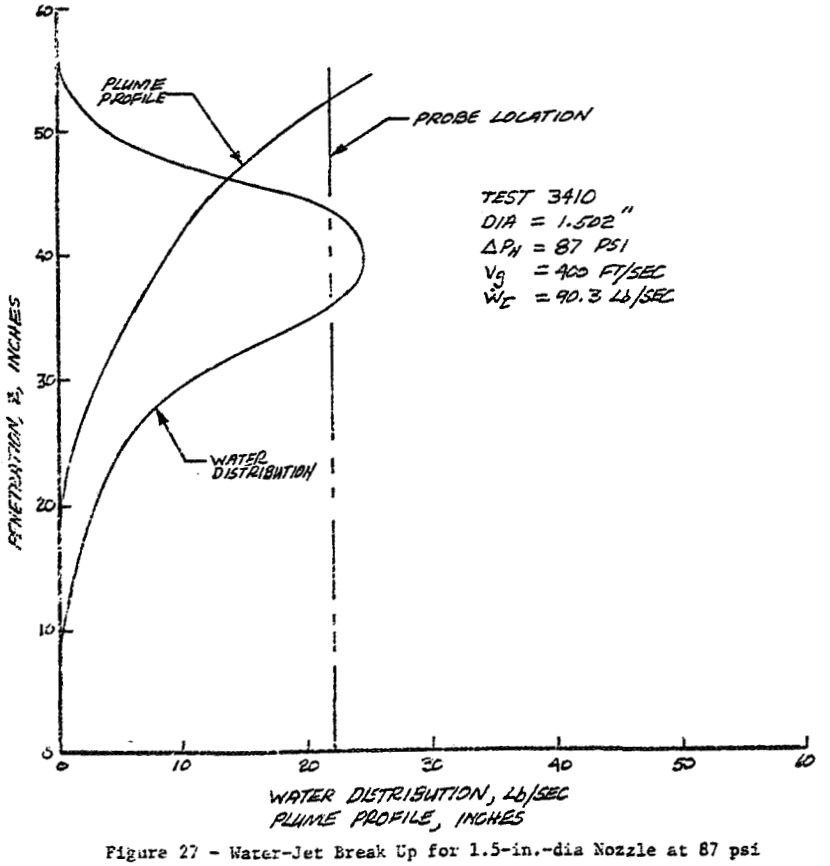

Figure 27 - Water-Jet Break Up for 1.5-in.-dia Nozzle at 87 psi

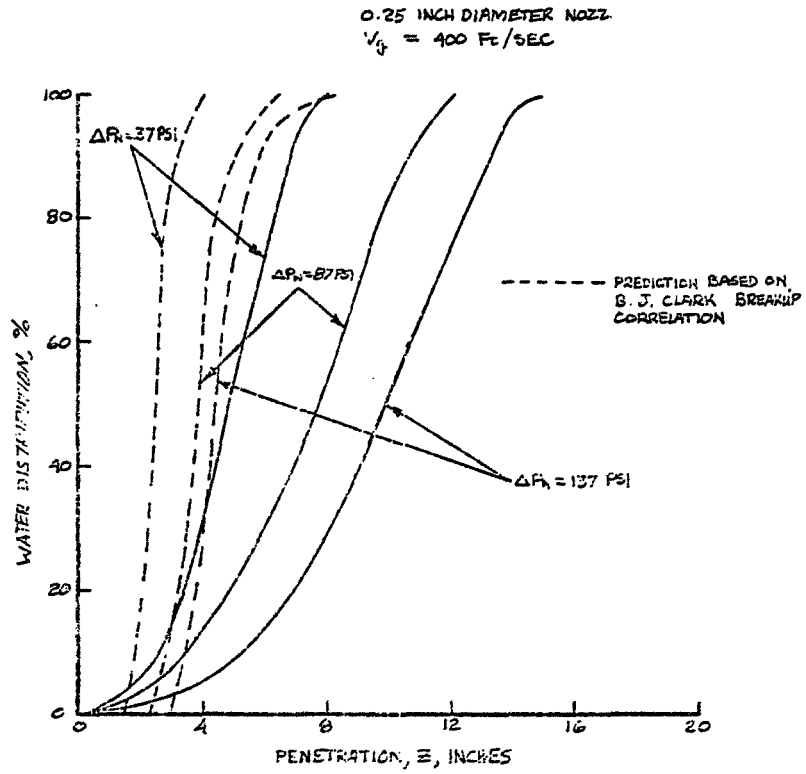

Figure 28 - Experimental Water-Distribution Data Compared with Clark Break-Up Model for 0.25-in.-dia Nozzle

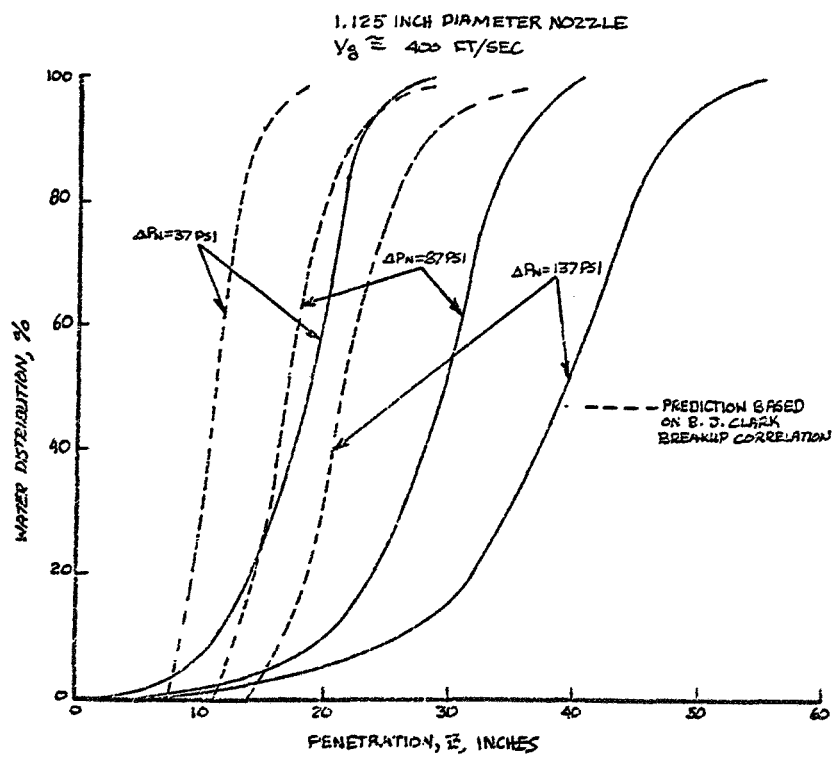

Figure 29 - Experimental Water-Distribution Data Compared with Clark Break-Up Model for 1.125-in.-dia Nozzle

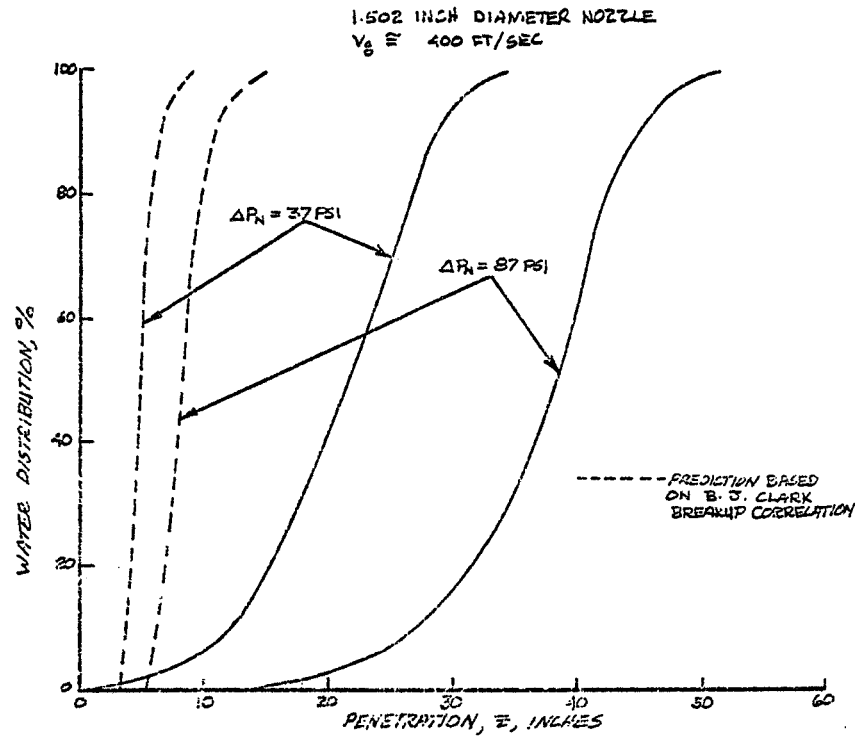

Figure 30 - Experimental Water-Distribution Data Compared with Clark Break-Up Model for 1.5-in.-dia Nozzle

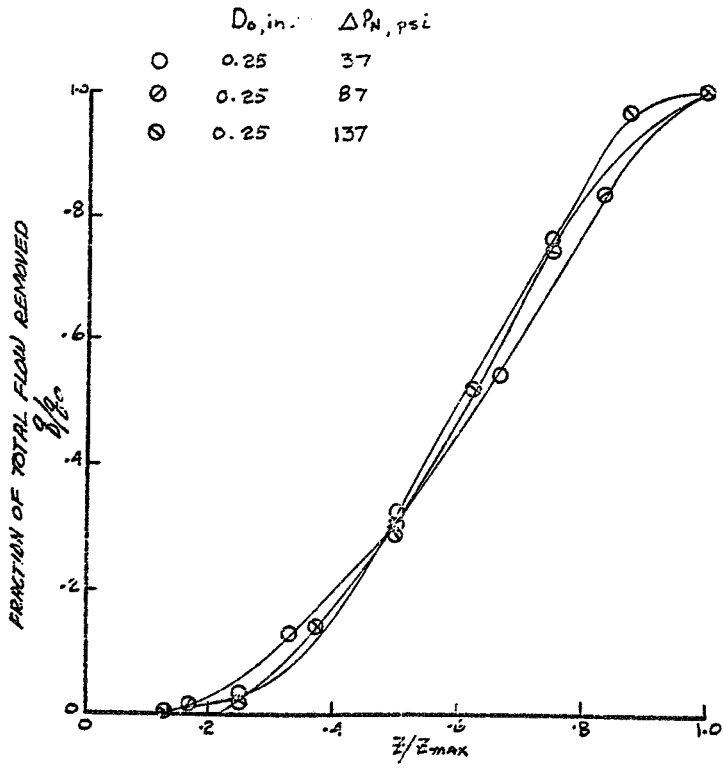

Figure 31 - Mass Distribution as a Function of Penetration Distance for 0.25-in.-dia Nozzle

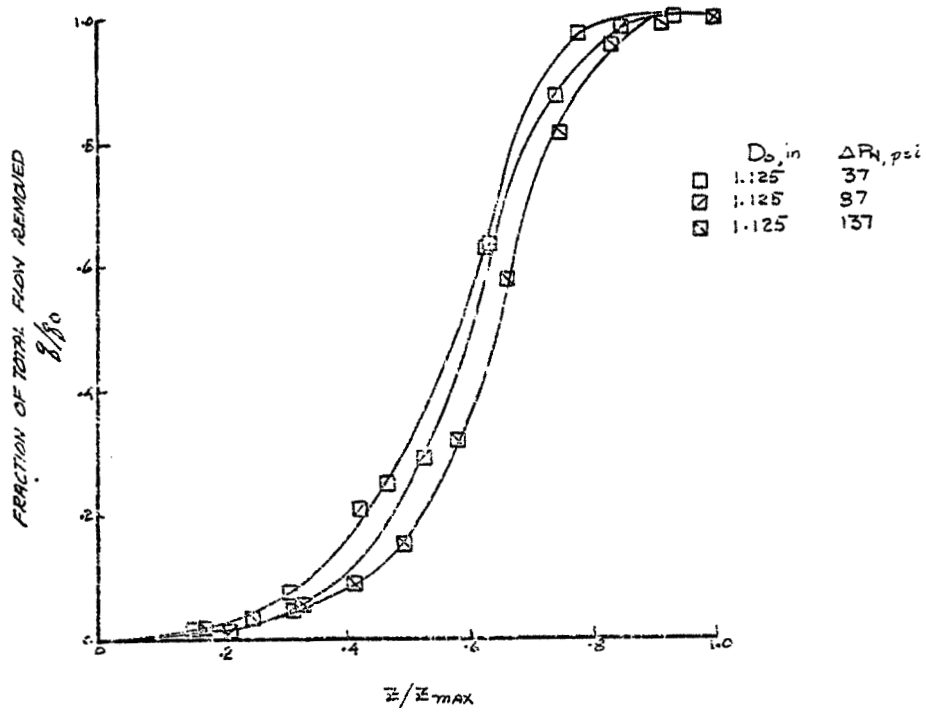

Figure 32 - Mass Distribution as a Function of Penetration Distance for 1.0-in.-dia Nozzle

[redacted]

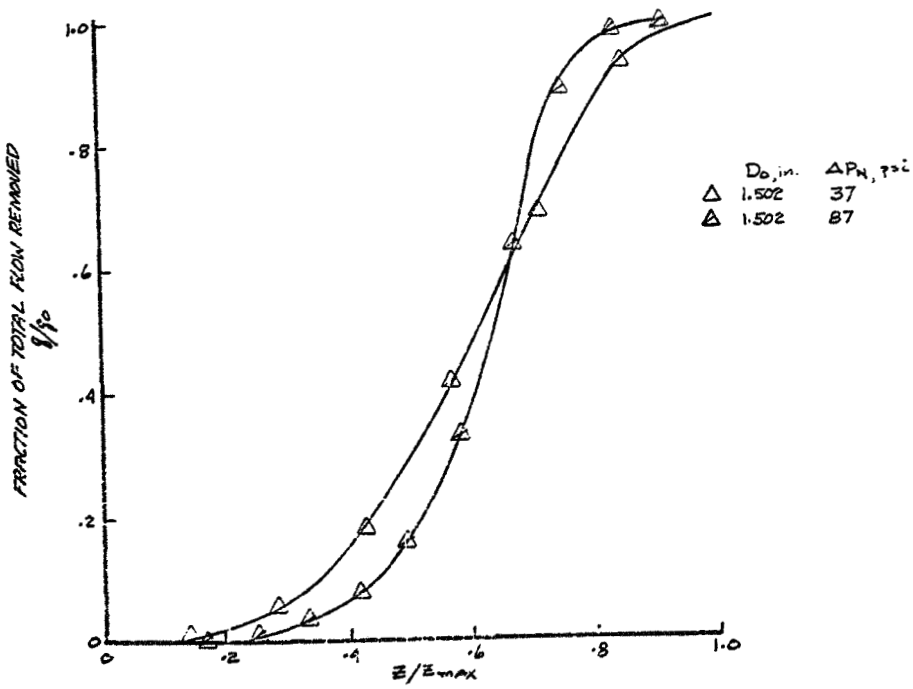

Figure 33 - Mass Distribution as a Function of Penetration Distance for 1.5-in.-dia Nozzle

the nozzle are the same. Also, the integrated areas for the same nozzle at two different discharge pressures did vary with the square root of the line pressure. Both these conditions tend to substantiate the validity of the test result.

A modified form of the Clark break-up parameter correlated with the water jet-break-up data.

C. WATER PENETRATION

Two flat-spray nozzles were tested in the wind tunnel as a part of this test program; however, the purpose of the tests was to determine the penetration characteristics of the nozzles. Photographs of the water jet penetrating into the gas flow were taken (Figure 34), and the data were analyzed in the same manner as the tests reported in Ref 9. The results of the penetration tests are summarized in Figure 35. The flat-spray nozzles generated fan-shaped sprays with spray angles of 40 and 80 degrees. The penetration varied with these spray angles; the smaller the spray angle the greater the penetration. Compared to the penetration nozzles, the spray nozzles penetrated only 50 to 60% as far as the solid-jet nozzles previously tested. Table 4 is a tabulation of the test data for the spray nozzles. Equations for the flat-spray-nozzle penetrations are:

Spray Angle 80°

$$Z = d_o \left(\frac{X}{d_o}\right)^{0.27} \left(\frac{q_w}{q_g}\right)^{0.5} \qquad \text{(Eq. 10)}$$

Spray Angle 40°

$$Z = 1.2\, d_o \left(\frac{X}{d_o}\right)^{0.27} \left(\frac{q_w}{q_g}\right)^{0.5} \qquad \text{(Eq. 11)}$$

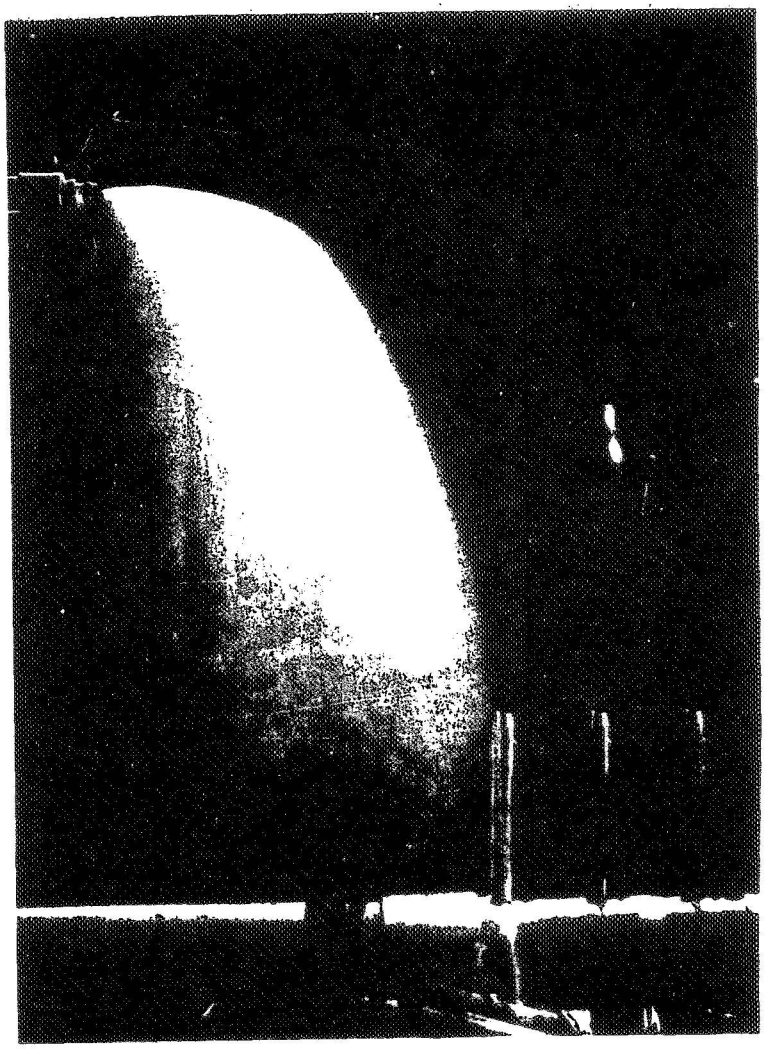

Figure 34 - View of Penetration for a Flat-Spray Nozzle

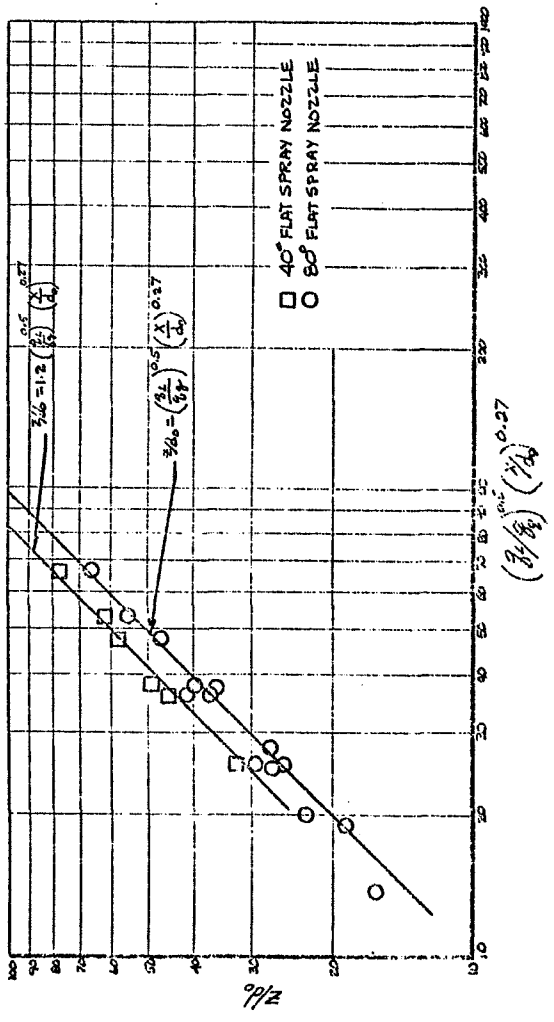

Figure 35 - Penetration of Flat-Spray Nozzles

TABLE 4

FLAT-SPRAY NOZZLE PENETRATION TEST DATA

Test Run No.	Nominal Nozzle Dia, in.	Water Jet Velocity ft/sec	Gas Stream Velocity ft/sec	Air Pressure in. Hg	Air Temp. °F	Mixing Length in.	Penetration Distance in.	Nozzle Spray Angle Degrees
110	0.296	79.2	144	28.56	45	7	7.6	80
	"	79.2	"	"	"	7	8.74	"
	"	117.0	"	"	"	7	11.8	"
	"	146.2	"	"	"	7	13.8	"
110	0.296	79.2	144	28.56	45	22	10.82	80
	"	79.2	"	"	"	22	12.15	"
	"	117.0	"	"	"	22	16.3	"
	"	146.2	"	"	"	22	19.4	"
111	0.296	79.2	144	28.56	45	7	9.5	40
	"	117.0	"	"	"	7	14.5	"
	"	146.2	"	"	"	7	17.0	"
111	0.296	79.2	144	28.56	45	22	13.3	40
	"	117.0	"	"	"	22	18.2	"
	"	146.2	"	"	"	22	22.8	"
115	0.296	79.2	285	26.26	46	7	4.8	80
	"	117.0	"	"	"	7	6.8	"
	"	146.2	"	"	"	7	8.0	"
115	0.296	79.2	285	26.26	46	22	5.6	80
	"	117.0	"	"	"	22	8.1	"
	"	146.2	"	"	"	22	11.2	"

VI. DISCUSSION OF RESULTS AND RECOMMENDATIONS

A. WATER-DROPLET-SIZE STUDY

Difficulty was experienced in shadographing the entire water jet plume. Therefore, drop sizes were measured for selected regions in the plume, usually near the outer edge (either top or bottom) of the air-water jet interaction zone. The density of droplets in the central regions of the plume generally precluded any shadowgraphs of that region. Figure 15 compares the Ingebo test data (Reference 2) with the data of the current test program. In general, there is considerably more variability or apparent scatter for the large-diameter-nozzle test data (as indicated by the ± 50% limit lines) for this data trend to support the Ingebo test results. According to the relationship of Ingebo, the drop size should vary with the square root of the nozzle diameter. However, the large-nozzle data indicate less dependence on nozzle diameter. This is in agreement with the results of other investigators, such as Weiss and Worshim (Reference 4) who found no nozzle geometry dependence other than a weak dependence on the nozzle discharge flow rate. Attempts to compare the test results of this program with the predictive equation of Reference 4, however, were unsatisfactory.

Results from using the Ingebo equation to predict droplet sizes indicate larger droplets than those measured from the one in. or large-diameter nozzles and slightly smaller than the droplets measured from tests using the 0.25-in.-dia nozzle.

The maximum drop size results from these tests indicate a smaller range of drop sizes (by about 30%) than those found by Ingebo. Because the final droplet sizes are a function of Weber number, all droplets will subdivide until a stable size is reached. The critical Weber number has been defined by various authors; however, Masugi defines the critical Weber number as:

$$We_c = \frac{\rho_s V_o^2 d_f}{2\sigma} = 7.6 \qquad \text{(Eq. 12)}$$

d_f = final droplet diameter, ft

V_o = relative droplet velocity

As long as $We_c > 7.6$ the droplet is unstable and will further subdivide. In Ingebo's tests, the gas velocity ranged from 100 to 700 ft/sec, which bounds the 200 to 400 ft/sec achieved in this study; however, in this study, the sampling point was 7 in. or more downstream of the nozzle rather than the 1.25 in. in Ref 2. Consequently, the residence time in the gas stream was up to five times or more than that reached in Ref 2. Longer residence times permit the droplets to further subdivide and thus could result in a smaller maximum drop size.

The decrease in droplet diameter for the same total mass flow of water means an increase in droplet surface area exposed to the hot gases; consequently, an initial increase in the extent of evaporation for a wet-elbow system can be anticipated.

The droplet test results were incorporated in the computer program that was prepared as a model for the NASS wet-elbow vaporization and cooling problems.

B. MASS DISTRIBUTION

The mass-distribution test results were reduced to the following expression and incorporated into the water-jet break-up and penetration model for the NASS wet elbow. Figure 36 shows this relationship.

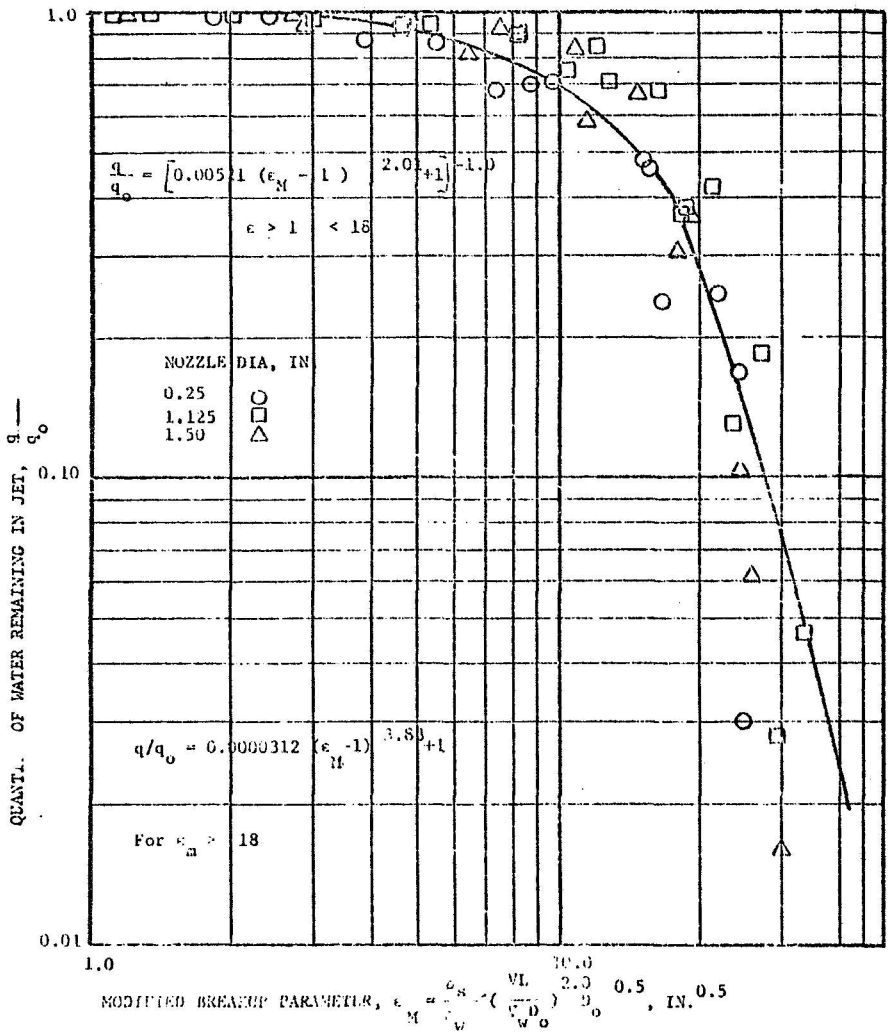

Figure 36 - Empirical Correlation for Water Mass Distribution

$$q/q_o = \left[c\,(\epsilon_M - 1)^n + 1\right]^{-1} \qquad \text{(Eq. 13)}$$

where:

q/q_o = Fraction of water remaining in the water stream

c, n = Empirical constants (see Fig. 36)

ϵ_M = Clarks break-up parameter modified as follows:

$$s = \frac{\rho_s}{\rho_w} \quad \frac{V_s\,L^2}{V_w\,D_o} \quad (D_o)^{0.5}$$

L = Distance jet penetrated into gas stream

The information generated in this experimental study improves the understanding of the way water from different nozzles is deposited in a cross flow of gas. Designing the water injection system to distribute the water uniformly in the gas stream proportional to the gas flow tends to reduce the importance of water droplets mixing with the gas to achieve a uniform mixture, and consequently more rapid overall cooling. This makes the design problems less critical in the wet-elbow configuration.

C. FLAT-SPRAY NOZZLE PENETRATION

An analytical expression was developed for predicting the penetration characteristics of flat-spray nozzles. The equation will be used to determine the water distribution from small spray nozzles currently considered for application in the wet elbow.

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6. R. A. Dobbins, L. Crocco, and I. Glassman, "Measurement of Mean Particle Liquid Strays from Diffractively Scattered Light", AIAA Journal, Vol. 1, No. 8, August 1963, Fig. 3, p 1882-1886

7. M. Wicks, III and A. E. Dukler, "In Situ Measurement of Drop Size Distribution in Two Phase Flow - A Method of Electrically Conducting Liquids", Third International Heat Transfer Conference, Paper No. 155, August 1966.

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9. AGC Report RN-TM-0559, Water Jet Penetration of a High-Velocity Gas Stream in Cross Flow, December 1967

10. N. I. Masugi, "Theoretical and Experimental Study of the Deformation and Atomization of a Liquid Drop in a High Velocity Gas Stream", ARS 11th Annual Meeting, Paper No. 355-56, Nov. 1956

APPENDIX

WATER BREAK-UP AND DISTRIBUTION TEST DATA

APPENDIX

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Droplet Diameter Statistics, Programmed Calculations	31
Mass Distribution Profiles	55

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...TRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDU... AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)			
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
6	1405	221	221	0.250	0.387	40.000			
58.89	429.99	0.5316E-03	0.1041E 07	117.7			9.9	10.0	8.4
		0.1880E 04	0.1427E 06		7.3	9.3			
7	1410	221	221	0.250	0.390	90.000			
82.80	430.25	0.5310E-03	0.1186E 07	113.9			15.1	15.1	8.4
		0.1883E 04	0.2282E 06		9.7	12.9			
8	1415	221	221	0.250	0.388	140.000			
105.01	428.41	0.5355E-03	0.1142E 07	115.2			18.6	18.9	8.4
		0.1867E 04	0.2800E 06		11.1	15.0			
9	1405	211	224	0.250	0.390	41.000			
56.35	430.81	0.5296E-03	0.1168E 07	114.2			10.[illegible]	10.2	8.4
		0.1886E 04	0.1528E 06		7.6	9.7			
10	1410	211	224	0.250	0.388	93.000			
87.06	429.99	0.5316E-03	0.1088E 07	116.4			15.0	15.3	8.4
		0.1880E 04	0.2223E 06		9.6	12.7			
11	1415	211	224	0.250	0.391	136.000			
103.50	431.31	0.5283E-03	0.1150E 07	114.6			18.2	18.5	8.4
		0.1892E 04	0.2759E 06		10.9	14.7			
12	1410	211	224	0.250	0.390	90.000			
85.67	431.31	0.5283E-03	0.1111E 07	115.6			14.8	15.0	8.4
		0.1892E 04	0.2206E 06		9.5	12.5			
13	1405	211	223	0.250	0.387	40.000			
57.11	427.85	0.5369E-03	0.1102E 07	116.3			10.1	10.1	8.4
		0.1862E 04	0.1471E 06						

Test Runs 1 through 5 were system checkout and evaluation tests only. Second entry of test conditions were obtained before system shutdown to establish flow variation during test.

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)					
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.		
14	1410	211	223	0.250	0.376	90.000					
84.19	414.92	0.5709E-03	0.1106E 07	116.0				15.5	15.6	8.4	
		0.1751E 04	0.2245E 06			10.1	13.4				
14	1410	211	223	0.250	0.384	90.000					
84.19	424.62	0.5451E-03	0.1132E 07	116.0				15.2	15.3	8.4	
		0.1634E 04	0.2245E 06			9.6	13.0				
15	1415	211	223	0.250	0.385	141.000					
102.79	424.10	0.5465E-03	0.1186E 07	114.6				19.1	19.2	8.4	
		0.1829E 04	0.2860E 06			11.4	15.5				
16	1405	111	225	0.250	0.385	40.000					
54.31	423.53	0.5479E-03	0.1206E 07	114.3				10.5	10.2	8.4	
		0.1824E 04	0.1546E 06			7.8	10.0				
17	1410	111	225	0.250	0.384	94.000					
86.79	424.93	0.5444E-03	0.1113E 07	116.4				15.4	15.6	8.4	
		0.1836E 04	0.2274E 06			9.9	13.1				
18	1415	111	225	0.250	0.385	135.000					
101.41	423.84	0.5471E-03	0.1168E 07	115.2				18.6	18.8	8.4	
		0.1827E 04	0.2796E 06			11.2	15.2				
19	1405	121	221	0.250	0.381	40.000					
55.20	420.01	0.5572E-03	0.1158E 07	115.9				10.5	10.3	8.4	
		0.1794E 04	0.1521E 06			7.8	10.0				
20	1410	121	221	0.250	0.382	92.000					
83.71	421.36	0.5536E-03	0.1161E 07	115.7				15.6	15.6	8.4	
		0.1806E 04	0.2308E 06			10.0	13.4				

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PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)					
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.		
21	1410	121	221	0.250	0.381	90.000					
83.49	420.58	0.5557E-03	0.1140E 07	116.3				15.4	15.4	8.4	
		0.1799E 04	0.2264E 06			10.0	13.2				
22	1415	121	221	0.250	0.382	144.000					
105.60	421.93	0.5521E-03	0.1144E 07	116.0				19.2	19.5	8.4	
		0.1811E 04	0.2863E 06			11.4	15.5				
[redacted] 23	2405	221	221	1.125	0.387	37.000					
59.85	427.30	0.1196E-03	0.5127E 07	244.9				35.3	32.4	23.0	
		0.8360E 04	0.7182E 06			35.8	45.7				
24	2305	221	221	1.125	0.304	35.000					
54.90	333.36	0.1965E-03	0.4496E 07	286.5				44.9	40.4	23.0	
		0.5087E 04	0.7405E 06			49.1	66.1				
25	2405	221	221	1.125	0.405	40.000					
59.26	444.40	0.1106E-03	0.5876E 07	232.1				36.2	32.4	23.0	
		0.9041E 04	0.7838E 06			36.0	46.0				
26	2405	221	221	1.125	0.379	40.000					
50.22	417.29	0.1254E-03	0.5347E 07	245.2				38.1	34.5	23.0	
		0.7971E 04	0.7717E 06			38.4	49.7				
27	2410	221	221	1.125	0.363	96.000					
93.29	399.07	0.1371E-03	0.5114E 07	253.6				60.3	56.0	23.0	
		0.7290E 04	0.1195E 07			52.7	71.9				
28	2415	221	221	1.125	0.389	108.000					

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	NO.	LOS (VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC. (ING)IN.	(CHEL)IN.	(AGC)IN	WIDTH (AGC)IN.
21	1410	121	221	0.250	0.381	90.000				
83.49	420.58	0.5557E-03	0.1140E 07		116.3			15.4	15.4	8.4
		0.1799E 04	0.2264E 06			10.0	13.2			
22	1415	121	221	0.250	0.382	144.000				
105.00	421.93	0.6521E-03	0.1144E 07		116.0			19.2	19.5	8.4
		0.1811E 04	0.2863E 06			11.4	15.5			
23	2405	221	221	1.125	0.387	37.000				
56.85	427.34	0.1196E-03	0.5127E 07		244.9			35.3	32.4	23.0
		0.8360E 04	0.7182E 06			35.6	45.7			
24	2305	221	221	1.125	0.304	35.000				
54.90	333.36	0.1965E-03	0.4496E 07		286.5			44.9	40.4	23.0
		0.5067E 04	0.7405E 06			49.1	66.1			
25	2405	221	221	1.125	0.405	40.000				
59.26	444.40	0.1106E-03	0.5876E 07		232.1			36.2	32.4	23.0
		0.9041E 04	0.7838E 06			36.0	46.0			
26	2405	221	221	1.125	0.379	40.000				
50.22	417.29	0.1254E-03	0.5347E 07		245.2			38.1	34.5	23.0
		0.7971E 04	0.7717E 06			38.4	49.7			
27	2410	221	221	1.125	0.363	96.000				
93.29	399.07	0.1271E-03	0.5114E 07		253.6			60.3	56.0	23.0
		0.7290E 04	0.1195E 07			52.7	71.9			
28	2415	221	221	1.125	0.369	108.000				
100.57	428.92	0.1187E-03	0.5321E 07		242.2			59.1	55.2	23.0
		0.6422E 04	0.1247E 07			49.6	66.9			

[redacted]

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO XYZ-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
29	2405	221	221	1.125	0.394	38.000			
60.15	434.50	0.1157E-03	0.5302E 07		240.8			35.3	32.3	23.0
		0.8642E 04	0.7340E 06			35.5	45.3			
30	2405	221	221	1.125	0.388	40.000				
62.77	428.67	0.1188E-03	0.5056E 07		245.3			36.4	33.6	23.0
		0.8412E 04	0.7404E 06			36.3	46.5			
31	2410	221	221	1.125	0.387	84.000				
92.58	428.67	0.1188E-03	0.4881E 07		247.5			51.3	48.7	23.0
		0.8412E 04	0.1054E 07			44.9	59.5			
32	2415	221	221	1.125	0.000	144.000				
110.30	0.00	0.4870E-02	0.0000E 00		29439.7			22058.3	78.6	23.0
		0.2053E 03	0.1516E 07			518.3	1033.5			
33	2410	221	221	1.125	0.391	94.000				
90.86	429.69	0.1163E-03	0.5681E 07		238.0			56.1	51.4	23.0
		0.8452E 04	0.1201E 07			48.4	65.0			
33	2410	221	221	1.125	0.370	94.000				
90.08	405.86	0.1326E-03	0.5366E 07		248.4			59.3	54.5	23.0
		0.7540E 04	0.1201E 07			51.8	70.4			
34	2405	221	221	1.125	0.398	42.000				
57.40	434.75	0.1155E-03	0.6438E 07		229.3			39.0	34.0	23.0
		0.8652E 04	0.8501E 06			38.8	56.2			
34	2405	221	221	1.125	0.377	42.000				
57.40	411.75	0.1286E-03	0.6098E 07		238.9			41.1	35.9	23.0
		0.7761E 04	0.8501E 06			41.4	54.2			

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO XYZ-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)										
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.					
No data recorded during Run No. 35.														
36	2410	211	224	1.125	0.389	93.000								
91.10	427.13	0.1197E-03	0.5560E 07	240.0			55.9	51.5	23.0					
		0.8352E 04	0.1186E 07		48.4	65.0								
36	2410	211	224	1.125	0.363	93.000								
91.10	398.79	0.1373E-03	0.5191E 07	252.7			59.7	55.1	23.0					
		0.7280E 04	0.1186E 07		52.5	71.5								
37	2415	211	224	1.125	0.382	142.000								
131.53	428.41	0.1190E-03	0.4089E 07	258.8			62.8	63.4	23.0					
		0.8402E 04	0.1255E 07		49.9	67.3								
37	2415	211	224	1.125	0.339	142.000								
131.53	379.97	0.1512E-03	0.3027E 07	283.2			70.4	71.5	23.0					
		0.6609E 04	0.1255E 07		57.6	75.7								
38	2405	251	223	1.125	0.391	42.000								
62.20	430.45	0.1178E-03	0.5438E 07	240.5			37.7	34.3	23.0					
		0.8482E 04	0.7844E 06		37.4	48.1								
38	2405	251	223	1.125	0.364	42.000								
62.20	400.44	0.1362E-03	0.5049E 07	253.9			40.4	36.9	23.0					
		0.7340E 04	0.7844E 06		40.8	53.2								
39	2410	251	223	1.125	0.392	94.000								
97.94	433.74	0.1161E-03	0.4939E 07	245.3			53.5	51.0	23.0					
		0.8612E 04	0.1115E 07		45.6	60.9								
39	2410	251	223	1.125	0.365	94.000								
97.94	403.97	0.1338E-03	0.4600E 07	258.8			57.2	54.7	23.0					
		0.7470E 04	0.1115E 07		49.8	67.3								

[redacted]

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO XYZ-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)										
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.					
40	2415	251	223	1.125	0.397	144.000								
105.35	433.24	0.1163E-03	0.6530E 07	226.9			70.6	63.1	23.0					
		0.8592E 04	0.1588E 07		56.7	78.1								
40	2415	251	223	1.125	0.341	144.000								
105.35	371.83	0.1579E-03	0.5605E 07	256.7			81.7	73.6	23.0					
		0.6329E 04	0.1588E 07		68.1	96.8								
41	2405	261	222	1.125	0.401	42.000								
57.92	437.76	0.1139E-03	0.6367E 07	229.2			38.6	33.7	23.0					
		0.8772E 04	0.8425E 06		38.2	49.4								
41	2405	261	222	1.125	0.374	42.000								
57.92	408.82	0.1307E-03	0.5946E 07	241.3			41.1	36.1	23.0					
		0.7651E 04	0.8425E 06		41.5	54.4								
42	2410	261	222	1.125	0.400	100.000								
95.98	440.75	0.1124E-03	0.5558E 07	236.3			55.7	51.7	23.0					
		0.8892E 04	0.1210E 07		47.1	63.1								
42	2410	261	222	1.125	0.371	100.000								
95.98	408.82	0.1307E-03	0.5155E 07	250.0			59.8	55.8	23.0					
		0.7651E 04	0.1210E 07		51.6	70.1								
43	2415	261	222	1.125	0.396	140.000								
107.72	432.96	0.1165E-03	0.6068E 07	233.2			68.4	62.3	23.0					
		0.8582E 04	0.1509E 07		55.0	75.5								
43	2415	261	222	1.125	0.347	140.000								
107.72	379.97	0.1512E-03	0.5329E 07	257.2			77.4	71.0	23.0					
		0.6609E 04	0.1509E 07		64.3	90.6								

TESTS CONDU AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)							
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION (CHEL)IN.	CALC.) (AGC)IN.	WIDTH (AGC)IN.			
44	3405	261	222	1.500	0.393	42.000						
63.35	431.97	0.8779E-04	0.7496E 07	274.8			49.0	43.6	27.9			
		0.1138E 05	0.1099E 07		51.2	66.1						
44	3405	261	222	1.500	0.362	42.000						
63.35	397.97	0.1034E-03	0.6908E 07	292.2			53.0	47.4	27.9			
		0.9667E 04	0.1099E 07		56.5	74.2						
45	3410	261	222	1.500	0.394	92.000						
95.27	433.99	0.8698E-04	0.7297E 07	276.0			70.3	64.3	27.9			
		0.1149E 05	0.1601E 07		63.8	85.5						
45	3410	261	222	1.500	0.336	92.000						
95.27	371.83	0.1184E-03	0.6252E 07	310.0			81.4	75.1	27.9			
		0.8438E 04	0.1601E 07		76.8	106.2						
46	3405	241	221	1.500	0.389	37.000						
60.41	428.41	0.8926E-04	0.7203E 07	278.7			46.1	41.3	27.9			
		0.1120E 05	0.1015E 07		49.3	63.3						
46	3405	241	221	1.500	0.359	37.000						
60.41	395.49	0.1047E-03	0.6650E 07	296.0			49.8	44.7	27.9			
		0.9547E 04	0.1015E 07		54.2	70.8						
47	3405	241	221	1.500	0.391	37.000						
62.47	432.23	0.8759E-04	0.6797E 07	281.0			44.9	40.9	27.9			
		0.1140E 05	0.9825E 06		47.8	61.1						
47	3405	241	221	1.500	0.366	37.000						
62.47	405.05	0.9985E-04	0.6370E 07	295.6			47.8	43.7	27.9			
		0.1001E 05	0.9825E 06		51.7	66.9						

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDU D AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)							
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION (CHEL)IN.	CALC.) (AGC)IN.	WIDTH (AGC)IN.			
48	3410	241	221	1.500	0.390	37.000						
94.98	431.21	0.8810E-04	0.6899E 07	280.8			68.0	63.0	27.9			
		0.1134E 05	0.1519E 07		62.3	83.1						
48	3410	241	221	1.500	0.328	87.000						
94.98	362.59	0.1246E-03	0.5801E 07	319.8			80.1	74.9	27.9			
		0.8024E 04	0.1519E 07		76.7	106.0						
49	3405	211	223	1.500	0.391	37.000						
61.42	431.72	0.8790E-04	0.7024E 07	279.4			65.4	41.0	27.9			
		0.1137E 05	0.9993E 06		48.3	61.9						
49	3405	211	223	1.500	0.358	37.000						
61.42	395.21	0.1048E-03	0.6430E 07	290.6			49.4	44.6	27.9			
		0.9533E 04	0.9993E 06		53.8	70.0						
50	3410	211	223	1.500	0.388	87.000						
94.98	428.67	0.8915E-04	0.6856E 07	282.1			68.3	63.3	27.9			
		0.1121E 05	0.1519E 07		62.7	83.8						
50	3410	211	223	1.500	0.333	87.000						
94.98	367.68	0.1211E-03	0.5882E 07	316.5			79.1	73.8	27.9			
		0.8251E 04	0.1519E 07		75.4	103.9						
51	3410	211	223	1.500	0.389	87.000						
93.40	429.18	0.8894E-04	0.7099E 07	279.5			66.9	63.3	27.9			
		0.1124E 05	0.1545E 07		63.2	84.7						
51	3410	211	223	1.500	0.328	87.000						
93.40	361.69	0.1252E-03	0.5983E 07	317.8			81.0	75.1	27.9			
		0.7984E 04	0.1545E 07		77.7	107.6						

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO XYZ-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)								
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.			
52	3405	221	224	1.500	0.389	37.000						
60.41	426.41	0.8926E-04	0.7203E 07	278.7				46.1	41.3	27.9		
		0.1120E 05	0.1015E 07		49.3	63.3						
52	3405	221	224	1.500	0.356	37.000						
60.41	392.44	0.1063E-03	0.6598E 07	297.7				50.2	45.1	27.9		
		0.9400E 04	0.1015E 07		54.7	71.6						
53	2410	221	220	1.500	0.387	87.000						
92.64	426.62	0.9001E-04	0.7173E 07	279.6				69.6	63.6	27.9		
		0.1110E 05	0.1557E 07		64.0	85.9						
53	2410	221	224	1.500	0.334	87.000						
92.64	367.98	0.1200E-03	0.6147E 07	312.4				80.1	73.8	27.9		
		0.8260E 04	0.1557E 07		70.5	105.6						
54	3405	111	231	1.500	0.385	42.000						
66.73	427.13	0.8979E-04	0.6301E 07	288.6				47.5	44.1	27.9		
		0.1113E 05	0.1014E 07		49.4	63.5						
54	3405	111	231	1.500	0.366	42.000						
66.73	406.67	0.9906E-04	0.5999E 07	299.5				49.7	46.4	27.9		
		0.1009E 05	0.1014E 07		52.4	68.0						
55	3410	111	231	1.500	0.390	91.000						
99.72	431.47	0.8600E-04	0.6551E 07	284.4				68.4	64.3	27.9		
		0.1136E 05	0.1514E 07		62.1	82.9						
55	3410	111	231	1.500	0.342	91.000						
99.72	378.82	0.1141E-03	0.5751E 07	313.6				77.4	73.3	27.9		
		0.8759E 04	0.1514E 07		72.6	99.4						

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO XYZ-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)								
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.			
56	3405	111	232	1.500	0.388	42.000						
64.37	426.88	0.8990E-04	0.7177E 07	279.5				49.2	44.2	27.9		
		0.1112E 05	0.1082E 07		51.4	66.5						
56	3405	111	232	1.500	0.367	42.000						
64.37	403.97	0.1003E-03	0.6792E 07	291.3				51.8	46.7	27.9		
		0.9961E 04	0.1082E 07		54.9	71.8						
57	3410	111	232	1.500	0.388	92.000						
96.85	428.41	0.8926E-04	0.6970E 07	281.0				70.5	65.2	27.9		
		0.1120E 05	0.1575E 07		64.1	86.1						
57	3410	111	232	1.500	0.338	92.000						
96.85	373.29	0.1175E-03	0.6073E 07	311.6				80.4	74.8	27.9		
		0.8505E 04	0.1575E 07		75.7	104.4						
58	3405	251	233	1.500	0.385	40.000						
67.07	427.39	0.8969E-04	0.6305E 07	288.5				46.4	43.1	27.9		
		0.1114E 05	0.9896E 06		48.6	62.3						
58	3405	251	233	1.500	0.355	40.000						
67.07	394.10	0.1054E-03	0.5614E 07	306.6				50.1	46.7	27.9		
		0.9480E 04	0.9896E 06		53.6	69.8						
59	3410	251	233	1.500	0.383	90.000						
99.17	424.57	0.9088E-04	0.6446E 07	287.9				69.1	65.0	27.9		
		0.1100E 05	0.1505E 07		53.1	84.4						
59	3410	251	233	1.500	0.335	90.000						
99.17	370.85	0.1192E-03	0.5627E 07	318.8				78.6	74.5	27.9		
		0.8385E 04	0.1505E 07		74.3	102.1						

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ NOZ. D(INCHES)	DIA.	MACH NO. M	NOZ.PRES. PN(PSIG)					
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.		
60	3410	251	234	1.500	0.368	90.000					
94.23	427.65	0.8958E-04	0.7190E 07	279.1			70.5	64.6	27.9		
		0.1116E 05	0.1584E 07		64.5	86.6					
60	3410	251	234	1.500	0.332	90.000					
94.23	365.30	0.1227E-03	0.6142E 07	314.1			81.9	75.6	27.9		
		0.6149E 04	0.1584E 07		77.9	108.0					
61	2410	251	231	1.125	0.388	94.000					
93.82	426.16	0.1191E-03	0.5312E 07	242.5			55.4	51.6	23.0		
		0.6392E 04	0.1164E 07		47.7	63.9					
61	2410	251	231	1.125	0.376	94.000					
93.82	414.13	0.1270E-03	0.5438E 07	248.6			57.2	53.4	23.0		
		0.7051E 04	0.1164E 07		49.6	67.0					
62	2415	251	231	1.125	0.390	143.000					
114.78	429.43	0.1184E-03	0.5415E 07	241.0			67.7	63.5	23.0		
		0.8442E 04	0.1447E 07		54.2	74.1					
62	2415	251	231	1.125	0.352	143.000					
114.78	387.67	0.1453E-03	0.4888E 07	260.2			74.6	70.3	23.0		
		0.6879E 04	0.1447E 07		61.2	85.6					
63	2410	231	232	1.125	0.386	93.000					
97.42	427.65	0.1194E-03	0.4859E 07	248.0			53.9	51.4	23.0		
		0.6371E 04	0.1109E 07		46.4	61.9					
63	2410	231	232	1.125	0.369	93.000					
97.42	408.28	0.1310E-03	0.4649E 07	256.7			56.3	53.8	23.0		
		0.7631E 04	0.1109E 07		49.0	66.0					

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ NOZ. D(INCHES)	DIA.	MACH NO. M	NOZ.PRES. PN(PSIG)					
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.		
64	2415	231	232	1.125	0.390	142.000					
114.38	429.94	0.1181E-03	0.5422E 07	240.7			67.4	63.2	23.0		
		0.8462E 04	0.1442E 07		54.0	73.8					
64	2415	231	232	1.125	0.353	142.000					
114.38	388.51	0.1447E-03	0.4899E 07	259.8			74.2	69.9	23.0		
		0.6909E 04	0.1442E 07		61.0	85.1					
65	2410	241	233	1.125	0.391	94.000					
91.59	430.20	0.1180E-03	0.5600E 07	238.7			55.8	51.4	23.0		
		0.8472E 04	0.1192E 07		48.1	64.6					
65	2410	241	233	1.125	0.373	94.000					
91.59	409.62	0.1301E-03	0.5332E 07	247.7			58.5	54.0	23.0		
		0.7681E 04	0.1192E 07		51.0	69.2					
66	2415	241	233	1.125	0.393	140.000					
106.72	430.20	0.1180E-03	0.6143E 07	233.3			69.2	62.7	23.0		
		0.6472E 04	0.1524E 07		55.7	76.7					
66	2415	241	233	1.125	0.357	140.000					
106.72	389.92	0.1436E-03	0.5560E 07	251.1			75.9	69.2	23.0		
		0.6960E 04	0.1524E 07		62.7	88.0					
67	2415	141	234	1.125	0.392	141.000					
109.14	429.69	0.1183E-03	0.5908E 07	235.7			68.8	63.0	23.0		
		0.6452E 04	0.1500E 07		55.3	76.0					
67	2415	141	234	1.125	0.357	141.000					
109.14	390.76	0.1430E-03	0.5373E 07	253.1			75.3	69.3	23.0		
		0.6990E 04	0.1500E 07		62.0	86.8					

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)							
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.			
66	2415	141	234	1.125	0.390	140.000						
112.66	428.67	0.1186E-03	0.5493E 07	240.3			67.4	62.9	23.0			
		0.8412E 04	0.1443E 07		54.2	74.2						
68	2415	141	234	1.125	0.355	140.000						
112.66	391.04	0.1428E-03	0.5011E 07	257.5			73.6	69.0	23.0			
		0.7000E 04	0.1443E 07		60.5	84.4						
69	2410	141	234	1.125	0.391	96.000						
92.56	429.43	0.1184E-03	0.5590E 07	239.0			56.5	52.0	23.0			
		0.8442E 04	0.1205E 07		48.5	65.2						
69	2410	141	234	1.125	0.367	96.000						
92.56	403.70	0.1340E-03	0.5255E 07	250.4			59.9	55.3	23.0			
		0.7440E 04	0.1205E 07		52.2	71.1						
70	7415	141	231	0.750	0.393	142.000						
100.76	431.97	0.1755E-03	0.3690E 07	195.1			43.9	41.5	17.5			
		0.5694E 04	0.5609E 06		33.5	45.2						
70	7415	141	231	0.750	0.386	142.000						
100.78	424.31	0.1819E-03	0.3624E 07	197.7			44.6	42.3	17.5			
		0.5494E 04	0.8609E 06		34.2	46.4						
71	7415	241	241	0.750	0.390	144.000						
104.00	429.94	0.1772E-03	0.3497E 07	198.2			43.8	42.0	17.5			
		0.5641E 04	0.8461E 06		33.3	45.0						
71	7415	241	241	0.750	0.377	144.000						
104.00	416.50	0.1888E-03	0.3388E 07	203.0			45.1	43.4	17.5			
		0.5294E 04	0.8461E 06		34.6	47.0						

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)							
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.			
72	2415	241	241	1.125	0.390	135.000						
112.44	429.94	0.1181E-03	0.5334E 07	241.7			65.5	61.6	23.0			
		0.8462E 04	0.1395E 07		52.9	72.1						
72	2415	241	241	1.125	0.342	135.000						
112.44	376.50	0.1540E-03	0.4671E 07	267.0			74.3	70.4	23.0			
		0.6489E 04	0.1395E 07		62.0	86.9						
73	2415	241	242	1.125	0.394	138.000						
114.63	434.25	0.1158E-03	0.5299E 07	240.9			65.3	61.7	23.0			
		0.8632E 04	0.1398E 07		52.4	71.3						
73	2415	241	242	1.125	0.350	138.000						
114.63	386.54	0.1462E-03	0.4717E 07	262.9			72.9	69.3	23.0			
		0.6839E 04	0.1398E 07		60.2	83.9						
74	2415	121	243	1.125	0.389	138.000						
111.85	427.90	0.1193E-03	0.5463E 07	240.6			67.1	62.6	23.0			
		0.8382E 04	0.1433E 07		54.1	74.0						
74	2415	121	243	1.125	0.360	138.000						
111.85	395.77	0.1394E-03	0.5071E 07	255.1			72.2	67.7	23.0			
		0.7170E 04	0.1433E 07		59.4	82.6						
75	2415	121	244	1.125	0.389	137.000						
113.27	428.67	0.1188E-03	0.5318E 07	242.3			66.2	62.2	23.0			
		0.8412E 04	0.1405E 07		53.3	72.8						
75	2415	121	244	1.125	0.352	137.000						
113.27	387.67	0.1453E-03	0.4809E 07	261.2			72.8	68.8	23.0			
		0.6879E 04	0.1405E 07		60.2	83.8						

TESTS CONDU D AT LEWIS ICING TUNNE JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
76	3405	121	243	1.500	0.387	40.000
76	3405	121	243	1.500	0.359	40.000
77	3410	121	243	1.500	0.390	88.000
77	3410	121	243	1.500	0.347	88.000
78	3410	221	242	1.500	0.391	90.000
78	3410	221	242	1.500	0.349	90.000
79	3410	261	241	1.500	0.389	90.000
79	3410	261	241	1.500	0.344	90.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS ND.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
63.33	426.88	0.8990E-04	0.706.E 07	280.6			47.8	43.1	27.9
		0.1112E 05	0.1047E 07		50.4	65.0			
63.33	395.77	0.1045E-03	0.6547E 07	297.0			51.4	46.5	27.9
		0.9560E 04	0.1047E 07		55.2	72.3			
93.17	429.69	0.8873E-04	0.7225E 07	278.1			69.5	63.5	27.9
		0.1128E 05	0.1566E 07		63.7	85.4			
93.17	362.56	0.1119E-03	0.6432E 07	303.4			77.6	71.4	27.9
		0.8932E 04	0.1566E 07		73.2	100.5			
95.79	431.47	0.8800E-04	0.7020E 07	279.5			69.3	64.0	27.9
		0.1136E 05	0.1558E 07		63.2	84.6			
95.79	385.12	0.1104E-03	0.6266E 07	304.4			77.2	71.7	27.9
		0.9053E 04	0.1558E 07		72.4	99.2			
95.79	429.18	0.8894E-04	0.6983E 07	280.7			69.7	64.3	27.9
		0.1124E 05	0.1558E 07		63.6	85.2			
95.79	379.40	0.1136E-03	0.6173E 07	307.9			78.3	72.8	27.9
		0.8766E 04	0.1558E 07		73.7	101.3			

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDU D AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
80	3205	261	241	1.500	0.202	40.000
80	3205	261	241	1.500	0.150	40.000
81	3405	111	211	1.500	0.386	39.000
81	3405	111	211	1.500	0.354	39.000
82	3410	111	211	1.500	0.391	82.000
82	3410	111	211	1.500	0.331	82.000
83	3205	111	211	1.500	0.202	38.000
83	3205	111	211	1.500	0.143	38.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS ND.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.82	222.35	0.3313E-03	0.3859E 07	452.3			90.1	82.8	27.9
		0.3017E 04	0.1073E 07		111.9	164.8			
61.82	164.70	0.6039E-03	0.2858E 07	566.4			119.8	111.8	27.9
		0.1655E 04	0.1073E 07		160.5	250.9			
66.23	428.92	0.8905E-04	0.6328E 07	287.7			45.6	42.4	27.9
		0.1122E 05	0.9771E 06		48.1	61.5			
66.23	393.27	0.1059E-03	0.5802E 07	307.1			49.6	46.2	27.9
		0.9440E 04	0.9771E 06		53.3	69.4			
94.66	432.98	0.8738E-04	0.6574E 07	283.7			64.9	60.9	27.9
		0.1144E 05	0.1437E 07		59.9	79.5			
94.66	360.19	0.1221E-03	0.5560E 07	321.7			76.1	72.0	27.9
		0.8165E 04	0.1437E 07		73.3	100.5			
60.26	221.85	0.3328E-03	0.3851E 07	453.0			88.1	80.9	27.9
		0.3004E 04	0.1046E 07		110.5	162.4			
60.26	157.92	0.6569E-03	0.2741E 07	584.6			121.7	113.7	27.9
		0.1522E 04	0.1046E 07		166.2	261.4			

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
84	3405	211	212	1.500	0.392	40.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
64.96	432.98	0.8730E-04 0.1144E 05	0.6809E 07 0.1021E 07	281.2	48.8	62.6	46.6	42.5	27.9

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
84	3405	211	212	1.500	0.358	40.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
64.96	395.77	0.1045E-03 0.9560E 04	0.6224E 07 0.1021E 07	300.8	54.4	71.0	50.7	46.5	27.9

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
85	3405	231	213	1.500	0.390	38.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
63.31	430.96	0.8821E-04 0.1133E 05	0.6777E 07 0.9957E 06	282.2	48.3	61.9	45.7	41.6	27.9

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
85	3405	231	213	1.500	0.360	38.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
63.31	397.97	0.1034E-03 0.9667E 04	0.6259E 07 0.9957E 06	299.5	53.2	69.2	49.2	45.1	27.9

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
86	3405	131	214	1.500	0.389	38.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
60.74	427.65	0.8956E-04 0.1116E 05	0.7307E 07 0.1037E 07	278.0	50.0	64.4	47.0	41.9	27.9

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
86	3405	131	214	1.500	0.355	38.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
60.74	390.20	0.1076E-03 0.9293E 04	0.6667E 07 0.1037E 07	297.8	55.8	73.2	51.3	46.0	27.9

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
87	3405	221	215	1.500	0.386	36.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.62	426.88	0.8990E-04 0.1112E 05	0.6713E 07 0.9692E 06	284.2	46.1	61.5	44.9	40.9	27.9

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
87	3405	221	215	1.500	0.349	36.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.62	385.69	0.1101E-03 0.9079E 04	0.6065E 07 0.9692E 06	306.7	54.3	70.9	49.4	45.3	27.9

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
88	2405	221	211	1.125	0.386	40.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.71	425.85	0.1204E-03 0.8301E 04	0.5196E 07 0.7531E 06	244.5	36.9	47.5	36.9	33.8	23.0

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
88	2405	221	211	1.125	0.370	40.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.71	407.74	0.1313E-03 0.7610E 04	0.4975E 07 0.7531E 06	252.6	38.9	50.4	38.5	35.3	23.0

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
89	2410	221	211	1.125	0.386	90.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
92.57	426.11	0.1203E-03 0.8312E 04	0.5199E 07 0.1129E 07	244.4	47.1	63.0	54.3	50.7	23.0

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
89	2410	221	211	1.125	0.362	90.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
92.57	399.07	0.1371E-03 0.7290E 04	0.4869E 07 0.1129E 07	256.7	51.0	69.1	57.7	54.2	23.0

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
90	2405	111	212	1.125	0.386	40.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.71	426.11	0.1203E-03 0.8312E 04	0.5199E 07 0.7531E 06	244.4	36.9	47.4	36.9	33.8	23.0

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
90	2405	111	212	1.125	0.366	40.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.71	403.70	0.1340E-03 0.7460E 04	0.4926E 07 0.7531E 06	254.5	39.4	51.2	38.8	35.7	23.0

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
91	2405	111	213	1.125	0.387	40.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.20	426.11	0.1203E-03 0.8312E 04	0.5286E 07 0.7593E 06	243.4	37.1	47.7	37.1	33.8	23.0

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)
91	2405	111	213	1.125	0.363	40.000

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.
61.20	400.44	0.1362E-03 0.7340E 04	0.4968E 07 0.7593E 06	255.0	40.0	52.0	39.3	36.0	23.0

TESTS CONDUC AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)						
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.			
92	2405	131	213	1.125	0.388	40.000						
63.89	430.20	0.1160E-03	0.4898E 07	246.9				35.9	33.5	23.0		
		0.8472E 04	0.7275E 06		35.8	45.7						
92	2405	131	213	1.125	0.369	40.000						
63.89	405.82	0.1307E-03	0.4655E 07	256.5				37.7	35.2	23.0		
		0.7651E 04	0.7275E 06		38.0	49.1						
93	2405	231	214	1.125	0.393	40.000						
62.23	434.50	0.1157E-03	0.5213E 07	241.8				36.1	33.2	23.0		
		0.8642E 04	0.7468E 06		35.9	45.9						
93	2405	231	214	1.125	0.371	40.000						
62.23	409.62	0.1301E-03	0.4916E 07	252.8				38.1	35.2	23.0		
		0.7681E 04	0.7468E 06		38.5	49.8						
94	2205	231	211	1.125	0.204	40.000						
60.22	224.31	0.4341E-03	0.2874E 07	390.6				68.8	64.3	23.0		
		0.2303E 04	0.7717E 06		81.0	118.5						
94	2205	231	211	1.125	0.181	40.000						
60.22	198.98	0.5516E-03	0.2549E 07	427.4				77.1	72.5	23.0		
		0.1912E 04	0.7717E 06		93.5	140.2						
Run No. 95 was aborted.												
96	2205	251	221	1.125	0.205	41.000						
61.46	225.76	0.4255E-03	0.2847E 07	390.3				68.9	64.7	23.0		
		0.2332E 04	0.7750E 06		80.6	117.6						
96	2205	251	221	1.125	0.183	41.000						
61.46	202.25	0.5339E-03	0.2550E 07	423.9				76.5	72.2	23.0		
		0.1872E 04	0.7750E 06		91.9	137.4						

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCT AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)						
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.			
97	2205	261	231	1.125	0.205	42.000						
62.20	226.25	0.4267E-03	0.2853E 07	389.7				69.5	65.3	23.0		
		0.2343E 04	0.7844E 06		80.9	118.5						
97	2205	261	231	1.125	0.186	42.000						
62.20	204.94	0.5200E-03	0.2564E 07	419.7				76.4	72.1	23.0		
		0.1922E 04	0.7844E 06		91.1	136.1						
98	8205	221	221	0.296	0.201	40.000						
62.10	222.25	0.1674E-02	0.7160E 06	204.5				25.5	25.6	9.4		
		0.5973E 03	0.2096E 06		21.9	32.3						
99	8210	221	221	0.296	0.202	85.000						
93.35	222.84	0.1666E-02	0.7416E 06	202.5				36.7	37.6	9.4		
		0.5999E 03	0.3106E 06		27.7	42.4						
100	8210	221	221	0.296	0.201	90.000						
96.05	221.36	0.1689E-02	0.7367E 06	203.5				37.9	39.0	9.4		
		0.5920E 03	0.3196E 06		28.4	43.7						
101	8215	221	221	0.296	0.201	144.000						
122.49	221.36	0.1689E-02	0.7248E 06	204.3				47.2	49.3	9.4		
		0.5920E 03	0.4011E 06		32.6	51.2						
102	4205	221	221	0.296	0.202	40.000						
63.02	221.85	0.1681E-02	0.7622E 06	201.5				26.0	26.9	9.4		
		0.5946E 03	0.2165E 06		22.4	33.1						
103	4210	221	221	0.296	0.200	92.000						
98.73	220.87	0.1696E-02	0.7113E 06	205.5				38.1	39.5	9.4		
		0.5893E 03	0.3179E 06		28.4	43.6						

TESTS CONDUC) AT LEWIS ICING TUNNE JUNE -JULY 1969

RUN	TEST	-PHOTO XYZ	-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)					
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.		
104	4215	221	221	0.296	0.200	144.000					
121.50	220.87	0.1696E-02	0.7350E 06	203.8			47.5	49.4	9.4		
		0.5893E 03	0.4043E 06		32.8	51.6					
105	4415	221	221	0.296	0.389	147.000					
126.98	429.69	0.4488E-03	0.1337E 07	125.8			25.0	25.6	9.4		
		0.2230E 04	0.3951E 06		14.5	20.0					
106	8415	221	221	0.296	0.390	147.000					
129.19	432.23	0.4430E-03	0.1298E 07	126.3			24.7	25.5	9.4		
		0.2257E 04	0.3882E 06		14.3	19.6					
107	8205	221	231	0.296	0.198	40.000					
64.56	214.38	0.1735E-02	0.7150E 06	206.4			26.0	26.3	9.4		
		0.5761E 03	0.2114E 06		22.5	33.3					
108	8210	221	231	0.296	0.198	92.000					
90.73	219.38	0.1735E-02	0.7033E 06	207.2			38.5	39.9	9.4		
		0.5761E 03	0.3179E 06		28.8	44.3					
109	8215	221	231	0.296	0.198	144.000					
123.52	218.68	0.1727E-02	0.7049E 06	206.9			47.5	49.8	9.4		
		0.5786E 03	0.3978E 06		32.9	51.7					

Runs No. 110 Through 115 were for Fan Spray Nozzles

116	8215	231	222	0.296	0.203	144.000					
120.53	222.33	0.1659E-02	0.7553E 06	201.3			47.2	46.9	9.4		
		0.6025E 03	0.4076E 06		32.5	51.1					
117	8215	231	223	0.296	0.204	144.000					
121.50	224.79	0.1637E-02	0.7481E 06	201.1			46.7	48.5	9.4		
		0.6105E 03	0.4043E 06		32.1	50.4					

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUC AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST	-PHOTO XYZ	-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)					
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION CALC.) (CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.		
118	8215	231	224	0.296	0.202	144.000					
123.52	223.33	0.1659E-02	0.7192E 06	203.8			46.6	48.9	9.4		
		0.6025E 03	0.3978E 06		32.1	50.3					
119	2405	321	331	1.125	0.384	38.000					
66.14	428.41	0.1190E-03	0.4326E 07	255.2			34.1	32.8	23.0		
		0.8402E 04	0.6679E 06		34.1	43.3					
119	2405	321	331	1.125	0.363	38.000					
66.14	405.32	0.1329E-03	0.4093E 07	266.0			35.9	34.7	23.0		
		0.7520E 04	0.6679E 06		36.5	46.8					
120	2405	321	331	1.125	0.387	42.000					
68.45	431.72	0.1172E-03	0.4498E 07	251.7			35.8	34.2	23.0		
		0.8532E 04	0.7133E 06		35.2	44.8					
120	2405	321	331	1.125	0.368	42.000					
68.45	410.15	0.1298E-03	0.4274E 07	261.6			37.5	36.0	23.0		
		0.7701E 04	0.7133E 06		37.4	48.2					
121	2410	321	331	1.125	0.386	92.000					
102.10	430.96	0.1176E-03	0.4421E 07	253.0			51.8	50.7	23.0		
		0.8502E 04	0.1047E 07		44.4	58.8					
121	2410	321	331	1.125	0.367	92.000					
102.10	406.82	0.1207E-03	0.4194E 07	263.3			54.4	53.5	23.0		
		0.7851E 04	0.1047E 07		47.3	63.3					
122	2415	321	331	1.125	0.394	144.000					
115.18	434.25	0.1158E-03	0.5476E 07	238.9			67.2	63.0	23.0		
		0.8632E 04	0.1452E 07		53.6	73.2					

D(INCHES) M PN(PSIG)

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WE N.	REYNOLDS NO.(VG/VL)	DROP DIA. (IN MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION (CHEL)IN.	C.) IN.	WIDTH (AGC)IN.
118	6215	231	224	0.296	0.202	144.000			
123.52	223.33	0.1659E-02	0.7192E 06	203.8			46.6	48.9	9.4
		0.6025E 03	0.3978E 06			32.1	50.3		
119	2405	321	331	1.125	0.384	38.000			
66.14	428.41	0.1190E-03	0.4326E 07	255.2			34.1	32.8	23.0
		0.6402E 04	0.6679E 06			34.1	43.3		
119	2405	321	331	1.125	0.363	38.000			
66.14	405.32	0.1329E-03	0.4093E 07	266.0			35.9	34.7	23.0
		0.7520E 04	0.6679E 06			36.5	46.8		
120	2405	321	331	1.125	0.387	42.000			
68.45	431.72	0.1172E-03	0.4498E 07	251.7			35.8	34.2	23.0
		0.8532E 04	0.7133E 06			35.2	44.8		
120	2405	321	331	1.125	0.368	42.000			
68.45	410.15	0.1298E-03	0.4274E 07	261.6			37.5	36.0	23.0
		0.7701E 04	0.7133E 06			37.4	48.2		
121	2410	321	321	1.125	0.386	92.000			
102.10	430.96	0.1176E-03	0.4421E 07	253.0			51.8	50.7	23.0
		0.8502E 04	0.1047E 07			44.4	58.8		
121	2410	321	331	1.125	0.367	92.000			
102.10	408.82	0.1307E-03	0.4194E 07	263.3			54.4	53.5	23.0
		0.7051E 04	0.1047E 07			47.3	63.3		
122	2415	321	331	1.125	0.394	144.000			
115.18	434.25	0.1153E-03	0.5476E 07	238.9			67.2	63.0	23.0
		0.8632E 04	0.1452E 07			53.6	73.2		
122	2415	321	331	1.125	0.350	144.000			
115.18	[illegible]	0.1468E-03	0.4663E 07	261.2			75.2	70.9	23.0
		[illegible]	[illegible]			[illegible]	[illegible]		

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PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUC AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST	PHOTO	XYZ-PROBE	XYZ NOZ.	DIA.	MACH NO.	NOZ.PRES.
					D(INCHES)	M	PN(PSIG)

LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM (ING)IN.	PENETRATION (CHEL)IN.	CALC.) (AGC)IN.	WIDTH (AGC)IN.
123	2410	331	341	1.125	0.388	92.000			
98.30	430.96	0.1176E-03	0.4768E 07	248.3			52.8	50.7	23.0
		0.6502E 04	0.1087E 07			45.4	60.4		
123	2410	331	341	1.125	0.365	92.000			
98.30	404.78	0.1333E-03	0.4479E 07	260.3			56.1	54.0	23.0
		0.7500E 04	0.1087E 07			49.0	65.9		
124	2415	331	341	1.125	0.388	144.000			
118.08	428.92	0.1187E-03	0.5146E 07	244.2			67.1	63.8	23.0
		0.8422E 04	0.1416E 07			53.5	73.2		
124	2415	331	341	1.125	0.341	144.000			
118.08	376.79	0.1538E-03	0.4521E 07	269.1			75.9	72.6	23.0
		0.6499E 04	0.1416E 07			62.6	87.7		
125	2405	331	341	1.125	0.388	42.000			
62.20	426.88	0.1198E-03	0.5383E 07	242.0			38.0	34.6	23.0
		0.8342E 04	0.7844E 06			37.8	48.7		
125	2405	331	341	1.125	0.365	42.000			
62.20	401.60	0.1353E-03	0.5067E 07	253.3			40.3	36.8	23.0
		0.7390E 04	0.7844E 06			40.5	53.0		
126	2405	311	321	1.125	0.391	42.000			
63.77	431.72	0.1172E-03	0.5180E 07	243.0			37.1	34.2	23.0
		0.8522E 04	0.7652E 06			36.7	47.1		
126	2405	311	321	1.125	0.371	42.000			
63.77	409.35	0.1303E-03	0.4911E 07	252.9			39.1	36.1	23.0
		0.7671E 04	0.7652E 06			39.1	50.7		

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PENETRATION OF LIQUID JETS INTO VELOCITY GAS STREAMS

TESTS CONDUCTED AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)								
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.				
127	2415	311	321	1.125	0.390	143.000							
117.67	430.70	0.1177E-03	0.5168E 07	243.0			66.6	63.3	23.0				
		0.6492E 04	0.1412E 07		53.2	72.6							
127	2415	311	321	1.125	0.338	143.000							
117.67	373.29	0.1567E-03	0.4479E 07	271.0			76.3	73.0	23.0				
		0.6379E 04	0.1412E 07		63.1	88.7							
128	2410	311	321	1.125	0.385	92.000							
101.31	428.92	0.1167E-03	0.4469E 07	253.0			52.2	51.0	23.0				
		0.8422E 04	0.1055E 07		44.9	59.5							
128	2410	311	321	1.125	0.360	92.000							
101.31	401.53	0.1354E-03	0.4184E 07	265.8			55.6	54.5	23.0				
		0.7360E 04	0.1055E 07		48.6	65.3							
129	2410	311	321	1.125	0.389	92.000							
95.20	430.45	0.1178E-03	0.5077E 07	244.6			53.8	50.8	23.0				
		0.8482E 04	0.1122E 07		46.4	61.9							
130	2405	0	311	1.125	0.391	42.000							
61.22	429.94	0.1181E-03	0.5597E 07	238.8			38.1	34.3	23.0				
		0.8462E 04	0.7970E 06		37.8	48.7							
130	2405	0	311	1.125	0.365	42.000							
61.22	401.53	0.1354E-03	0.5227E 07	251.4			40.6	36.8	23.0				
		0.7380E 04	0.7970E 06		41.0	53.6							
131	2410	341	311	1.125	0.393	92.000							
92.06	432.48	0.1167E-03	0.5454E 07	239.7			54.5	50.6	23.0				
		0.8562E 04	0.1161E 07		47.0	62.9							
131	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
		[illegible]	0.1161E 07		51.6	69.7							

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127	2415	311	32.	1.125	0.338	143.000						
117.67	373.29	0.1567E-03	0.4479E 07	271.0					76.3	73.0	23.0	
		0.6379E 04	0.1412E 07			63.1	88.7					
128	2410	311	321	1.125	0.385	92.000						
101.31	428.92	0.1167E-03	0.4469E 07	253.0					52.2	51.0	23.0	
		0.8422E 04	0.1055E 07			44.9	59.5					
128	2410	311	321	1.125	0.360	92.000						
101.31	401.53	0.1354E-03	0.4184E 07	265.8					55.6	54.5	23.0	
		0.7360E 04	0.1055E 07			48.6	55.3					
129	2410	311	321	1.125	0.389	92.000						
95.20	430.45	0.1178E-03	0.5077E 07	244.6					53.8	50.8	23.0	
		0.8482E 04	0.1122E 07			46.4	61.9					
130	2405	0	311	1.125	0.391	42.000						
61.22	429.94	0.1181E-03	0.5597E 07	238.8					38.1	34.3	23.0	
		0.8462E 04	0.7970E 06			37.8	48.7					
130	2405	0	311	1.125	0.365	42.000						
61.22	401.53	0.1354E-03	0.5227E 07	251.4					40.6	36.8	23.0	
		0.7380E 04	0.7970E 06			41.0	52.6					
131	2410	341	311	1.125	0.393	92.000						
92.06	432.48	0.1167E-03	0.5454E 07	239.7					54.5	50.6	23.0	
		0.8562E 04	0.1161E 07			47.0	62.9					
131	2410	341	311	1.125	0.365	92.000						
92.06	401.80	0.1353E-03	0.5067E 07	253.3					58.5	54.4	23.0	
		[illegible]	[illegible]			51.4	69.7					

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUC AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO	XYZ-PROBE	XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)					
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.		
132	2415	341	311	1.125	0.393	144.000					
113.36	431.47	0.1173E-03	0.5617E 07	238.2					68.2	63.4	23.0
		0.8522E 04	0.1475E 07			54.5	74.7				
132	2415	341	311	1.125	0.340	144.000					
113.36	373.88	0.1562E-03	0.4667E 07	265.2					78.1	73.2	23.0
		0.6399E 04	0.1475E 07			64.7	91.2				
133	3405	341	311	1.500	0.395	42.000					
63.85	434.25	0.8688E-04	0.7419E 07	274.8					48.6	43.4	27.9
		0.1150E 05	0.1091E 07			50.6	65.3				
133	3405	341	311	1.500	0.360	42.000					
63.85	396.32	0.1043E-03	0.6771E 07	294.3					53.0	47.6	27.9
		0.9587E 04	0.1091E 07			56.5	74.2				
134	3410	341	311	1.500	0.391	85.000					
90.12	429.69	0.8873E-04	0.7458E 07	275.9					68.9	62.4	27.9
		0.1126E 05	0.1564E 07			63.6	85.3				
134	3410	341	311	1.500	0.322	85.000					
90.12	353.43	0.1311E-03	0.6134E 07	319.5					83.0	75.9	27.9
		0.7624E 04	0.1564E 07			80.5	112.1				
135	3510	361	321	1.500	0.389	90.000					
95.79	428.67	0.8915E-04	0.6974E 07	280.9					69.8	64.4	27.9
		0.1121E 05	0.1558E 07			63.7	85.3				
135	3510	361	321	1.500	0.319	90.000					
95.79	351.56	0.1325E-03	0.5720E 07	326.0					84.2	78.6	27.9
		0.7544E 04	0.1558E 07			80.8	112.7				

TESTS CONDUC AT LEWIS ICING TUN JUNE -JULY 1969

RUN	TEST -PHOTO XYZ-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)								
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.			
136	3505	361	321	1.500	0.386	42.000						
67.14	427.13	0.8979E-04	0.6601E 07	285.3			48.1	44.1	27.9			
		0.1113E 05	0.1037E 07		50.1	64.5						
136	3505	361	321	1.500	0.356	42.000						
67.14	393.55	0.1057E-03	0.6082E 07	303.4			52.0	47.9	27.9			
		0.9453E 04	0.1037E 07		55.3	72.3						
137	3505	351	331	1.500	0.386	44.000						
69.84	427.90	0.8947E-04	0.6405E 07	287.2			48.6	45.1	27.9			
		0.1117E 05	0.1045E 07		50.2	64.7						
137	3505	351	331	1.500	0.355	44.000						
69.84	393.55	0.1057E-03	0.5890E 07	305.8			52.7	49.0	27.9			
		0.9453E 04	0.1045E 07		55.5	72.7						
138	3510	351	331	1.500	0.385	92.000						
99.38	426.37	0.9012E-04	0.6589E 07	285.7			69.9	65.5	27.9			
		0.1109E 05	0.1535E 07		63.5	85.1						
138	3510	351	331	1.500	0.319	92.000						
99.38	352.81	0.1316E-03	0.5452E 07	329.3			83.7	79.1	27.9			
		0.7597E 04	0.1535E 07		79.7	111.0						
139	3510	351	341	1.500	0.392	92.000						
100.26	434.50	0.8678E-04	0.6597E 07	282.9			68.3	64.3	27.9			
		0.1152E 05	0.1522E 07		61.8	82.4						
139	3510	351	341	1.500	0.315	92.000						
100.26	348.75	0.1246E-03	0.5295E 07	333.7			84.2	80.1	27.9			
		0.7424E 04	0.1522E 07		80.8	112.1						

PENETRATION OF LIQUID JETS INTO HIGH VELOCITY GAS STREAMS

TESTS CONDUCT AT LEWIS ICING TUNNEL JUNE -JULY 1969

RUN	TEST -PHOTO XYZ-PROBE XYZ	NOZ. DIA. D(INCHES)	MACH NO. M	NOZ.PRES. PN(PSIG)								
LIQ.VEL. FT/SEC	GAS VEL. FT/SEC	WEBER NO.	REYNOLDS NO.(VG/VL)	DROP DIA. (ING)MICR	MASS CONC (ING)IN.	(MAXIMUM PENETRATION CALC.) (ING)IN.	(CHEL)IN.	(AGC)IN.	WIDTH (AGC)IN.			
140	3510	351	341	1.500	0.389	90.000						
95.00	426.41	0.8926E-04	0.7087E 07	279.9			70.1	64.5	27.9			
		0.1120E 05	0.1571E 07		64.0	85.9						
140	3510	351	341	1.500	0.330	90.000						
95.00	363.80	0.1237E-03	0.6018E 07	316.4			81.9	75.9	27.9			
		0.8076E 04	0.1571E 07		77.9	108.0						
141	3505	311	323	1.500	0.387	44.000						
66.42	426.62	0.9001E-04	0.7057E 07	280.8			50.1	45.2	27.9			
		0.1110E 05	0.1098E 07		51.9	67.3						
141	3505	311	323	1.500	0.347	44.000						
66.42	382.56	0.1119E-03	0.6328E 07	304.7			55.6	50.5	27.9			
		0.8932E 04	0.1098E 07		59.2	78.4						
142	3505	313	323	1.500	0.386	44.000						
68.13	427.13	0.8979E-04	0.6717E 07	284.1			49.4	45.2	27.9			
		0.1113E 05	0.1071E 07		51.1	66.0						
142	3505	313	323	1.500	0.344	44.000						
68.13	380.26	0.1133E-03	0.5980E 07	310.0			55.1	50.6	27.9			
		0.8826E 04	0.1071E 07		58.7	77.6						
143	3505	313	322	1.500	0.386	44.000						
68.72	427.13	0.8979E-04	0.6601E 07	285.3			49.1	45.2	27.9			
		0.1113E 05	0.1062E 07		50.8	65.6						
143	3505	313	322	1.500	0.350	44.000						
68.72	386.82	0.1094E-03	0.5978E 07	307.3			54.0	49.9	27.9			
		0.9133E 04	0.1062E 07		57.9	74.9						

```
140     3510     351      34      1.500     0.389    90.000
  95.00  426.41  0.8926E-04  0.7087E 07    279.9                    70.1     64.5     27.9
                 0.1120E 05  0.1571E 07              64.0     85.9

140     3510     351      341     1.500     0.330    90.000
  95.00  363.80  0.1237E-03  0.6018E 07    316.4                    81.9     75.9     27.9
                 0.8076E 04  0.1571E 07              77.9    108.0

141     3505     311      323     1.500     0.387    44.000
  66.42  426.62  0.9001E-04  0.7057E 07    280.8                    50.1     45.2     27.9
                 0.1110E 05  0.1098E 07              51.9     67.3

141     3505     311      323     1.500     0.347    44.000
  66.42  382.56  0.1119E-03  0.6328E 07    304.7                    55.6     50.5     27.9
                 0.8932E 04  0.1098E 07              59.2     78.4

142     3505     313      323     1.500     0.386    44.000
  68.13  427.13  0.8979E-04  0.6717E 07    284.1                    49.4     45.2     27.9
                 0.1113E 05  0.1071E 07              51.1     66.0

142     3505     313      323     1.500     0.344    44.000
  68.13  380.26  0.1133E-03  0.5980E 07    310.0                    55.1     50.6     27.9
                 0.8826E 04  0.1071E 07              58.7     77.6

143     3505     313      322     1.500     0.386    44.000
  68.72  427.13  0.8979E-04  0.6601E 07    285.3                    49.1     45.2     27.9
                 0.1113E 05  0.1062E 07              50.8     65.6

143     3505     313      322     1.500     0.350    44.000
  68.72  366.82  0.1094E-03  0.5978E 07    307.3                    54.0     49.9     27.9
                 0.9133E 04  0.1062E 07              57.2     75.3
```

Test Runs No. 144 Through 147 were to evaluate gross effects of polyox addition in water.

```
PAGE   1

// JOB T                                                    1

LOG DRIVE   CART SPEC   CART AVAIL  PHY DRIVE
  0000        0001        0001        0000

V2 M04   ACTUAL 16K  CONFIG 16K

*EQUAT(PRNTZ,PRNZ)

// DUP

*STORE      CD  UA  FINTR
CART ID 0001   DB ADDR  1CDB   DB CNT   000C

// FOR
*IOCS(CARD,TYPEWRITER,KEYBOARD,1132 PRINTER,DISK)
*LIST ALL
C
C  PENETRATION OF LIQUID JETS
C              INTO HIGH VELOCITY GAS STREAMS
C CALCULATION OF TESTING CONDITIONS AND PARAMETERS
C
      DIMENSION  TCF(50),  DCR(50),  VIS(50)
      READ (2,1004) NTAB
      READ (2,1005)    (TCF(I),I=1,NTAB)
      READ (2,1005)    (DCR(I),I=1,NTAB)
      READ (2,1005)    (VIS(I),I=1,NTAB)
C
C     NR  =RUN NUMBER      DN    =NOZZLE DIA.(IN.)   DELPI =PS-PT(IN.)
C     ID  =IDENTIFICATION COEF  =FLOW COEFFICIENT   TGF = AIR TEMP(*F)
C     IPHT=PHOTO LOCATION PN    =STATIC PRESSURE (PSIG)
C     IPRB=PROBE LOCATION
C
  190 CONTINUE
      WRITE (3,1050)
      WRITE (3,1055)
      WRITE (3,1060)
      J=1
  200 READ (2,1000) NR, ID, IPHT, IPRB
      IF (NR)  999,999,201
  201 READ (2,1001) DN, COEF, PN, DELPI, TGF ,DELW
      DCRT = FINTR (DCR,TCF,TGF,NTAB)
      VISTC = FINTR (VIS,TCF,TGF,NTAB)
      VISTF = VISTC * .000671969
      DENR = 62.4
      DEN = DENR * DCRT
      ANU = VISTF / DEN
      XD = 72.0
      R = 1714.0
      RHO = .002378
      G = 32.174
      PI = 3.1416
      SIGM = .00487
      GO TO 260
  250 DELPI = DELW
  260 CONTINUE
      DELP = DELPI * .03612628
```

```
// FOR
*IOCS(CARD,TYPEWRITER,KEYBOARD,1)      (INTER,DISK)
*LIST ALL
C
C  PENETRATION OF LIQUID JETS
C                INTO HIGH VELOCITY GAS STREAMS
C CALCULATION OF TESTING CONDITIONS AND PARAMETERS
C
      DIMENSION  TCF(50),  DCR(60),  VIS(60)
      READ (2,1004) NTAB
      READ (2,1005)     (TCF(I),I=1,NTAB)
      READ (2,1005)     (DCR(I),I=1,NTAB)
      READ (2,1005)     (VIS(I),I=1,NTAB)
C
C     NR  =RUN NUMBER      DN     =NOZZLE DIA.(IN.)   DELPI =PS-PT(IN.)
C     ID  =IDENTIFICATION (DEF   =FLOW COEFFICIENT    TGF = AIR TEMP(*F)
C     IPHT=PHOTO LOCATION PN     =STATIC PRESSURE (PSIG)
C     IPRB=PROBE LOCATION
C
  190 CONTINUE
      WRITE (3,1050)
      WRITE (3,1055)
      WRITE (3,1060)
      J=1
  200 READ (2,1000) NR, ID, IPHT, IPRB
      IF (NR)  999,999,201
  201 READ (2,1001) DN, COEF, PN, DELPI, TGF ,DELW
      DCRT = FINTR (DCR,TCF,TGF,NTAB)
      VISTC = FINTR (VIS,TCF,TGF,NTAB)
      VISTF = VISTC * .000671969
      DENR = 62.4
      DEN = DENR * DCRT
      ANU = VISTF / DEN
      XD = 72.0
      R = 1714.0
      RHO = .002378
      G = 32.174
      PI = 3.1416
      SIGM = .00487
      GO TO 260
  250 DELPI = DELW
  260 CONTINUE
      DELP = DELPI * .03612628
      TGR = TGF + 460.0
      J=J+1
C
C  WATER FLOW CONDITIONS
```

PAGE 2

```
      ARN =[illegible] * DN * DN / 4.0 / 144.0
      VL = COEF * SQRT (2.0 * G * PN * 144.0 /DEN )
      WFLD = VL * ARN * DEN
      QW = DEN *VL * VL /2.0 /G / 144.0
C
C  GAS FLOW CONDITIONS
      VG = SQRT (2.0 * DELP * 144.0 / RHO )
      QG = RHO * VG * VG / 2.0 / 144.0
      VC = SQRT ( 1.4 * R * TGR )
      GM = VG / VC
C
      WRITE  (3,1070)  NR, ID, IPHT, IPRB, DN, GM, PN
C
C  WEBER NUMBER -WE  ****REYNOLDS NUMBER - RN
      WE = SIGM / ( RHO * VG * VG * DN / 12.0 )
      W67 = 1.0 / WE
      RN = DN * VG / ANU / 12.0
      R67 = DN * VL / ANU / 12.0
C
C   INGEBO MEAN MASS DROP SIZE - D30
      D30 = DN * 3.9 * ( WE /RN )**.25 / .00003937
C
C   INGEBO MAX  CONCENTRATION  PENETRATION
      ZCI = DN * 2.2 * ( R67 / W67 )**.6
C
C  INGEBO  MAX. PENETRATION
      ZMI = DN * 1.8 * (R67/W67)**.7
C
C  AGC  MAX. PENETRATION ZMA  **** WIDTH(TOTAL)  YMA
      ZMA=2.0*(QW/QG)**.5*(XD/DN)**.27*DN
      YMA=2.6*(XD/DN)**.33*DN*2.0
C
C   CHELKO  MAX. PENETRATION
      ZMC = DN * .45  * (VL / VG)**.95 * (DEN / (RHO * G ))**.74
     1      * ( XD / DN )**.22
C
      WRITE (3 ,1075  )  VL,VG,WE,RN,D30,          ZMC, ZMA, YMA
      WRITE (3,1076) W67, R67, ZCI, ZMI
C
      IF(DELPI-DELW)290,300,290
  290 CONTINUE
      IF(DELW)300,300,250
  300 CONTINUE
      IF(9-J)999,190,310
  310 CONTINUE
      GO TO 200
  999 STOP
C
 1000 FORMAT (4I5 )
 1001 FORMAT (5X, 6E10.3 )
 1004 FORMAT  (I2)
 1005 FORMAT  (8E10.2)
C
 1050 FORMAT (1H1, 63H PENETRATION OF LIQUID JETS INTO HIGH VELOCITY
     1 GAS STREAMS    ,// , 58H TESTS CONDUCTED AT LEWIS ICING TUNNEL
     2 JUNE -JULY 1969    , // )
```

```
      VC = SQRT ( 1.4 * R * TGR )
      GM = VG / VC
C
      WRITE  (3,1070)  NR, IS    MT, IPRB, DN, GM, PN
C
C  WEBER NUMBER =WE  ****REYNOLDS NUMBER = RN
      WE = SIGM / ( RHO * VG * VG * DN / 12.0 )
      W67 = 1.0 / WE
      RN = DN * VG / ANU / 12.0
      R67 = DN * VL / ANU / 12.0
C
C   INGEBO MEAN MASS DROP SIZE - D30
      D30 = DN * 3.9 * ( WE /RN )**.25 / .00003937
C
C   INGEBO MAX  CONCENTRATION  PENETRATION
      ZCI = DN * 2.2 * ( R67 / W67 )**.6
C
C  INGEBO  MAX. PENETRATION
      ZMI = DN * 1.8 * (R67/W67)**.7
C
C  AGC  MAX. PENETRATION ZMA  **** WIDTH(TOTAL)  YMA
      ZMA=2.6*(DG/DG)**.5*(XD/DN)**.27*DN
      YMA=2.6*(XD/DN)**.33*DN*2.0
C
C   CHELKO  MAX. PENETRATION
      ZMC = DN * .45  * (VL / VG)**.95 * (DEN / (RHO * G ))**.74
     1      * ( XD / DN )**.22
C
      WRITE (3 ,1075  )  VL,VG,WE,RN,D30,          ZMC, ZMA, YMA
      WRITE (3,1076) W67, R67, ZCI, ZMI
C
      IF(DELPI-DELW)290,300,290
  290 CONTINUE
      IF(DELW)300,300,250
  300 CONTINUE
      IF(9-J)999,190,310
  310 CONTINUE
      GO TO 200
  999 STOP
C
 1000 FORMAT (4I5 )
 1001 FORMAT (5X, 6E10.3 )
 1004 FORMAT  (I2)
 1005 FORMAT  (6E10.2)
C
 1050 FORMAT (1H1, 63H PENETRATION OF LIQUID JETS INTO HIGH VELOCITY
     1 GAS STREAMS     .// . 58H TESTS CONDUCTED AT LEWIS ICING TUNNEL
     2 JUNE -JULY 1969     . // )
C
 1055 FORMAT (    70H      RUN        TEST -PHOTO XYZ-PROBE XYZ NOZ. DIA.
     1VACH NO.  NOZ.PRES.,/,40X, 30H D(INCHES)     M      PN(PSIG)  ./.)
 1060 FORMAT (5X,100H LIQ.VEL.  GAS VEL.   WEBER    REYNOLDS  DROP DIA.
     1VAGE CONC (MAXIMUM PENETRATION CALC.)     WIDTH    . /. 5X.
     [illegible]  [illegible]  [illegible]  NO.    NR.(VG/VC) (ING)MICR (ING)IN.
```

```
AGC   3

     3(ING)I.   (CHEL)IN. (AGC)IN.  (AGC)IN. . //.)
 1070 FORMAT  ( 4I9 . 3F10.3 ./)
 1075 FORMAT  ( 5X. 2F6.2.2X. E10.4. 2X. E10.4. F9.1. 18X. 3F9.1)
 1076 FORMAT (23X. E10.4. 2X. E10.4. 9X. 2F9.1 .//)
      END
VARIABLE ALLOCATIONS
   TCF(R )=0062-0000    DCR(R )=00C6-0064    VIS(R )=012A-00C8    DN(R )=012C    COEF(R )=012E    PN(R )=0130
 DELPI(R )=0132         TGF(R )=0134         DELW(R )=0136        DCRT(R )=0138  VISTC(R )=013A   VISTF(R )=013C
  DENR(R )=013F         DEN(R )=0140         ANU(R )=0142         XD(R )=0144    R(R )=0146       RHO(R )=0148
    G(R )=014A           PI(R )=014C         SIGM(R )=014E        DELP(R )=0150  TGR(R )=0152     ARN(R )=0154
   VL(R )=0156         WFLD(R )=0158          OW(R )=015A          VG(R )=015C    GG(R )=015E      VC(R )=0160
   GM(R )=0162           WE(R )=0164         W67(R )=0166         RN(R )=0168    R67(R )=016A     D30(R )=016C
  ZCI(R )=016E         ZMI(R )=0170         ZMA(R )=0172         YMA(R )=0174   ZMC(R )=0176    NTAB(I )=017E
    I(I )=0180           J(I )=0182          NR(I )=0184          ID(I )=0186    IPHT(I )=0188   IPRB(I )=018A

STATEMENT ALLOCATIONS
 1000 =01D6  1001 =01D9  1004 =01DD  1005 =01DF  1050 =01E2  1055 =0228  1060 =0260  1070 =02CC  1075 =02D2  1076 =02DE
  190  =0348  200  =0358  201  =0367  250  =0386  260  =03BA  290  =0515  300  =051A  310  =0522  999  =0524

FEATURES SUPPORTED
 IOCS

CALLED SUBPROGRAMS
 FINTR   FSQRT   FAXB    FSUB    FMPY    FDIV    FLD     FSTO    FDVR    TYPEZ   CARDZ   PRNTZ   SRED    SWRT    SCOMP
 SFID    SIOFX   SIOF    SIOI    SUBSC   STOP    SDFIO

REAL CONSTANTS
  .671969E-03=018E    .624000E 02=0190    .720000E 02=0192    .171400E 04=0194    .237800E-02=0196    .321740E 02=0198
  .314160E 01=019A    .487000E-02=019C    .361262E-01=019E    .460000E 03=01A0    .400000E 01=01A2    .144000E 03=01A4
  .200000E 01=01A6    .140000E 01=01A8    .120000E 02=01AA    .100000E 01=01AC    .390000E 01=01AE    .250000E 00=01B0
  .193700E-04=01B2    .220000E 01=01B4    .600000E 00=01B6    .180000E 01=01B8    .700000E 00=01BA    .500000E 00=01BC
  .270000E 00=01BE    .260000E 01=01C0    .330000E 00=01C2    .450000E 00=01C4    .950000E 00=01C6    .740000E 00=01C8
  .230000E 00=01CA

INTEGER CONSTANTS
    2=01CC    1=01CD    3=01CE    9=01CF    0=01D0

CORE REQUIREMENTS FOR
 COMMON      0  VARIABLES    398  PROGRAM    920

 END OF COMPILATION

// XEQ
```

02

PARTICLE STATISTICS

1410 DUKEROMETER RUNS 7-10-12 1/23/70

506.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	2.	0.0039	0.0002	0.15	0.02
80.00					
100.00	76.	0.1501	0.0366	10.02	3.70
120.00					
140.00	244.	0.4822	0.3242	54.36	36.13
160.00					
180.00	133.	0.2628	0.3756	85.43	73.69
200.00					
220.00	51.	0.1007	0.2630	100.00	100.00
240.00					

NO. MEAN= 152.25 MASS MEAN= 159.78

NO. VARIANCE= 1181.09 NO. STD. DEV.= 34.36

MASS VARIANCE= 1237.86 MASS STD. DEV.= 35.18

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 154.76 MICRONS

1405 DUKEROMETER RUN. 9-16 JAN 23-70

731.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	112.	0.1532	0.0315	9.61	3.15
120.00					
140.00	290.	0.3967	0.2240	44.47	25.55
160.00					
180.00	205.	0.2804	0.3365	76.16	59.21
200.00					
220.00	117.	0.1600	0.3507	98.26	94.29
240.00					
260.00	6.	0.0082	0.0296	99.60	97.25
280.00					
300.00	0.	0.0000	0.0000	99.60	97.25
320.00					
340.00	0.	0.0000	0.0000	99.60	97.25
360.00					
380.00	0.	0.0000	0.0000	99.60	97.25
400.00					
420.00	0.	0.0000	0.0000	99.60	97.25
440.00					
460.00	1.	0.0013	0.0274	100.00	100.00
480.00					

NO. MEAN= 159.31 MASS MEAN= 169.36

NO. VARIANCE= 1603.36 NO. STD. DEV.= 40.04

MASS VARIANCE= 1704.36 MASS STD. DEV.= 41.28

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 169.04 MICRONS

PARTICLE STATISTICS

1415-221-221 DUKEROMETER PARTIAL FIELD RUN 8 11-25-69

196.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	1.	0.0051	0.0003	0.21	0.03
80.00					
100.00	55.	0.2806	0.0823	20.05	8.26
120.00					
140.00	94.	0.4795	0.3860	67.53	46.87
160.00					
180.00	28.	0.1428	0.2444	85.71	71.31
200.00					
220.00	18.	0.0918	0.2868	100.00	100.00
240.00					

NO. MEAN= 141.42 MASS MEAN= 150.49

NO. VARIANCE= 1295.91 NO. STD. DEV.= 35.99

MASS VARIANCE=1378.03 MASS STD. DEV.= 37.12

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS145.12 MICRONS

PARTICLE STATISTICS

2405 DUKEROMETER RUN 23-30-88-119-125 1/26/70

980.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	8.	0.0081	0.0000	0.09	0.00
40.00					
60.00	18.	0.0183	0.0005	0.75	0.05
80.00					
100.00	204.	0.2081	0.0288	13.21	2.94
120.00					
140.00	294.	0.3000	0.1142	38.34	14.36
160.00					
180.00	193.	0.1969	0.1593	59.56	30.30
200.00					
220.00	164.	0.1673	0.2472	81.59	55.02
240.00					
260.00	41.	0.0418	0.1020	88.10	65.22
280.00					
300.00	36.	0.0367	0.1376	94.69	78.98
320.00					
340.00	7.	0.0071	0.0389	96.15	82.88
360.00					
380.00	9.	0.0091	0.0699	98.24	89.87
400.00					
420.00	3.	0.0030	0.0314	99.01	93.01
440.00					
460.00	1.	0.0010	0.0137	99.29	94.39
480.00					
500.00	0.	0.0000	0.0000	99.29	94.39
520.00					
540.00	1.	0.0010	0.0222	99.62	96.62
560.00					
580.00	0.	0.0000	0.0000	99.62	96.62
600.00					
620.00	1.	0.0010	0.0337	100.00	100.00
640.00					

NO. MEAN= 167.10 MASS MEAN= 193.15

NO. VARIANCE= 4320.16 NO. STD. DEV.= 65.72

MASS VARIANCE= 4998.97 MASS STD. DEV.= 70.70

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 211.87 MICRONS

2415 DUKEROMETER RUNS 43- -124 1/26/70

112.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	3.	0.0267	0.0008	0.93	0.08
80.00					
100.00	8.	0.0714	0.0108	5.08	1.17
120.00					
140.00	38.	0.3392	0.1414	32.67	15.32
160.00					
180.00	39.	0.3482	0.3086	69.08	46.18
200.00					
220.00	14.	0.1250	0.2022	85.06	66.41
240.00					
260.00	5.	0.0446	0.1192	91.80	78.34
280.00					
300.00	3.	0.0267	0.1099	96.47	89.33
320.00					
340.00	2.	0.0178	0.1066	100.00	100.00
360.00					

NO. MEAN= 172.14 MASS MEAN= 187.37

NO. VARIANCE= 2652.54 NO. STD. DEV.= 51.50

MASS VARIANCE= 2884.57 MASS STD. DEV.= 53.70

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 187.53 MICRONS

2410 DUKEROMETER R 63-126 1/26/70

417.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	13.	0.0311	0.0000	0.38	0.00
40.00					
60.00	12.	0.0287	0.0011	1.46	0.11
80.00					
100.00	64.	0.1534	0.0274	11.05	2.85
120.00					
140.00	125.	0.2997	0.1469	37.27	17.55
160.00					
180.00	104.	0.2494	0.2598	65.32	43.54
200.00					
220.00	75.	0.1798	0.3421	90.05	77.76
240.00					
260.00	15.	0.0359	0.1129	95.89	89.06
280.00					
300.00	8.	0.0191	0.0925	99.49	98.31
320.00					
340.00	1.	0.0023	0.0168	100.00	100.00
360.00					

NO. MEAN= 160.04 MASS MEAN= 177.53

NO. VARIANCE= 3131.89 NO. STD. DEV.= 55.96

MASS VARIANCE= 3437.68 MASS STD. DEV.= 58.63

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 187.54 MICRONS

PARTICLE STATISTICS

3505 DUKEROMETER RUNS 141-143 1/26/73

261.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	5.	0.0191	0.0000	0.26	0.00
40.00					
60.00	41.	0.1570	0.0062	6.86	0.62
80.00					
100.00	68.	0.2605	0.0480	25.09	5.43
120.00					
140.00	42.	0.1609	0.0814	40.85	13.58
160.00					
180.00	71.	0.2720	0.2927	75.12	42.86
200.00					
220.00	13.	0.0498	0.0978	82.78	52.64
240.00					
260.00	11.	0.0421	0.1366	90.45	66.31
280.00					
300.00	3.	0.0114	0.0572	92.86	72.04
320.00					
340.00	2.	0.0076	0.0555	94.69	77.60
360.00					
380.00	4.	0.0153	0.1551	98.76	93.11
400.00					
420.00	0.	0.0000	0.0000	98.76	93.11
440.00					
460.00	1.	0.0038	0.0688	100.00	100.00
480.00					

NO. MEAN= 142.91 MASS MEAN= 175.63

NO. VARIANCE= 4926.38 NO. STD. DEV.= 70.18

MASS VARIANCE= 5997.46 MASS STD. DEV.= 77.44

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 209.18 MICRONS

PARTICLE STATISTICS

2205 DUKEROMETER RUNS 94-96 1/23/70

288.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	7.	0.0243	0.0008	0.89	0.08
120.00					
140.00	20.	0.0694	0.0068	4.45	0.76
160.00					
180.00	38.	0.1319	0.0275	13.15	3.52
200.00					
220.00	61.	0.2118	0.0806	30.22	11.59
240.00					
260.00	36.	0.1250	0.0786	42.13	19.45
280.00					
300.00	45.	0.1562	0.1509	59.31	34.54
320.00					
340.00	29.	0.1006	0.1416	71.65	48.71
360.00					
380.00	15.	0.0520	0.1022	79.10	58.93
400.00					
420.00	20.	0.0694	0.1840	89.79	77.34
440.00					
460.00	15.	0.0520	0.1813	98.57	95.48
480.00					
500.00	1.	0.0034	0.0155	99.21	97.03
520.00					
540.00	0.	0.0000	0.0000	99.21	97.03
560.00					
580.00	0.	0.0000	0.0000	99.21	97.03
600.00					
620.00	1.	0.0034	0.0296	100.00	100.00
640.00					

NO. MEAN= 272.91 MASS MEAN= 303.45

NO. VARIANCE= 8794.26 NO. STD. DEV.= 93.77

MASS VARIANCE= 9726.54 MASS STD. DEV.= 98.62

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 345.04 MICRONS

3410 DUKEROMETER RUNS 44-59-78-82 1/26/70

436.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	2.	0.0045	0.0000	0.05	0.00
40.00					
60.00	1.	0.0022	0.0000	0.13	0.00
80.00					
100.00	54.	0.1238	0.0167	7.18	1.68
120.00					
140.00	140.	0.3211	0.1192	32.80	13.61
160.00					
180.00	100.	0.2293	0.1811	56.32	31.72
200.00					
220.00	109.	0.2500	0.3604	87.66	67.76
240.00					
260.00	11.	0.0252	0.0600	91.40	73.76
280.00					
300.00	10.	0.0229	0.0838	95.32	82.15
320.00					
340.00	0.	0.0000	0.0000	95.32	82.15
360.00					
380.00	6.	0.0137	0.1022	98.30	92.37
400.00					
420.00	2.	0.0045	0.0460	99.39	96.97
440.00					
460.00	1.	0.0022	0.0302	100.00	100.00
480.00					

NO. MEAN= 175.50 MASS MEAN= 194.73

NO. VARIANCE= 3322.90 NO. STD. DEV.= 57.64

MASS VARIANCE= 3692.76 MASS STD. DEV.= 60.76

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 200.28 MICRONS

3405-341-311 DUKERO. ER PARTIAL FIELD RUN 133 11-25-69

208.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCE DIAMETER	CUMULATIVE-PERCE MAS
0.00					
20.00	4.	0.0192	0.0000	0.30	0.0
40.00					
60.00	25.	0.1201	0.0096	6.07	0.9
80.00					
100.00	72.	0.3461	0.1281	33.76	13.7
120.00					
140.00	59.	0.2836	0.2880	65.53	42.5
160.00					
180.00	42.	0.2019	0.4358	94.61	85.1
200.00					
220.00	4.	0.0192	0.0757	98.00	93.7
240.00					
260.00	2.	0.0096	0.0625	100.00	100.0
280.00					

NO. MEAN= 125.00 MASS MEAN= 139.27

NO. VARIANCE= 1959.61 NO. STD. DEV.= 44.26

MASS VARIANCE=2163.38 MASS STD. DEV.= 46.51

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS146.80 MICRONS

PARTICLE STATISTICS

1205-221-221 DUKEROMETER FULL FIELD 8/8/69

1214.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	15.	0.0114	0.0002	0.35	0.02
80.00					
100.00	96.	0.0730	0.0082	4.16	0.85
120.00					
140.00	267.	0.2031	0.0626	18.99	7.13
160.00					
180.00	346.	0.2633	0.1729	43.70	24.42
200.00					
220.00	395.	0.3006	0.3605	78.17	60.47
240.00					
260.00	122.	0.0928	0.1837	90.75	78.85
280.00					
300.00	51.	0.0388	0.1180	96.82	90.66
320.00					
340.00	14.	0.0106	0.0471	98.71	95.37
360.00					
380.00	4.	0.0030	0.0188	99.31	97.26
400.00					
420.00	3.	0.0022	0.0190	99.81	99.16
440.00					
460.00	1.	0.0007	0.0083	100.00	100.00
480.00					

NO. MEAN= 191.84 MASS MEAN= 207.05

NO. VARIANCE= 3036.63 NO. STD. DEV.= 55.10

MASS VARIANCE=3266.13 MASS STD. DEV.= 57.16

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS205.37 MICRONS

PARTICLE STATISTICS

F8205 DUKEROMETER RUNS 98-107 1/26/70

445.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	1.	0.0022	0.0000	0.02	0.00
40.00					
60.00	52.	0.1168	0.0035	4.29	0.35
80.00					
100.00	79.	0.1775	0.0250	15.11	2.86
120.00					
140.00	79.	0.1775	0.0687	30.24	9.74
160.00					
180.00	108.	0.2426	0.1993	56.85	29.72
200.00					
220.00	76.	0.1707	0.2567	79.74	55.39
240.00					
260.00	23.	0.0516	0.1282	87.92	66.22
280.00					
300.00	19.	0.0426	0.1627	95.72	84.49
320.00					
340.00	2.	0.0044	0.0249	96.66	86.98
360.00					
380.00	3.	0.0067	0.0522	98.22	92.21
400.00					
420.00	2.	0.0044	0.0470	99.37	96.91
440.00					
460.00	1.	0.0022	0.0308	100.00	100.00
480.00					

NO. MEAN= 164.17 MASS MEAN= 192.03

NO. VARIANCE= 4948.81 NO. STD. DEV.= 70.34

MASS VARIANCE= 5724.96 MASS STD. DEV.= 75.66

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 211.59 MICRONS

1405-221-221 DUKEROMETER PARTIAL F...D RUN 6 11-25-69

239.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	53.	0.2217	0.0538	14.73	5.38
120.00					
140.00	105.	0.4393	0.2927	55.58	34.66
160.00					
180.00	47.	0.1966	0.2765	79.09	62.51
200.00					
220.00	33.	0.1380	0.3570	99.27	98.21
240.00					
260.00	1.	0.0041	0.0178	100.00	100.00
280.00					

NO. MEAN= 150.54 MASS MEAN= 160.27

NO. VARIANCE= 1902.21 NO. STD. DEV.= 38.75

MASS VARIANCE=1596.93 MASS STD. DEV.= 39.96

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS162.03 MICRONS

1205-221-221 DUKEROME... FULL FIELD Y-4 8/8/69

194.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	2.	0.0101	0.0002	0.31	0.02
80.00					
100.00	15.	0.0757	0.0091	4.30	0.93
120.00					
140.00	33.	0.1666	0.0551	16.59	6.45
160.00					
180.00	64.	0.3232	0.2272	47.23	29.17
200.00					
220.00	61.	0.3080	0.3954	82.92	68.72
240.00					
260.00	14.	0.0707	0.1498	92.60	83.70
280.00					
300.00	7.	0.0353	0.1150	98.19	95.21
320.00					
340.00	2.	0.0101	0.0478	100.00	100.00
360.00					

NO. MEAN= 189.89 MASS MEAN= 202.41

NO. VARIANCE= 2512.10 NO. STD. DEV.= 50.12

MASS VARIANCE=2668.84 MASS STD. DEV.= 51.66

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS201.06 MICRONS

PARTICLE STATISTICS

1405-211-224 DUKEROMETER PARTIAL FIELD RUN 9 11-25-69

225.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	36.	0.1600	0.0348	10.18	3.48
120.00					
140.00	94.	0.4177	0.2498	47.42	28.46
160.00					
180.00	61.	0.2711	0.3445	78.49	62.92
200.00					
220.00	31.	0.1377	0.3196	97.79	94.89
240.00					
260.00	3.	0.0133	0.0510	100.00	100.00
280.00					

NO. MEAN= 157.06 MASS MEAN= 166.16

NO. VARIANCE= 1472.28 NO. STD. DEV.= 38.37

MASS VARIANCE= 1555.11 MASS STD. DEV.= 39.43

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 164.99 MICRONS

PARTICLE STATISTICS

1410-221-221 DUKEROMETER PARTIAL FIELD RUN 7 11-25-69

201.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	28.	0.1393	0.0334	9.07	3.34
120.00					
140.00	99.	0.4925	0.3244	53.98	35.79
160.00					
180.00	52.	0.2587	0.3622	84.31	72.01
200.00					
220.00	22.	0.1094	0.2798	100.00	100.00
240.00					

NO. MEAN= 153.53 MASS MEAN= 160.88

NO. VARIANCE= 1154.18 NO. STD. DEV.= 33.97

MASS VARIANCE=1208.26 MASS STD. DEV.= 34.76

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS155.68 MICRONS

1410-211-224 DUKEROMETER PARTIAL FIE IN 12 11-26-69

104.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	21.	0.2019	0.0580	13.88	5.80
120.00					
140.00	51.	0.4903	0.3865	61.11	44.45
160.00					
180.00	29.	0.2788	0.4671	95.63	91.17
200.00					
220.00	3.	0.0288	0.0882	100.00	100.00
240.00					

NO. MEAN= 145.38 MASS MEAN= 151.54

NO. VARIANCE= 924.65 NO. STD. DEV.= 30.41

MASS VARIANCE= 962.80 MASS STD. DEV.= 31.02

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 144.74 MICRONS

1410-211-224 DUKEROMET ARTIAL FIELD RUN 10 11-25-69

201.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	2.	0.0099	0.0004	0.38	0.04
80.00					
100.00	27.	0.1343	0.0311	9.07	3.16
120.00					
140.00	94.	0.4676	0.2980	51.44	32.97
160.00					
180.00	52.	0.2587	0.3503	81.58	68.01
200.00					
220.00	26.	0.1293	0.3198	100.00	100.00
240.00					

NO. MEAN= 154.52 MASS MEAN= 162.67

NO. VARIANCE= 1309.35 NO. STD. DEV.= 36.18

MASS VARIANCE=1375.79 MASS STD. DEV.= 37.09

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS159.43 MICRONS

PARTICLE STATISTICS

2405-221-221 DUKEROMETER FULL FIELD RUN 23 11/10/69

242.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	19.	0.0785	0.0091	4.14	0.91
120.00					
140.00	63.	0.2603	0.0829	23.36	9.20
160.00					
180.00	57.	0.2355	0.1594	45.72	25.15
200.00					
220.00	70.	0.2892	0.3575	79.29	60.91
240.00					
260.00	14.	0.0578	0.1180	87.22	72.71
280.00					
300.00	17.	0.0702	0.2202	98.34	94.73
320.00					
340.00	0.	0.0000	0.0000	98.34	94.73
360.00					
380.00	2.	0.0082	0.0526	100.00	100.00
400.00					

NO. MEAN= 189.58 MASS MEAN= 204.97

NO. VARIANCE= 3002.30 NO. STD. DEV.= 54.79

MASS VARIANCE= 3239.12 MASS STD. DEV.= 56.91

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS 207.79 MICRONS

PARTICLE STATISTICS

1405-111-225 DUKEROMETER PARTIAL FIELD RUN 16 11-26-69

267.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	23.	0.0861	0.0149	5.09	1.49
120.00					
140.00	90.	0.3370	0.1605	32.97	17.54
160.00					
180.00	98.	0.3670	0.3715	72.02	54.70
200.00					
220.00	53.	0.1985	0.3668	97.83	91.38
240.00					
260.00	2.	0.0074	0.0228	98.98	93.67
280.00					
300.00	0.	0.0000	0.0000	98.98	93.67
320.00					
340.00	0.	0.0000	0.0000	98.98	93.67
360.00					
380.00	0.	0.0000	0.0000	98.98	93.67
400.00					
420.00	0.	0.0000	0.0000	98.98	93.67
440.00					
460.00	1.	0.0037	0.0632	100.00	100.00
480.00					

NO. MEAN= 169.21 MASS MEAN= 179.26

NO. VARIANCE= 1633.46 NO. STD. DEV.= 40.41

MASS VARIANCE=1734.44 MASS STD. DEV.= 41.64

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS174.93 MICRONS

PARTICLE STATISTICS

2415-261-222 DUKEROMETER FULL FIELD RUN 43 11/11/69

[illegible].PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.00
[illegible]	3.	[illegible]	[illegible]	[illegible]	0.12
[illegible]	8.	0.0924	[illegible]	[illegible]	1.60
[illegible]	32.	0.3462	0.1680	[illegible]	18.40
[illegible]	37.	0.3814	0.4004	[illegible]	58.45
[illegible]	11.	0.1134	0.2173	[illegible]	89.19
[illegible]	3.	0.0309	0.0978	[illegible]	97.97
[illegible]	2.	0.0206	0.1932	100.	100.00

NO. MEAN= 165.56 MASS MEAN= 177.09

NO. VARIANCE= 1985.50 NO. STD. DEV.= 44.55

MASS VARIANCE=2116.59 MASS STD. DEV.= 46.02

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS171.55 MICRONS

PARTICLE STATISTICS

2405-271-221 DUKEROMETER FULL FIELD RUN 30 11/11/69

213.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	11.	0.0516	0.0041	2.54	0.41
120.00					
140.00	53.	0.2488	0.0554	19.74	5.96
160.00					
180.00	50.	0.2347	0.1111	40.61	17.08
200.00					
220.00	61.	0.2863	0.2476	71.71	41.84
240.00					
260.00	14.	0.0657	0.0938	80.19	51.22
280.00					
300.00	12.	0.0563	0.1235	88.50	63.57
320.00					
340.00	3.	0.0140	0.0449	90.66	68.07
360.00					
380.00	4.	0.0187	0.0836	94.39	76.43
400.00					
420.00	3.	0.0140	0.0647	97.31	84.91
440.00					
460.00	0.	0.0000	0.0000	97.31	84.91
480.00					
500.00	0.	0.0000	0.0000	97.31	84.91
520.00					
540.00	1.	0.0046	0.0600	98.56	90.91
560.00					
580.00	0.	0.0000	0.0000	98.56	90.91
600.00					
620.00	1.	0.0046	0.0908	100.00	100.00
640.00					

NO. MEAN= 202.53 MASS MEAN= 230.91

NO. VARIANCE= 5351.31 NO. STD. DEV.= 73.15

MASS VARIANCE=6156.75 MASS STD. DEV.= 78.46

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS254.78 MICRONS

PARTICLE STATISTICS

3410-251-233 DUKEROMETER PARTIAL FIELD RUN 59 11-26-69

57.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	3.	0.0526	0.0087	3.00	0.87
120.00					
140.00	17.	0.2982	0.1353	26.85	14.40
160.00					
180.00	22.	0.3859	0.3723	66.53	51.64
200.00					
220.00	14.	0.2456	0.4325	97.39	94.89
240.00					
260.00	1.	0.0175	0.0510	100.00	100.00
280.00					

NO. MEAN= 175.08 MASS MEAN= 182.16

NO. VARIANCE= 1295.16 NO. STD. DEV.= 35.98

MASS VARIANCE=1345.20 MASS STD. DEV.= 36.67

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS178.23 MICRONS

PARTICLE STATISTICS

3410-261-222 DUKEROMETER PARTIAL FIELD RUN 45 11-26-69

146.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	9.	0.0616	0.0066	3.24	0.66
120.00					
140.00	43.	0.2945	0.0874	24.92	9.40
160.00					
180.00	33.	0.2260	0.1425	46.32	23.66
200.00					
220.00	46.	0.3150	0.3628	82.78	59.95
240.00					
260.00	4.	0.0273	0.0520	86.52	65.16
280.00					
300.00	7.	0.0479	0.1400	94.09	79.16
320.00					
340.00	0.	0.0000	0.0000	94.09	79.16
360.00					
380.00	2.	0.0136	0.0813	96.82	87.29
400.00					
420.00	1.	0.0068	0.0546	98.34	92.78
440.00					
460.00	1.	0.0068	0.0721	100.00	100.00
480.00					

NO. MEAN= 190.13 MASS MEAN= 209.86

NO. VARIANCE= 3612.30 NO. STD. DEV.= 60.10

MASS VARIANCE=4001.51 MASS STD. DEV.= 63.25

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS209.02 MICRONS

PARTICLE STATIS

3410-221-242 DUKEROMETER PARTIAL FIELD RUN 78 11-26-69

216.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	1.	0.0046	0.0001	0.17	0.01
80.00					
100.00	42.	0.1944	0.0343	12.18	3.44
120.00					
140.00	80.	0.3703	0.1792	44.22	21.37
160.00					
180.00	41.	0.1898	0.1952	65.33	40.90
200.00					
220.00	45.	0.2083	0.3913	93.64	80.04
240.00					
260.00	3.	0.0138	0.0430	95.88	84.34
280.00					
300.00	1.	0.0046	0.0220	96.73	86.55
320.00					
340.00	0.	0.0000	0.0000	96.73	86.55
360.00					
380.00	3.	0.0138	0.1344	100.00	100.00
400.00					

NO. MEAN= 161.85 MASS MEAN= 178.29

NO. VARIANCE= 2618.79 NO. STD. DEV.= 51.17

MASS VARIANCE=2889.01 MASS STD. DEV.= 53.74

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS189.29 MICRONS

PARTI .TATISTICS

2410-231-232 DUKEROMETER FULL FIELD RUN 63 11/11/69

351.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	1.	0.0028	0.0000	0.09	0.00
80.00					
100.00	48.	0.1367	0.0217	8.08	2.18
120.00					
140.00	111.	0.3162	0.1380	53.94	15.98
160.00					
180.00	92.	0.2621	0.2431	61.49	40.29
200.00					
220.00	75.	0.2136	0.3618	88.95	76.46
240.00					
260.00	15.	0.0427	0.1194	95.44	88.43
280.00					
300.00	8.	0.0227	0.0976	99.42	98.21
320.00					
340.00	1.	0.0028	0.0178	100.00	100.00
360.00					

NO. MEAN= 171.22 MASS MEAN= 194.55

NO. VARIANCE= 2361.74 NO. STD. DEV.= 48.59

MASS VARIANCE=2539.53 MASS STD. DEV.= 50.39

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS190.72 MICRONS

1300.00	2.	0.0081	0.0274	87.20	50.9
1320.00					
1340.00	1.	0.0040	0.0194	88.02	52.06
1360.00					
1380.00	4.	0.0163	0.0689	91.43	58.96
1400.00					
1420.00	0.	0.0000	0.0000	91.43	58.96
1440.00					
1460.00	0.	0.0000	0.0000	91.43	58.96
1480.00					
1500.00	1.	0.0040	0.0235	92.38	61.31
1520.00					
1540.00	1.	0.0040	0.0259	93.35	63.90
1560.00					
1580.00	0.	0.0000	0.0000	93.35	63.90
1600.00					
1620.00	1.	0.0040	0.0311	94.39	67.02
1640.00					
1660.00	1.	0.0040	0.0340	95.46	70.42
1680.00					
1700.00	0.	0.0000	0.0000	95.46	70.42
1720.00					
1740.00	0.	0.0000	0.0000	95.46	70.42
1760.00					
1780.00	0.	0.0000	0.0000	95.46	70.42
1800.00					
1820.00	0.	0.0000	0.0000	95.46	70.42
1840.00					
1860.00	0.	0.0000	0.0000	95.46	70.42
1880.00					
1900.00	0.	0.0000	0.0000	95.46	70.42
1920.00					
1940.00	0.	0.0000	0.0000	95.46	70.42
1960.00					
1980.00	0.	0.0000	0.0000	95.46	70.42
2000.00					
2020.00	0.	0.0000	0.0000	95.46	70.42
2040.00					
2060.00	0.	0.0000	0.0000	95.46	70.42
2080.00					
2100.00	1.	0.0040	0.0781	96.87	76.24
2120.00					
2140.00	1.	0.0040	0.0833	98.31	86.57
2160.00					
2180.00	0.	0.0000	0.0000	98.31	86.57
2200.00					
2220.00	0.	0.0000	0.0000	98.31	86.57
2240.00					
2260.00	0.	0.0000	0.0000	98.31	86.57
2280.00					
2300.00	0.	0.0000	0.0000	98.31	86.57
2320.00					
2340.00	0.	0.0000	0.0000	98.31	86.57
2360.00					
2380.00	0.	0.0000	0.0000	98.31	86.57
2400.00					
2420.00	0.	0.0000	0.0000	98.31	86.57
2440.00					
2460.00	0.	0.0000	0.0000	98.31	86.57
2480.00					
2500.00	0.	0.0000	0.0000	98.31	86.57
2520.00					

PARTICLE STATISTICS

2415-241-242 DUKEROMETER FULL FIELD RUN 73 11/11/69

245.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	0.	0.0000	0.0000	0.00	0.00
120.00					
140.00	0.	0.0000	0.0000	0.00	0.00
160.00					
180.00	3.	0.0122	0.0002	0.41	0.02
200.00					
220.00	8.	0.0326	0.0011	1.78	0.15
240.00					
260.00	10.	0.0408	0.0022	3.79	0.38
280.00					
300.00	29.	0.1183	0.0101	10.53	1.37
320.00					
340.00	15.	0.0612	0.0076	14.48	2.15
360.00					
380.00	16.	0.0653	0.0113	19.18	3.27
400.00					
420.00	25.	0.1020	0.0299	27.21	6.67
440.00					
460.00	29.	0.1183	0.0365	37.64	9.55
480.00					
500.00	21.	0.0857	0.0340	45.77	12.73
520.00					
540.00	15.	0.0612	0.0306	52.05	15.79
560.00					
580.00	13.	0.0530	0.0328	57.69	19.08
600.00					
620.00	12.	0.0489	0.0370	63.65	22.78
640.00					
660.00	3.	0.0122	0.0111	65.18	23.90
680.00					
700.00	6.	0.0244	0.0266	68.43	26.57
720.00					
740.00	1.	0.0040	0.0052	69.01	27.09
760.00					
780.00	1.	0.0040	0.0061	69.61	27.70
800.00					
820.00	19.	0.0408	0.0714	75.96	34.85
840.00					
860.00	7.	0.0285	0.0576	80.62	40.62
880.00					

1220.00	1.	0.0040	0239	92.38	61.31
1240.00					
1260.00	1.	0.0040	0.0259	93.35	63.90
1280.00					
1300.00	0.	0.0000	0.0000	93.35	63.90
1320.00					
1340.00	1.	0.0040	0.0311	94.39	67.02
1360.00					
1380.00	1.	0.0040	0.0340	95.46	70.42
1400.00					
1420.00	0.	0.0000	0.0000	95.46	70.42
1440.00					
1460.00	0.	0.0000	0.0000	95.46	70.42
1480.00					
1500.00	0.	0.0000	0.0000	95.46	70.42
1520.00					
1540.00	0.	0.0000	0.0000	95.46	70.42
1560.00					
1580.00	0.	0.0000	0.0000	95.46	70.42
1600.00					
1620.00	0.	0.0000	0.0000	95.46	70.42
1640.00					
1660.00	0.	0.0000	0.0000	95.46	70.42
1680.00					
1700.00	0.	0.0000	0.0000	95.46	70.42
1720.00					
1740.00	0.	0.0000	0.0000	95.46	70.42
1760.00					
1780.00	0.	0.0000	0.0000	95.46	70.42
1800.00					
1820.00	1.	0.0040	0.0781	96.87	76.24
1840.00					
1860.00	1.	0.0040	0.0633	98.31	86.57
1880.00					
1900.00	0.	0.0000	0.0000	98.31	86.57
1920.00					
1940.00	0.	0.0000	0.0000	98.31	86.57
1960.00					
1980.00	0.	0.0000	0.0000	98.31	86.57
2000.00					
2020.00	0.	0.0000	0.0000	98.31	86.57
2040.00					
2060.00	0.	0.0000	0.0000	98.31	86.57
2080.00					
2100.00	0.	0.0000	0.0000	98.31	86.57
2120.00					
2140.00	0.	0.0000	0.0000	98.31	86.57
2160.00					
2180.00	1.	0.0040	0.1342	100.00	100.00
2200.00					

	NUMBER	MASS	DIAMETER	MASS
0.00				
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	0.	0.0000	0.0000	0.00	0.00
120.00					
140.00	0.	0.0000	0.0000	0.00	0.00
160.00					
180.00	3.	0.0122	0.0002	0.41	0.02
200.00					
220.00	8.	0.0326	0.0011	1.78	0.15
240.00					
260.00	10.	0.0408	0.0022	3.79	0.36
280.00					
300.00	29.	0.1183	0.0101	10.53	1.37
320.00					
340.00	15.	0.0612	0.0076	14.46	2.15
360.00					
380.00	16.	0.0653	0.0113	19.18	3.27
400.00					
420.00	29.	0.1020	0.0239	27.31	5.67
440.00					
460.00	29.	0.1183	0.0365	37.64	9.23
480.00					
500.00	21.	0.0857	0.0340	45.77	12.73
520.00					
540.00	15.	0.0612	0.0306	52.05	15.79
560.00					
580.00	13.	0.0530	0.0328	57.89	19.08
600.00					
620.00	12.	0.0489	0.0370	63.65	22.78
640.00					
660.00	3.	0.0122	0.0111	65.18	23.90
680.00					
700.00	6.	0.0244	0.0266	68.43	26.57
720.00					
740.00	1.	0.0040	0.0052	69.01	27.09
760.00					
780.00	1.	0.0040	0.0061	69.51	27.70
800.00					
820.00	13.	0.0408	0.0714	75.96	34.85
840.00					
860.00	7.	0.0285	0.0576	80.62	40.62
880.00					
900.00	4.	0.0163	0.0377	83.41	44.40
920.00					
940.00	2.	0.0081	0.0215	84.86	46.55
960.00					
980.00	1.	[illegible]	[illegible]	[illegible]	[illegible]

NO. MEAN= 527.10 MASS MEAN= 680.38

NO. VARIANCE=75582.12 NO. STD. DEV.= 274.92

MASS VARIANCE=99078.70 MASS STD. DEV.= 314.76

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS1012.41 MICRONS

PARTICLE STATISTICS

3410-111-211 DUKEROMETER PARTIAL FIELD RUN 82 11-26-69

17.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	2.	0.1176	0.0000	1.04	0.00
40.00					
60.00	0.	0.0000	0.0000	1.04	0.00
80.00					
100.00	0.	0.0000	0.0000	1.04	0.00
120.00					
140.00	0.	0.0000	0.0000	1.04	0.00
160.00					
180.00	4.	0.2352	0.0773	19.89	7.73
200.00					
220.00	4.	0.2352	0.1412	42.93	21.86
240.00					
260.00	3.	0.1764	0.1748	63.35	39.34
280.00					
300.00	2.	0.1176	0.1790	79.05	57.24
320.00					
340.00	0.	0.0000	0.0000	79.05	57.24
360.00					
380.00	1.	0.0588	0.1819	89.00	75.43
400.00					
420.00	1.	0.0588	0.2456	100.00	100.00
440.00					

NO. MEAN= 224.70 MASS MEAN= 260.80

NO. VARIANCE= 9954.31 NO. STD. DEV.= 99.77

MASS VARIANCE=******* MASS STD. DEV.= 106.10

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS283.81 MICRONS

PARTICLE STATIS

2205-231-211 DUKEROMETER FULL FIELD RUN 94 11-20-69

37.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	0.	0.0000	0.0000	0.00	0.00
120.00					
140.00	0.	0.0000	0.0000	0.00	0.00
160.00					
180.00	2.	0.0540	0.0087	5.23	0.87
200.00					
220.00	9.	0.2432	0.0717	21.00	8.04
240.00					
260.00	8.	0.2162	0.1052	39.67	18.56
280.00					
300.00	6.	0.1621	0.1212	55.83	30.68
320.00					
340.00	4.	0.1081	0.1176	68.04	42.45
360.00					
380.00	3.	0.0810	0.1231	78.27	54.77
400.00					
420.00	1.	0.0270	0.0554	82.04	60.31
440.00					
460.00	5.	0.0810	0.2185	94.43	82.16
480.00					
500.00	0.	0.0000	0.0000	94.43	82.16
520.00					
540.00	0.	0.0000	0.0000	94.43	82.16
560.00					
580.00	0.	0.0000	0.0000	94.43	82.16
600.00					
620.00	1.	0.0270	0.1783	100.00	100.00
640.00					

NO. MEAN= 301.06 MASS MEAN= 330.53

NO. VARIANCE= 8624.23 NO. STD. DEV.= 92.75

MASS VARIANCE=9471.64 MASS STD. DEV.= 97.32

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS364.50 MICRONS

PARTICLE STATISTICS

2405-221-211 DUKEROMETER FULL FIELD RUN 88 11/11/69

257.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	5.	0.0194	0.0019	0.94	0.19
80.00					
100.00	122.	0.4747	0.2201	39.53	22.20
120.00					
140.00	109.	0.4241	0.5396	87.79	76.16
160.00					
180.00	19.	0.0739	0.1999	98.60	96.15
200.00					
220.00	2.	0.0077	0.0384	100.00	100.00
240.00					

NO. MEAN= 173.03 MASS MEAN= 129.19

NO. VARIANCE= 744.32 NO. STD. DEV.= 27.64

MASS VARIANCE= 802.26 MASS STD. DEV.= 28.32

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS120.60 MICRONS

PARTICLE STATISTICS

F6205-221-221 DUKEROMETER PARTIAL FIELD RUN 98 11-26-69

231.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	1.	0.0043	0.0003	0.20	0.03
120.00					
140.00	33.	0.1428	0.0333	9.64	3.37
160.00					
180.00	73.	0.3160	0.1570	36.49	19.07
200.00					
220.00	74.	0.3203	0.2906	69.75	48.14
240.00					
260.00	23.	0.0995	0.1491	81.97	63.05
280.00					
300.00	19.	0.0822	0.1892	93.62	81.97
320.00					
340.00	2.	0.0086	0.0289	95.01	84.67
360.00					
380.00	3.	0.0129	0.0607	97.34	90.94
400.00					
420.00	2.	0.0086	0.0546	99.06	96.40
440.00					
460.00	1.	0.0043	0.0359	100.00	100.00
480.00					

NO. MEAN= 211.86 MASS MEAN= 227.24

NO. VARIANCE= 3154.54 NO. STD. DEV.= 56.16

MASS VARIANCE=3391.18 MASS STD. DEV.= 58.23

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS224.98 MICRONS

PARTICLE STATISTICS

2205-251-221 DUKEROMETER FULL FIELD RUN 96 11/11/69

251.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	7.	0.0278	0.0010	1.03	0.10
120.00					
140.00	20.	0.0796	0.0078	5.15	0.88
160.00					
180.00	36.	0.1434	0.0300	14.66	3.89
200.00					
220.00	52.	0.2071	0.0793	31.52	11.63
240.00					
260.00	27.	0.1075	0.0680	41.86	18.63
280.00					
300.00	39.	0.1553	0.1509	59.08	33.73
320.00					
340.00	24.	0.0956	0.1352	71.09	47.25
360.00					
380.00	12.	0.0478	0.0943	77.80	56.69
400.00					
420.00	19.	0.0756	0.2017	89.54	76.87
440.00					
460.00	12.	0.0478	0.1674	97.67	93.61
480.00					
500.00	2.	0.0079	0.0358	99.14	97.20
520.00					
540.00	0.	0.0000	0.0000	99.14	97.20
560.00					
580.00	1.	0.0039	0.0279	100.00	100.00
600.00					

NO. MEAN= 270.67 MASS MEAN= 302.88

NO. VARIANCE= 9262.88 NO. STD. DEV.= 96.24

MASS VARIANCE=******* MASS STD. DEV.= 101.48

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS351.63 MICRONS

PARTICLE STATISTICS

F8215-231-222 DUKEROMETER PARTIAL FIELD RUN 116 11-25-69

253.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	1.	0.0039	0.0000	0.05	0.00
40.00					
60.00	10.	0.0395	0.0017	1.61	0.17
80.00					
100.00	71.	0.2806	0.0569	20.13	5.86
120.00					
140.00	71.	0.2806	0.1561	46.06	21.48
160.00					
180.00	57.	0.2252	0.2664	72.92	48.13
200.00					
220.00	27.	0.1067	0.2304	88.31	71.18
240.00					
260.00	9.	0.0355	0.1248	94.41	83.86
280.00					
300.00	6.	0.0237	0.1298	99.11	96.84
320.00					
340.00	1.	0.0039	0.0315	100.00	100.00
360.00					

NO. MEAN= 151.54 MASS MEAN= 170.19

NO. VARIANCE= 2946.63 NO. STD. DEV.= 54.28

MASS VARIANCE=3294.46 MASS STD. DEV.= 57.39

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS183.23 MICRONS

PARTICLE STATISTICS

F8205-221-231 DUKEROMETER PARTIAL FIELD RUN 107 11-25-69

214.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	1.	0.0046	0.0000	0.06	0.00
40.00					
60.00	52.	0.2429	0.0254	13.01	2.54
80.00					
100.00	78.	0.3644	0.1769	45.35	20.24
120.00					
140.00	46.	0.2149	0.2863	72.05	43.87
160.00					
180.00	35.	0.1635	0.4629	96.17	95.16
200.00					
220.00	2.	0.0093	0.0483	100.00	100.00
240.00					

NO. MEAN= 112.71 MASS MEAN= 127.23

NO. VARIANCE= 1782.37 NO. STD. DEV.= 42.21

MASS VARIANCE=1993.40 MASS STD. DEV.= 44.64

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS140.97 MICRONS

48

PARTICLE STATISTICS

2415-331-341 DUKEROMETER FULL FIELD RUN 124 11-20-69

15.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	0.	0.0000	0.0000	0.00	0.00
120.00					
140.00	5.	0.3333	0.0692	21.73	6.92
160.00					
180.00	2.	0.1333	0.0588	32.91	12.81
200.00					
220.00	3.	0.2000	0.1612	53.41	28.94
240.00					
260.00	2.	0.1333	0.1774	69.56	46.68
280.00					
300.00	1.	0.0666	0.1363	78.88	60.31
320.00					
340.00	2.	0.1333	0.3968	100.00	100.00
360.00					

NO. MEAN= 214.66 MASS MEAN= 236.35

NO. VARIANCE= 4878.21 NO. STD. DEV.= 69.84

MASS VARIANCE=5348.59 MASS STD. DEV.= 73.13

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS269.72 MICRONS

PARTICLE STATISTICS

2405-321-331 DUKEROMETER FULL FIELD RUN 119 11-20-69

40.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	0.	0.0000	0.0000	0.00	0.00
120.00					
140.00	2.	0.0500	0.0064	2.71	0.64
160.00					
180.00	7.	0.1750	0.0476	14.92	5.40
200.00					
220.00	10.	0.2500	0.1242	36.24	17.82
240.00					
260.00	7.	0.1750	0.1435	53.87	32.19
280.00					
300.00	6.	0.1500	0.1890	71.31	51.08
320.00					
340.00	4.	0.1000	0.1834	84.49	69.43
360.00					
380.00	3.	0.0750	0.1920	95.54	88.64
400.00					
420.00	0.	0.0000	0.0000	95.54	88.64
440.00					
460.00	1.	0.0250	0.1135	100.00	100.00
480.00					

NO. MEAN= 258.00 MASS MEAN= 277.72

NO. VARIANCE= 5195.99 NO. STD. DEV.= 72.08

MASS VARIANCE=5585.04 MASS STD. DEV.= 74.73

MASS MEDIAN PARTICLE DIAMETER.
USING LINEAR INTERPOLATION. IS297.69 MICRONS

49

PARTICLE STATISTICS

2-13-311-321 DUKEROMETER PARTIAL FIELD RUN 128 12-1-69

66.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	13.	0.1969	0.0008	3.91	0.08
40.00					
60.00	11.	0.1666	0.0187	13.86	1.95
80.00					
100.00	16.	0.2424	0.1261	37.95	14.56
120.00					
140.00	14.	0.2121	0.3027	67.46	44.84
160.00					
180.00	12.	0.1818	0.5515	100.00	100.00
200.00					

NO. MEAN= 130.60 MASS MEAN= 124.33

NO. VARIANCE= 3029.93 NO. STD. DEV.= 55.04

MASS VARIANCE=3593.01 MASS STD. DEV.= 59.94

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS143.74 MICRONS

PARTICLE STATISTICS

2409-331-341 DUKEROMETER FULL FIELD RUN 125 11-20-69

224.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	8.	0.0350	0.0003	3.48	0.03
40.00					
60.00	13.	0.0570	0.0029	9.38	0.30
80.00					
100.00	52.	0.2280	0.0550	32.14	5.66
120.00					
140.00	67.	0.2938	0.1946	61.61	25.68
160.00					
180.00	60.	0.2631	0.3704	88.24	67.30
200.00					
220.00	21.	0.0921	0.2366	94.32	85.97
240.00					
260.00	6.	0.0263	0.1115	99.09	97.14
280.00					
300.00	1.	0.0043	0.0285	100.00	100.00
320.00					

NO. MEAN= 143.85 MASS MEAN= 160.60

NO. VARIANCE= 2721.94 NO. STD. DEV.= 52.17

MASS VARIANCE=3002.41 MASS STD. DEV.= 54.79

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS166.70 MICRONS

PARTICLE STATISTICS

3505-311-323 DUKEROMETER PARTIAL FIELD RUN 141 11-25-69

52.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	0.	0.0000	0.0000	0.00	0.00
80.00					
100.00	1.	0.0192	0.0012	0.85	0.12
120.00					
140.00	4.	0.0769	0.0139	5.63	1.46
160.00					
180.00	23.	0.4423	0.1635	40.95	17.81
200.00					
220.00	7.	0.1346	0.0908	54.09	26.90
240.00					
260.00	7.	0.1346	0.1500	69.62	41.50
280.00					
300.00	3.	0.0576	0.0967	77.30	51.78
320.00					
340.00	2.	0.0384	0.0958	83.10	61.36
360.00					
380.00	4.	0.0769	0.2676	96.07	88.13
400.00					
420.00	0.	0.0000	0.0000	96.07	88.13
440.00					
460.00	1.	0.0192	0.1186	100.00	100.00
480.00					

NO. MEAN= 225.38 MASS MEAN= 250.76

NO. VARIANCE= 5663.31 NO. STD. DEV.= 75.25

MASS VARIANCE=6307.42 MASS STD. DEV.= 79.41

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS292.77 MICRONS

PARTICLE STATISTICS

3510-361-321 DUKEROMETER PARTIAL FIELD RUN 135 11-25-69

93.PARTICLES, OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	FRACTION OF TOTAL MASS	CUMULATIVE-PERCENT DIAMETER	CUMULATIVE-PERCENT MASS
0.00					
20.00	0.	0.0000	0.0000	0.00	0.00
40.00					
60.00	3.	0.0322	0.0007	1.06	0.07
80.00					
100.00	17.	0.1827	0.0199	11.07	2.06
120.00					
140.00	17.	0.1827	0.0546	25.08	7.53
160.00					
180.00	27.	0.2903	0.1844	53.71	25.98
200.00					
220.00	8.	0.0860	0.0998	64.07	35.96
240.00					
260.00	12.	0.1290	0.2471	82.44	60.67
280.00					
300.00	4.	0.0430	0.1265	89.51	73.32
320.00					
340.00	3.	0.0322	0.1381	95.52	87.14
360.00					
380.00	2.	0.0215	0.1285	100.00	100.00
400.00					

NO. MEAN= 182.58 MASS MEAN= 209.35

NO. VARIANCE= 5189.03 NO. STD. DEV.= 72.03

MASS VARIANCE=5905.94 MASS STD. DEV.= 76.85

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS242.72 MICRONS

PARTICLE STATISTICS

3969-313-322 DUKENOMETER PARTIAL FIELD RUN 143 11-29-69

264.PARTICLES. OUTPUT DATA

SIZE	NUMBER	FRACTION OF TOTAL NUMBER	MASS	CUMULATIVE-PERCENT DIAMETER	MASS
0.00					
20.00	5.	0.0239	0.0000	0.39	0.00
40.00					
60.00	41.	0.1961	0.0149	10.00	1.49
80.00					
100.00	67.	0.3205	0.1127	36.20	12.77
120.00					
140.00	38.	0.1818	0.1754	56.99	30.31
160.00					
180.00	48.	0.2296	0.4710	90.77	77.42
200.00					
220.00	6.	0.0287	0.1075	95.93	88.17
240.00					
260.00	4.	0.0191	0.1182	100.00	100.00
280.00					

NO. MEAN= 122.39 MASS MEAN= 141.66

NO. VARIANCE= 2629.68 NO. STD. DEV.= 51.28

MASS VARIANCE=3001.12 MASS STD. DEV.= 54.78

MASS MEDIAN PARTICLE DIAMETER,
USING LINEAR INTERPOLATION, IS156.71 MICRONS


```
PAGE   1
// JOB T
LOG DRIVE   CART SPEC.  CART AVAIL  PHY DRIVE
  0000        0001        0001        0000

V2 M04   ACTUAL  8K  CONFIG  8K

// FOR
*IOCS(CARD,TYPEWRITER,KEYBOARD,1132 PRINTER,DISK)
*LIST ALL
C       PARTICLE SIZE SORT, OPTIONAL CLASSIFIED INPUT
C       WITH MASS MEDIAN INTERPOLATION
C       AND WITH OPTIONAL PLOT
C
      DIMENSION  DIAM(12)  ,MFREQ(100),CMID(100)
       DIMENSION CUM1(100), CUM2(100),FREQ(100)
       DIMENSION HEADR (18).
      DIMENSION OUT(101),YPRNT(11)
   10 DO 20 I=1,100
   20  MFREQ(I)=0
       KMAX=1
      READ (2,1002) (HEADR (IA),IA=1,18)
C
C  ELG = ENLARGEMENT OF INPUT
C   CVG = CONVERSION FACTORFOR INPUT
C
      READ (2,1001)JMAX,DELC,INPT,IPLT,BLANK,SYM,ELG,CVG
       IF(INPT)25,25,27
   27  READ(2,1003) ( CMID(J), FREQ(J) ,J=1,JMAX)
       KMAX=JMAX
       FLJMX=0.
       DO 26 J=1,JMAX
   26  FLJMX=FLJMX+FREQ(J)
       WRITE (3,2004)
       WRITE(3,1002) (HEADR (IA),IA=1,18)
       WRITE (3,2005) FLJMX
       WRITE (3,2009)
       GO TO 110
   25  WRITE (3,2004)
       WRITE(3,1002) (HEADR (IA),IA=1,18)
       FLJMX=JMAX
       WRITE (3,2005) FLJMX
       LEFT=JMAX
  104  IF(LEFT-12) 28,29,31
   31  JFLG=1
       JJ=12
       GO TO 24
   29  JFLG=-1
       JJ=12
       GO TO 24
   28  JFLG=-1
       JJ=LEFT
   24  READ (2,1001) (DIAM(J),J=1,JJ)
       WRITE (3,2006) (DIAM(J),J=1,JJ)

       DO 100 J=1,JJ
```

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PAGE   2
   50  MFREQ(K)=MFREQ(K)+1
       IF(KMAX-K)60,100,100
   60  KMAX=K
  100  CONTINUE
       IF(JFLG) 103,103,105
  105  LEFT=LEFT-12
       GO TO 104
  103  DO 102 K=1,KMAX
  102  FREQ(K)=MFREQ(K)
       DO 150 K=1,KMAX
      FLOK=K
  150  CMID(K)=DELC*(FLOK-.499999)
  110  SUM1=0.
       SUM2=0.
       DO 190 K=1,KMAX
      FLOMK= FREQ(K)
       SUM1=SUM1+CMID(K)*FLOMK
       SUM2=SUM2+FLOMK* CMID(K)*CMID(K)*CMID(K)
       CUM1(K)=SUM1
  190  CUM2(K)=SUM2
       CLASS=0.001+CMID(1)-DELC/2.
       WRITE (3,2004)
       WRITE(3,1002) (HEADR (IA),IA=1,18)
       WRITE (3,2007) FLJMX
       WRITE (3,2008) CLASS
       DO 200 K=1,KMAX
       CLASS=CLASS+DELC
       CUM1(K)=CUM1(K)/SUM1*100.
       CUM2(K)=CUM2(K)/SUM2*100.
       FRACN=FREQ(K)/FLJMX
       IF(K-1) 201,201,202
  201  FRACM=CUM2(K)*.01
       GO TO 203
  202  FRACM=(CUM2(K)-CUM2(K-1))*.01
  203  WRITE(3,2003) CMID(K),FREQ(K),FRACN,FRACM,CUM1(K),CUM2(K)
  200  WRITE (3,2008) CLASS
       YNM=SUM1/FLJMX
       YYM=(SUM2/FLJMX)**.33333
       WRITE (3,2002) YNM,YMM
       SUM3=0.
       SUM4=0.
       DO 210 K=1,KMAX
      FLOMK= FREQ(K)
       SUM3=SUM3+  (YNM-CMID(K))*(YNM-CMID(K))*FLOMK
  210  SUM4=SUM4 + (YYM-CMID(K))*(YYM-CMID(K))*FLOMK
       VAR1=SUM3/FLJMX
       VAR2=SUM4/FLJMX
       DEV1=(VAR1)**.5
       DEV2=(VAR2)**.5
       WRITE (3,2006) VAR1,DEV1,VAR2,DEV2
C
C      INTERPOLATE FOR MASS MEDIAN PARTICLE DIAMETER
C
```

```
*IOCS(CARD,TYPEWRITER,KEYBOARD,1132 PRINTER,DISK)
*LIST ALL
C     PARTICLE SIZE SORT, OPTIONAL    CLASSIFIED INPUT
C     WITH MASS MEDIAN INTERPOLATION
C     AND WITH OPTIONAL PLOT
C
      DIMENSION DIAM(12)  CMID(100),FREQ(100),
      DIMENSION CUM1(100), CUM2(100),FREQ(100)
      DIMENSION HEADR (18)
      DIMENSION OUT(101),YPRNT(11)
   10 DO 20 I=1,100
   20 FREQ(I)=0
      KMAX=1
      READ (2,1002) (HEADR (IA),IA=1,18)
C
C  ELG = ENLARGEMENT OF INPUT
C  CVG = CONVERSION FACTOR FOR INPUT
C
      READ (2,1003)JMAX,DELC,INPT,IPLT,BLANK,SYM,ELG,CVG
      IF(INPT)25,25,27
   27 READ(2,1003) ( CMID(J), FREQ(J) ,J=1,JMAX)
      KMAX=JMAX
      FLJMX=0.
      DO 26 J=1,JMAX
   26 FLJMX=FLJMX+FREQ(J)
      WRITE (3,2004)
      WRITE(3,1002) (HEADR (IA),IA=1,18)
      WRITE (3,2005) FLJMX
      WRITE (3,2009)
      GO TO 110
   25 WRITE (3,2004)
      WRITE(3,1002) (HEADR (IA),IA=1,18)
      FLJMX=JMAX
      WRITE (3,2005) FLJMX
      LEFT=JMAX
  104 IF(LEFT-12) 28,29,31
   31 JFLG=1
      JJ=12
      GO TO 24
   29 JFLG=-1
      JJ=12
      GO TO 24
   28 JFLG=-1
      JJ=LEFT
   24 READ (2,1001) (DIAM(J),J=1,JJ)
      WRITE (3,2000) (DIAM(J),J=1,JJ)
      DO 100 J=1,JJ
      CLASS=DELC
      K=1
     DIAM(J) = DIAM(J) * CVG/ELG
   30 IF(DIAM(J)-(CLASS+0.0001))50,50,40
   40 CLASS=CLASS+DELC
      K=K+1
  102 FREQ(K)=FREQ(K)  +
      DO 150 K=1,KMAX
     FLOK=K
  150 CMID(K)=DELC*(FLOK-.4   /9)
  110 SUM1=0.
      SUM2=0.
      DO 190 K=1,KMAX
     FLOMK= FREQ(K)
      SUM1=SUM1+CMID(K)*FLOMK
      SUM2=SUM2+FLOMK* CMID(K)*CMID(K)*CMID(K)
      CUM1(K)=SUM1
  190 CUM2(K)=SUM2
      CLASS=0.001-CMID(1)-DELC/2.
      WRITE (3,2004)
      WRITE(3,1002) (HEADR (IA),IA=1,18)
      WRITE (3,2007) FLJMX
      WRITE (3,2008) CLASS
      DO 200 K=1,KMAX
      CLASS=CLASS+DELC
      CUM1(K)=CUM1(K)/SUM1*100.
      CUM2(K)=CUM2(K)/SUM2*100.
      FRACN=FREQ(K)/FLJMX
      IF(K-1) 201,201,202
  201 FRACM=CUM2(K)*.01
      GO TO 203
  202 FRACM=(CUM2(K)-CUM2(K-1))*.01
  203 WRITE(3,2003) CMID(K),FREQ(K),FRACN,FRACM,CUM1(K),CUM2(K)
  200 WRITE (3,2008) CLASS
      YNM=SUM1/FLJMX
      YMM=(SUM2/FLJMX)**.33333
      WRITE (3,2002) YNM,YMM
      SUM3=0.
      SUM4=0.
      DO 210 K=1,KMAX
     FLOMK= FREQ(K)
      SUM3=SUM3+  (YNM-CMID(K))*(YNM-CMID(K))*FLOMK
  210 SUM4=SUM4 + (YMM-CMID(K))*(YMM-CMID(K))*FLOMK
      VAR1=SUM3/FLJMX
      VAR2=SUM4/FLJMX
      DEV1=(VAR1)**.5
      DEV2=(VAR2)**.5
      WRITE (3,2006) VAR1,DEV1,VAR2,DEV2
C
C     INTERPOLATE FOR MASS MEDIAN PARTICLE DIAMETER
C
      DO 230 K=1,KMAX
      IF(CUM2(K)-50.) 230,225,220
  220 RATIO=(50.-CUM2(K-1))/(CUM2(K)-CUM2(K-1))
      YMED=CMID(K-1)+RATIO*DELC
      WRITE(3,2010) YMED
     GO TO 235
  230 CONTINUE
      GO TO 10
```

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PAGE   3

  235 IF(IPLT) 10,10,240
C
C        PLOT CUMULATIVE WEIGHT CURVE
C
  240 WRITE(3,2011)
       WRITE(3,1002) (HEADR (IA),IA=1,18)
      DO 70 I=1,KMAX
      DO 55 IX=1,101
   55 OUT(IX)=BLANK
      JP=CUM2(I)+1.5
      OUT(JP)=SYM
   70 WRITE(3,2012)CMID(I),(OUT(IZ),IZ=1,101)
      YPRNT(1)=0.
      DO 65 I=2,11
   65 YPRNT(I)=YPRNT(I-1)+10.0
      WRITE(3,2017)
      WRITE(3,2018)(YPRNT(IP),IP=1,11)
       GO TO 10
 1000 FORMAT(I5,F10.0,2I2,2A1,F5.0,E10.2)
 1001  FORMAT(12F6.2)
 1002  FORMAT(18A4)
 1003  FORMAT(6(F6.2,F6.0))
 2000  FORMAT(12F7.2)
 2002  FORMAT(//10H NO. MEAN=,F12.2, 9X,10HMASS MEAN=,F7.2)
 2003  FORMAT(F10.2,5X,F10.0,2F10.4,2F10.2)
 2004  FORMAT(1H122X,19HPARTICLE STATISTICS///)
 2005  FORMAT(1H015X,11HINPUT DATA,,F10.0,9HPARTICLES//)
 2006 FORMAT(/14H NO. VARIANCE=,F8.2,5X,14HNO. STD. DEV.=,F7.2//15H MAS
     1 VARIANCE=,F8.2,4X,15HMASS STD. DEV.=,F7.2)
 2007  FORMAT(//1X,F10.0,22HPARTICLES, OUTPUT DATA//6X,4HSIZE,10X,46HNU
     1BER   FRACTION OF TOTAL  CUMULATIVE=PERCENT//29X,36HNUMBER      MA
     2S    DIAMETER      MASS/)
 2008  FORMAT( F10.2)
 2009  FORMAT(/,15X,20HPRESORTED DATA INPUT)
 2010  FORMAT(/31H MASS MEDIAN PARTICLE DIAMETER,/
     1,31H USING LINEAR INTERPOLATION, IS, F7.2,8H MICRONS)
 2011 FORMAT(1H1)
 2012 FORMAT(///,6X,F6.2,5X,101A1)
 2017 FORMAT(17X,101H.          .          .          .          .          .
     1          .          .          .          .          .)
 2018 FORMAT(//,9X,11F10.2)
      END
VARIABLE ALLOCATIONS
  DIAM(R )=0016-0000. CMID(R )=00DE-C016  CUM1(R )=01A6-00E0  CUM2(R )=
   OUT(R )=0424-035C YPRNT(R )=043A-0426  DELC(R )=043C       BLANK(R )=
   CVG(R )=0444       FLJMX(R )=0446      CLASS(R )=0448       FLOK(R )=
 FLOMK(R )=0450       FRACN(R )=0452      FRACM(R )=0454        YNM(R )=
  SUM4(R )=045C        VAR1(R )=045E       VAR2(R )=0460       DEV1(R )=
  YMED(R )=0468       MFREQ(I )=0532-046C     I(I )=0534       KMAX(I )=
  INPT(I )=053C        IPLT(I )=053E       J(I )=0540        LEFT(I )=
     K(I )=054A          IX(I )=054A      JP(I )=054C          IZ(I )=
```
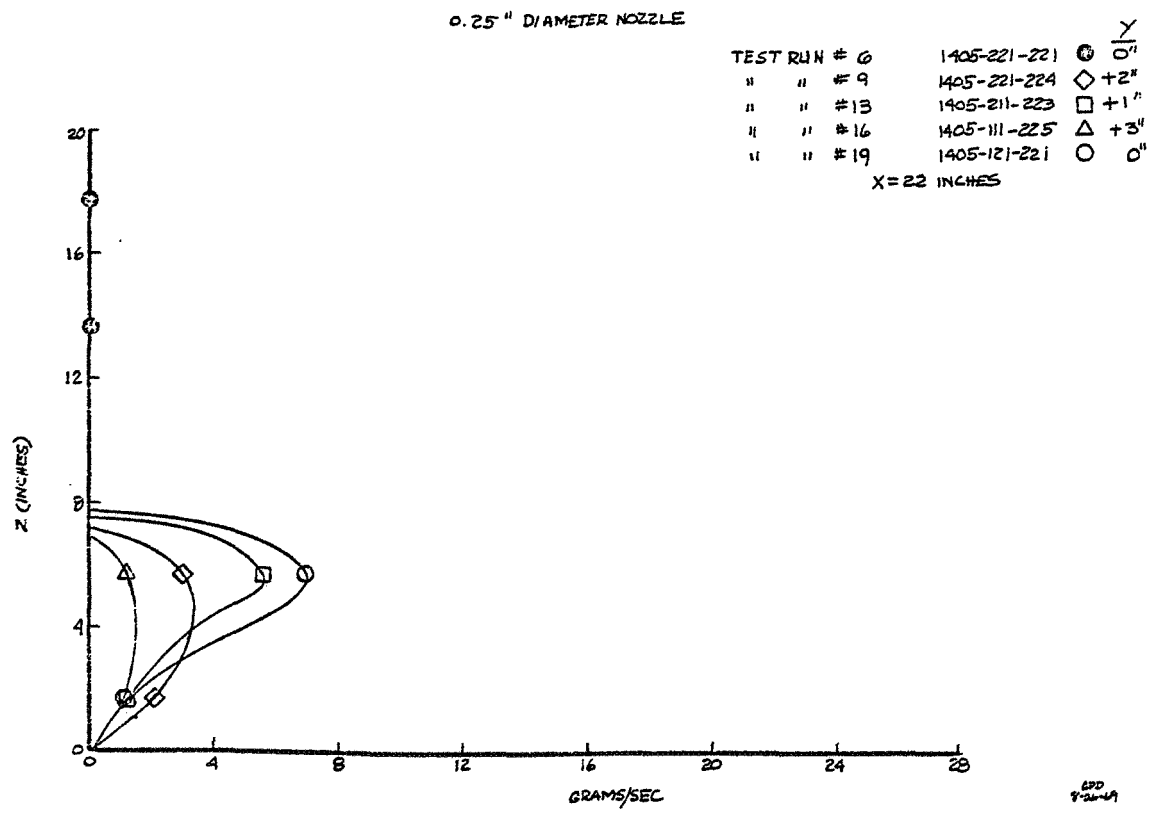

```
      DO [illegible] =1,101
   55 OUT[illegible] BLANK
      JP=CU[illegible](I)+1.5
      OUT(JP)=SYM
   70 WRITE(3,2012)CMID(I),(OUT(IZ),IZ=1,101)
      YPRNT(1)=0.
      DO 65 I=2,11
   65 YPRNT(I)=YPRNT(I-1)+10.0
      WRITE(3,2017)
      WRITE(3,2018)(YPRNT(IP),IP=1,11)
      GO TO 10
 1000 FORMAT(I5,F10.0,2I2,2A1,F5.0,E10.2)
 1001  FORMAT(12F6.2)
 1002  FORMAT(18A4)
 1003  FORMAT(6(F6.2,F6.0))
 2000  FORMAT(12F7.2)
 2002  FORMAT(//10H NO. MEAN=,F12.2, 9X,10HMASS MEAN=,F7.2)
 2003  FORMAT(F10.2,5X,F10.0,2F10.4,2F10.2)
 2004  FORMAT(1H122X,19HPARTICLE STATISTICS///)
 2005  FORMAT(1H015X,11HINPUT DATA,,F10.0,9HPARTICLES//)
 2006 FORMAT(/14H NO. VARIANCE=,F8.2,5X,14HNO. STD. DEV.=,F7.2//15H MAS
     1 VARIANCE=,F8.2,4X,15HMASS STD. DEV.=,F7.2)
 2007  FORMAT(//1X,F10.0,22HPARTICLES, OUTPUT DATA//6X,4HSIZE,10X,46HNU
     1BER   FRACTION OF TOTAL  CUMULATIVE-PERCENT//29X,36HNUMBER      MA
     2S    DIAMETER      MASS/)
 2008  FORMAT( F10.2)
 2009  FORMAT(/,15X,20HPRESORTED DATA INPUT)
 2010  FORMAT(/31H MASS MEDIAN PARTICLE DIAMETER,/
     1,31H USING LINEAR INTERPOLATION, IS, F7.2,8H MICRONS)
 2011 FORMAT(1H1)
 2012 FORMAT(///,6X,F6.2,5X,101A1)
 2017 FORMAT(17X,101H.          .          .          .          .
     1          .          .          .          .          .)
 2018 FORMAT(//,9X,11F10.2)
      END
VARIABLE ALLOCATIONS
  DIAM(R )=0016-0000. CMID(R )=00DE-0016  CUM1(R )=01A6-00E0  CUM2(R )=
   OUT(R )=0424-035C YPRNT(R )=043A-0426  DELC(R )=043C       BLANK(R )=
   CVG(R )=0444       FLJMX(R )=0446       CLASS(R )=0448       FLOK(R )=
 FLOMK(R )=0450       FRACN(R )=0452       FRACM(R )=0454        YMM(R )=
  SUM4(R )=045C        VAR1(R )=045E        VAR2(R )=0460       DEV1(R )=
  YMED(R )=0468       MFRED(I )=0532-046C      I(I )=0534       KMAX(I )=
  INPT(I )=053C        IPLT(I )=053E          J(I )=0540       LEFT(I )=
     K(I )=0548          IX(I )=054A         JP(I )=054C         IZ(I )=

STATEMENT ALLOCATIONS
 1000 =0580  1001 =0589  1002 =058C  1003 =053F  2000 =0594  2002 =059
 2007 =0603  2008 =064A  2009 =064C  2010 =065A  2011 =0685  2012 =06[illegible]
 27   =072D  26   =0751  25   =078C  104  =07B6  31   =07BE  29   =07C[illegible]
 50   =083E  60   =084F  100  =0853  105  =0860  103  =0868  102  =086[illegible]
 202  =0953  203  =0969  200  =097E  210  =09CD  220  =0A22  230  =0A4[illegible]
 70   =0AB2  65   =0AF0
```

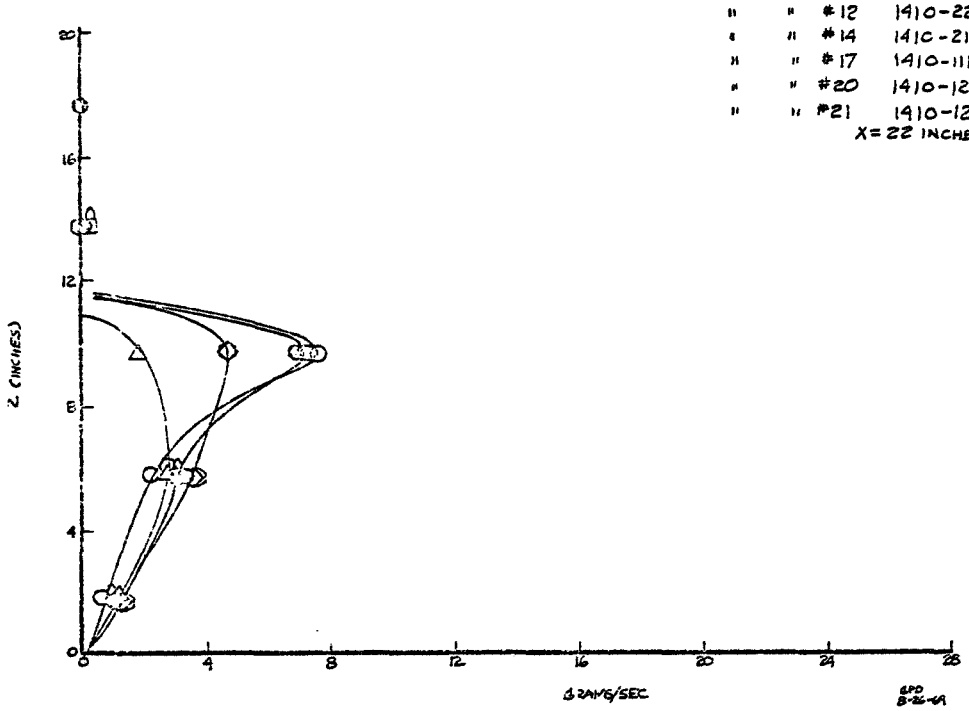


55

0.25" DIAMETER NOZZLE

					Y
TEST	RUN	#7	1410-221-221	●	0"
"	"	#10	1410-221-224	⬡	+2"
"	"	#12	1410-221-224	◇	+2"
"	"	#14	1410-211-223	□	+1"
"	"	#17	1410-111-225	△	+3"
"	"	#20	1410-121-221	⬮	0"
"	"	#21	1410-121-221	○	0"

X = 22 INCHES

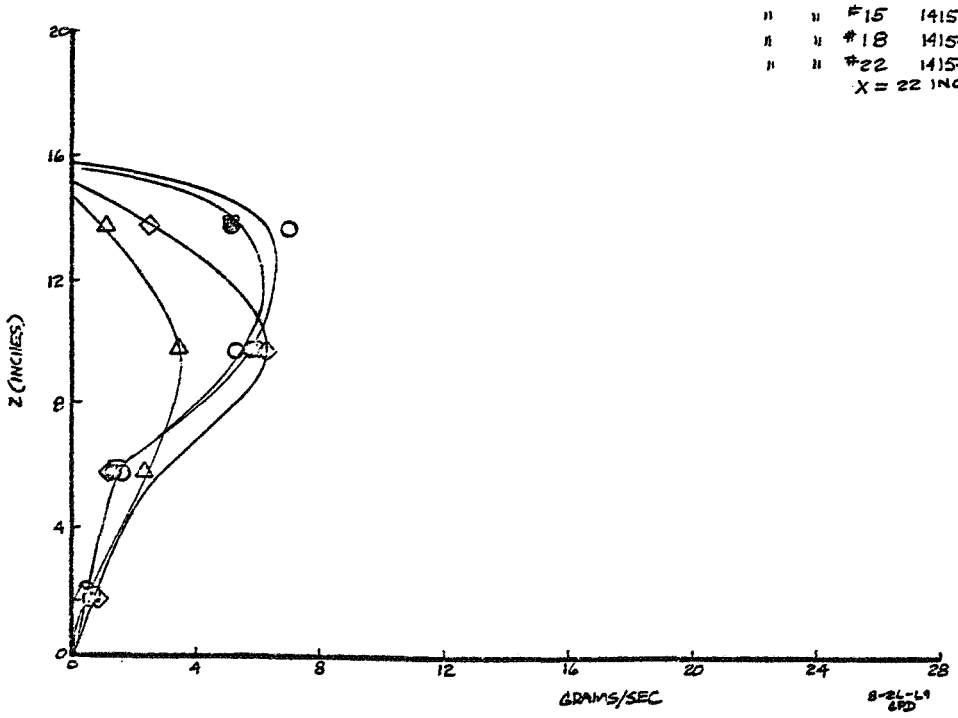


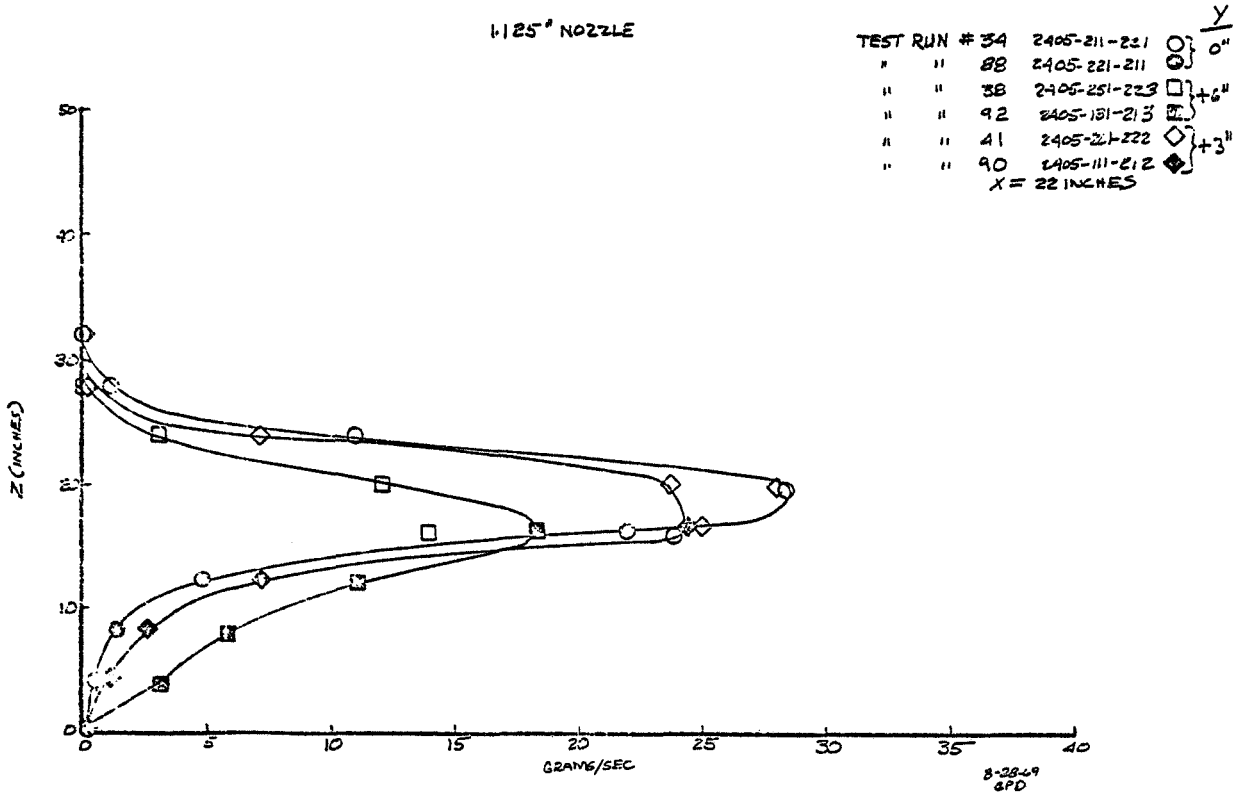
[redacted]

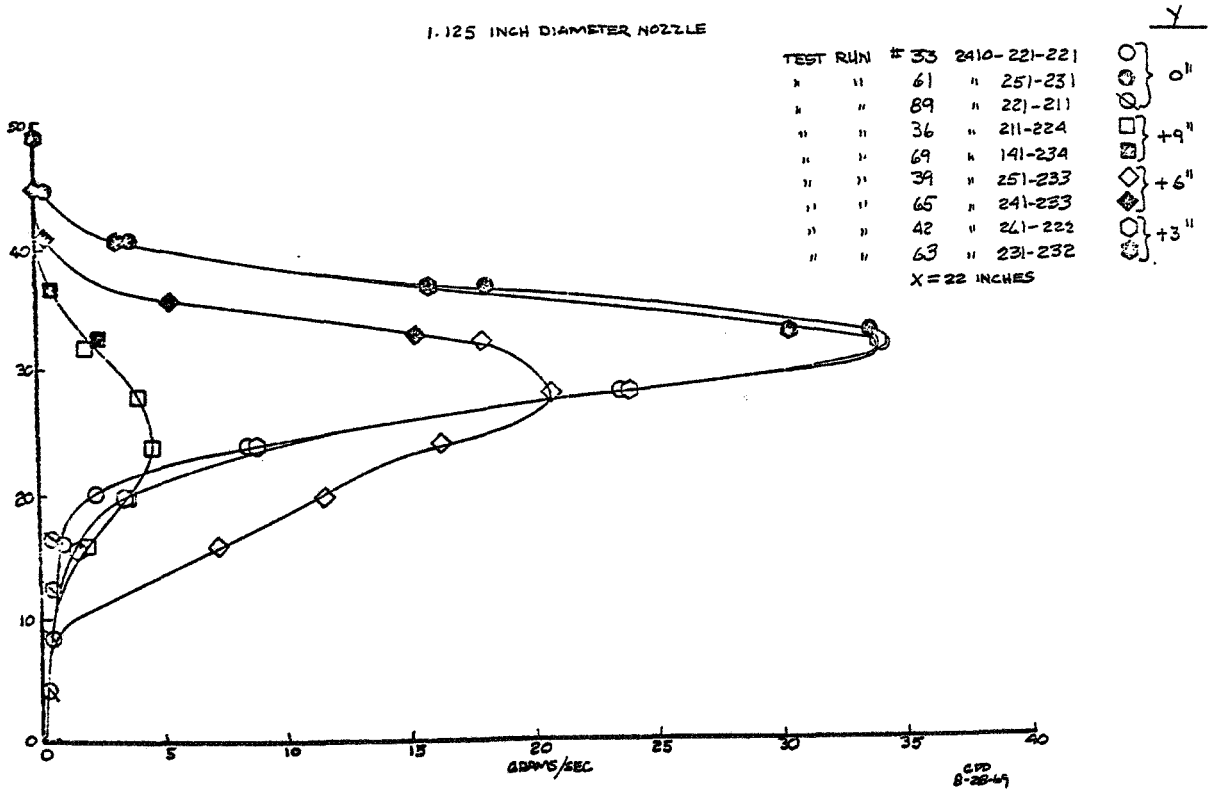
0.25" DIAMETER NOZZLE

					Y
TEST	RUN	#8	1415-221-221	●	0"
"	"	#11	1415-221-224	◇	+2"
"	"	#15	1415-211-223	□	+1"
"	"	#18	1415-111-225	△	+3"
"	"	#22	1415-121-221	○	0"

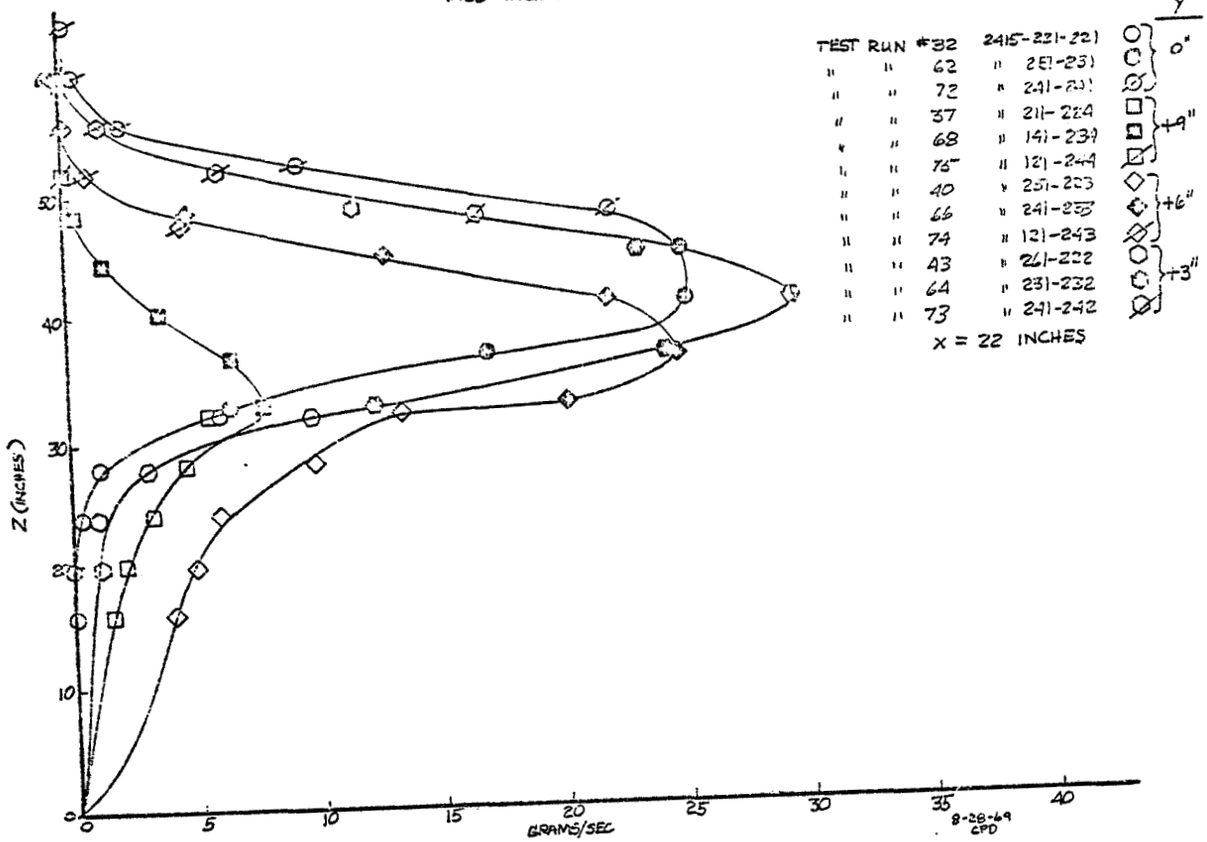
X = 22 INCHES



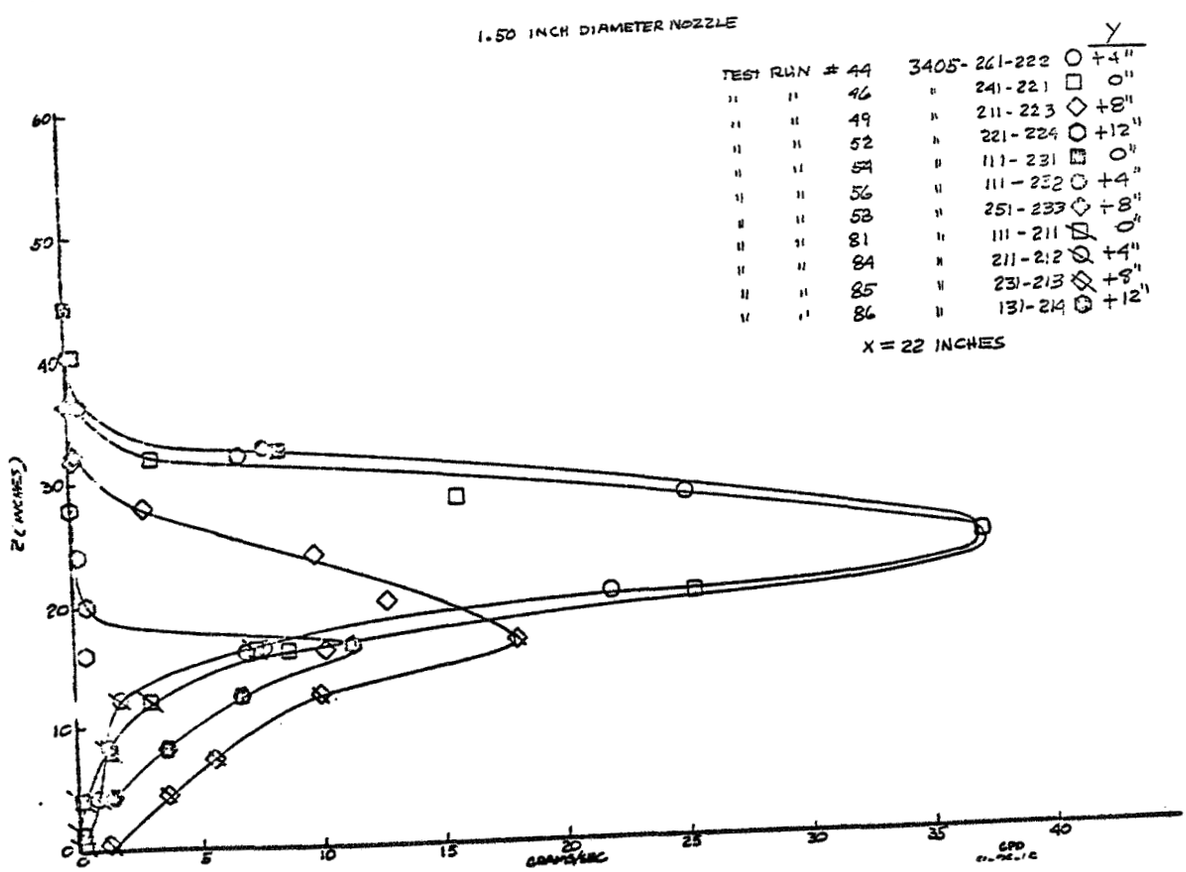

1.125" NOZZLE
TEST RUN # 34 2405-211-221
" " 88 2405-221-211
" " 38 2405-251-223
" " 92 2405-131-213
" " 41 2405-221-222
" " 90 2405-111-212
X = 22 INCHES
Y
0"
+6"
+3"
Z (INCHES)
GRAMS/SEC
8-28-49
GPD

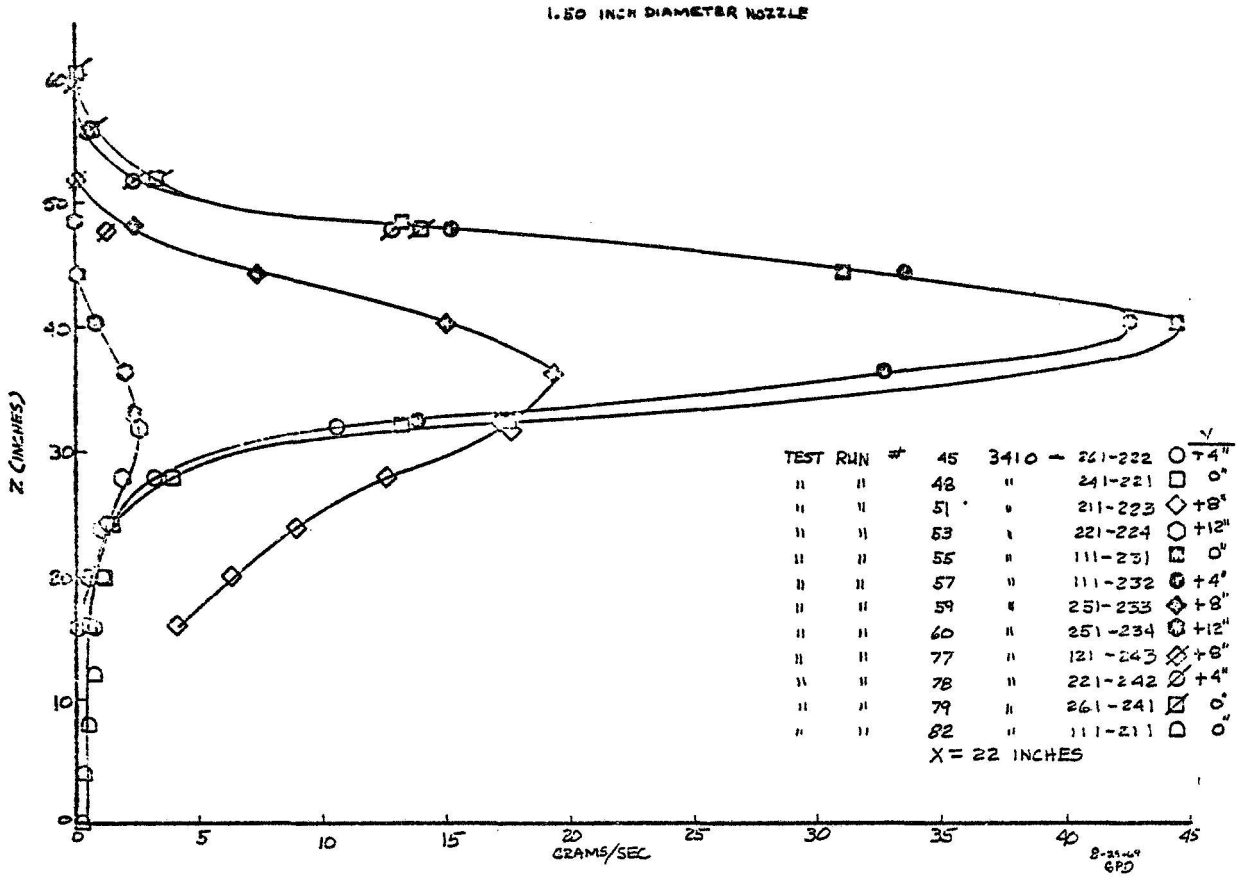

1.125 INCH DIAMETER NOZZLE
TEST RUN # 33 2410-221-221
" " 61 " 251-231
" " 89 " 221-211
" " 36 " 211-224
" " 69 " 141-234
" " 39 " 251-233
" " 65 " 241-233
" " 42 " 241-222
" " 63 " 231-232
X = 22 INCHES
Y
0"
+9"
+6"
+3"
GRAMS/SEC
GPD
8-28-49

1.125 INCH DIAMETER NOZZLE



1.50 INCH DIAMETER NOZZLE





DATE FILMED
10 / 13 / 70

END