DROPLET TESTING AT THE NEW YORK STATE ELECTRIC & GAS MILLIKEN STATION

Final Report
January 20, 1997

Prepared for
NEW YORK STATE ELECTRIC & GAS CORPORATION
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P. O. Box 5224
Binghamton, New York 13902-5224

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INTRODUCTION

Southern Research Institute was contracted by the New York State Electric and Gas (NYSEG) to perform droplet carryover testing at NYSEG's Milliken Station located near Ithaca, New York. The Milliken Station is comprised of two units, each with a nominal capacity of 150 MW. Each unit utilizes a single-module scrubber for flue gas desulfurization. The flue gas exhausted by each unit is discharged through separate flues in a common stack. Droplet tests were conducted at the inlet to the primary entrainment separator on Unit 1, at the outlets of the mist eliminators for each of the two units, and in the flues for each of the units near the top of the stack. Tests were conducted at three load conditions at each of these five test locations: low load (nominally 120 W), high load (nominally 150 MW), and in what is called "crossover-mode" operation (each unit operating nominally at 105 MW with the combined flow from both units passing through the single scrubber being tested). A copy of the test plan for conducting these measurements is included as Appendix A.

This report provides a description of the testing and the results obtained. The tests were conducted over the period October 1 through October 9, 1996. The tests included traverses of representative sections of the test locations using standard pitot methods to measure gas velocities over the measurement planes, and measurements of droplet concentrations with the Southern Research Video Droplet Analyzer (VDA). The rate at which water was collected by a stack drain system mounted within the flue of each unit was also measured during most of the tests. The results of the measurements are summarized in Table 1.

MEASUREMENT METHODS

The VDA uses on-the-fly video image analysis to detect and measure the diameters of all in-focus droplets that are entirely within the field of view of the camera in each video frame. The camera operates at a frame rate of 60 frames per second. Illumination is provided by a 0.5 microsecond flash-duration strobe lamp that is synchronized to fire immediately before the start of each video frame. Counts of measured droplets are accumulated in 160 size bins. These size bins were each 33 μm wide as the system was configured for the Milliken tests. The size range spanned by the VDA system for the Milliken tests was thus 33 μm to 5280 μm.

The size of the volume in space in which droplets are measured by the VDA is set by two factors. The first is the focal length of the lens used for imaging the droplets as this sets the field width and height (10.4 mm by 8 mm in the configuration used for these tests). The second factor is the depth-of-focus, which varies with droplet size. A signal related to image sharpness is generated for each image on each video scan line that intercepts it. A discriminator threshold is set which uses this signal to reject images that are out of focus. For the Milliken tests any image was rejected for which the measured size would have been in error by the greater of 33 μm or ten percent of its diameter. That is, the maximum error for droplets smaller than 330 μm was 33 μm while the maximum error for droplets larger than 330 μm was ten percent of the measured size. A calibration curve providing depth-of-focus versus droplet size is generated in the laboratory using glass beads and paint spots of known sizes mounted on microscope slides prior to departure for any test in which the VDA is to be used. This calibration is sensitive to the illumination intensity; consequently the signal level from the video camera is monitored continuously during operation of the VDA and the intensity is adjusted if it departs from the value used when doing the laboratory calibrations of the system. In addition, spot checks are made of the depth-of-focus at one or more selected sizes immediately before and after completion of each VDA measurement session to verify that the system operates as intended during each test. (A further description of the VDA system is provided in Appendix B.)

The VDA system measures the concentration at each traverse point independently. However, these concentrations must be weighted in proportion to the gas velocities at the traverse points to arrive at a concentration representative of the total flow through the duct. Also, in making measurements in vertical flow situations like those at Milliken, the net transport velocity of a droplet depends on its settling velocity as well as the local gas velocity. Consequently a velocity traverse of the duct must be made in conjunction with each droplet concentration traverse. The velocity measurements at Milliken were made using an "S-type" pitot equipped with an electronic micro-manometer. The flue gas compositions were not measured; instead, typical values for coal-fired power plant flue gases were used. The flue gas composition was used only for calculating the gas velocities in the ducts and the actual values used have only a very minor influence on the results of those calculations. (The calculated velocities would differ by less than one percent for any value of oxygen content over the range from 3% to 10% provided corresponding changes were made in the carbon dioxide value to keep the sum of the two at about 19 to 20 percent.) The moisture content of the flue gas was taken to be the saturation value at the average temperature measured during each velocity traverse.

The VDA probe was used in a standard traverse pattern to measure droplet concentrations over the selected sampling planes with pitot measurements being made to provide gas velocities at each of the same traverse points. Three sets of droplet measurements of equal duration were made at each traverse point in the measurement plane at each location. The sampling durations used for each of the three sets of measurements at each sampling point were one minute at the mist eliminator (ME) inlet location, two minutes at the mist eliminator outlet locations, and three minutes at the stack locations. The data for each set of measurements are stored as an independent record in a computer file. Each record contains the number of droplets counted in each of the 160 individual size bins together and an identifier for the traverse point at which that data set was obtained.

SAMPLING LOCATIONS

Measurements at Milliken were performed immediately above the exit planes of the second stage mist eliminators of the two modules. The total cross sectional area of each ME outlet is 770 square feet. However, structural steel beams running parallel to the direction of insertion of the VDA probe (below the level of the ports and centered between each port) reduced the effective cross section for flow at each outlet to 635.25 square feet. Similar steel beams located between the ports at the ME inlet sampling location reduced the flow cross section to the same value there as well. Measurements were made by introducing the probe through a series of four-inch pipe sampling ports located along one wall of the tower into the vertically flowing gas streams.

At the outlets of the mist eliminators measurements were made at depths of 1.25, 3.75, 6.25, and 8.75 feet from the duct wall through each of four traverse ports. These ports were spaced at equal intervals along one 35-foot long side of the 22 by 35 foot tower cross section. (The depths were selected to provide a standard rectangular traverse of one half of what we had been told were towers with a 20 by 40 foot cross section.) The same pattern was to be used at the Unit 1 mist eliminator inlet. However, one of the ports at the inlet could not be used because the distance from the port to some structural steel opposite the port was too short to permit insertion of the VDA probe. At the stack locations sampling was done at the points appropriate for a standard twelve-point traverse of a round duct (6.2, 22.1, and 42.6 inches for the 12-foot diameter flues at Milliken). The test plan called for sampling in the stack at these depths for each of four ports at 90 degrees around each flue. In fact, there were only three ports on each stack, so measurements there were made at only nine of the planned twelve points.

TEST PROCEDURE

Four modifications were made to the test plan after arrival at the plant. The first modification was to adjust sampling duration at each traverse point. These adjustments were made to facilitate the expeditious completion of each test while still measuring a statistically significant number of droplets. The second modification was the omission of the port that was rendered inaccessible by the structural steel at the ME inlet. The third modification was the use of only three ports at the stack locations as a result of the planned fourth port not having been present. Finally, the high load test at the Unit 2 ME outlet was scheduled to be performed on the afternoon of September 31. Unfortunately, while preparing to perform this test the electronic micro-manometer needed for measuring the gas velocities above the mist eliminator was found to have failed. Consequently that test was rescheduled for the end of the test program to follow the low load testing at the Unit 2 ME outlet. Velocity measurements at the crossover test conditions and at the stack did not require the micro-manometer and deferring the first test allowed time for a replacement to be sent while other tests were in progress. None of these changes in the test strategy made the measurements less representative in any significant way.

The VDA system calibrations were checked, adjusted if needed, and verified prior to the start of its use each day and were then rechecked to verify continued proper operation and calibration at the end of each day of measurement. The results of the calibration verifications were satisfactory in all cases.

A minimum of 10 minutes of warm-up time was allowed after the VDA probe was initially inserted into the duct to allow it to equilibrate at the flue gas temperature before starting to take data. A shorter time was allowed for equilibration after port moves unless the move took a relatively long time, as most moves could be completed before the probe had time to cool appreciably. The traverse of each port began at the maximum insertion depth and continued sequentially with the probe being withdrawn as required until the measurements nearest the duct wall had been done. Three consecutive sets of measurements, each of equal duration, were taken at each traverse point during each traverse.

RESULTS AND DISCUSSION

A velocity traverse was made on each duct or flue either immediately before or after making the droplet concentration traverse on it. Complete results for each of the velocity traverses are provided in Appendix C of this report. Because the whole of the sampling plane could not be measured during any of the traverses, cross-checks on how well emissions over the area sampled might represent the overall cross sections were desired. Two checks were used. First, total gas flows were calculated based on averages of the velocities measured over the sampling area. These were then compared to gas flows recorded by the plant's CEM systems. The results, included in Table 1, showed excellent agreement for the most part, although the flows extrapolated from the traverses were slightly high in some cases. Secondly, emission rates of droplets in the stack flues were expected to be comparable to, or greater than, those measured at the corresponding ME exit planes, as any droplets produced by condensate being stripped from the walls of the flues would add to the carryover from the mist eliminators. Such was found to be the case. Thus both checks confirmed that the traverses yielded data representative of the wholes of the flue gas streams.

The droplet data obtained in the stack for the Unit 2 scrubber system operating in crossover mode was obtained in only one of the three ports. The VDA system was set up and ready to begin the Unit 2 crossover stack test at about 3 p.m. on October 1. However, at the first attempt to insert the VDA probe we found that only the first couple of inches of the six-inch deep nipple had the needed open diameter. The inner four inches had a 1/8 to 3/16 inch thick layer of the plastic (or resin) coating the inner circumference of the nipple, making the opening too small for the probe to pass through it. A check of the remaining ports on both flues revealed the same problem was present in all cases. By about 6 p.m. the plant had located someone to grind away the excess material and the process of enlarging the openings was underway. The first of the three ports on the Unit 2 flue was opened enough to be usable by about 9 p.m. and testing in that port was completed at 9:40 p.m. At 10 p.m. it was apparent that the second port would not be usable until midnight or later, at which time the NYSEG shift supervisor strongly suggested that testing cease for the night, saying that the crossover operation could be continued long enough to permit the remainder of the measurements at that condition the following morning. As things transpired, the condition could not be held long enough the following morning to permit additional testing at the crossover condition, so data at that condition was limited to what had been taken in the single port the previous night. The reported emission rate for this test was calculated by assuming that the average rate for the one port applied to the stack as a whole. No further difficulties were encountered during the remaining tests at the stack locations.

During the course of the testing in the stack it was observed that condensate on the walls of the flues appeared to be flowing down the walls at the low load and high load test conditions. However, the condensate appeared to be flowing *up* the walls at the crossover test condition. This upward flow was presumed to be the result of high shear forces from the 100+ foot-per-second gas velocities in the flues during crossover operation. If the condensate was being driven up the flues as it appeared to have been, the actual droplet emissions from the tops of the flues during crossover operation would have been significantly greater than the values measured at the sampling plane.

During the crossover testing at both the Unit 2 and Unit 1 ME outlet locations we noted that major spikes in the emission rates were associated with the ME washes. Figures 1 through 4 show graphs of the measured total concentration of liquid contained in droplets *versus* time through several of the tests. It is estimated that 65% to 90% of the droplet carryover measured at the mist eliminator outlets was directly related to the wash events under all test conditions. It should be noted that the concentration data shown in the figures exaggerates the effects of wash events because it gives equal weights to the volumes of water contained in droplets of all sizes. Many of the larger droplets that contribute a great deal to the measured *concentration* contribute in smaller proportions to *carryover* because of their relatively high settling velocities. (The transport rate is the product of concentration and velocity and the net velocities of larger droplets are lower than those of smaller ones.)

Variations in droplet emission rates were also observed during the testing at the stack, and may have been the result of washes as well. However, at the stack longer averaging times were used, which would reduce the amplitude of the variations in the recorded data. Also, the emissions measured at the stack would have come from less well-defined areas of the mist eliminators than those measured immediately above ME outlets. The combined temporal and spatial averaging at the stack as compared to the ME outlet negated the value of attempting to remove the effects of washes in the stack data.

Three major difficulties were experienced in the testing at the Unit 1 mist eliminator inlet. Measurements were made in the crossover operating mode on Saturday, October 5. As mentioned previously, access to one sampling port was blocked by the structural steel so sampling could be done through only three of the four ports. Secondly, attempts to make velocity measurements at the ME inlet on that date and on Monday, October 7 (when the remainder of the ME inlet tests were performed) were stymied by overwhelming amounts of water in the gas stream. In places the video from the VDA gave one the impression that it was located under a waterfall and, in a sense, it may well have been. If the sketch of the layout that was provided us after the test is accurate, the line along which the traverses were made for each of the inlet ports was located directly under a valley in the primary entrainment separator, from which large amounts of water may have been draining. On two occasions when attempting to make measurements at a particularly bad location in this regard, the VDA probe had to be removed so that the windows and shrouds could be drained and cleaned because of virtually immediate "flooding" of one of the shrouds and windows. Further difficulties were created by the mist eliminator wash sprays, which produced droplets with enough horizontal velocity that the VDA shrouds and purge air were unable to keep them from reaching the illuminator and camera windows. This made frequent removal of the probe to clean the windows necessary and severely limited the amount of data that could be collected each time the probe was inserted. Discussions were held with the plant operating personnel regarding turning the wash systems off for long enough periods to traverse each port, but the operators on duty at the time lacked the authority to do so. As a consequence, the number of traverse points actually used during the inlet crossover test was less than called for by the test plan. However, data were obtained at enough locations that the resulting carryup rate is believed to be reasonably accurate barring errors for one additional complication.

ME outlet carryover and inlet carryup rates are calculated under the assumption that the net vertical velocity of a droplet is the difference between the local gas velocity and the settling velocity of the droplet. Although this can be expected to be true for droplets carried up from the absorber, it is clearly not the case for droplets produced by the wash sprays. The latter are ejected from the spray nozzles with much higher velocities than the local gas velocity and have too short a distance to travel to slow appreciably. Thus, the wash spray droplets have velocities that are far greater than the calculated net velocities (the gas velocity less the settling velocity) used in the data analysis. As a consequence, the calculated carryup rate for the crossover test condition at the inlet may significantly underestimate the true total rate at which liquid is conveyed to the ME because of the inability to properly account for the effect of the washes. On the other hand, the measured rates will include some part of the true rate from the washes and will thus be high when compared to the rates from the absorber sprays alone.

Only the inlet test under the crossover operating condition had the wash spray flooding problem. Arrangements were made to turn the wash sprays off during the traverses of each port when the other two ME inlet tests were conducted. With the wash sprays turned off, it was possible to make complete traverses through each of the three usable ports at the ME inlet for both the low-load and high-load test conditions. The calculated carryup rates for the ME inlet low-load and high-load tests thus represent the contribution from the absorber sprays but do not include the effects of washes. The inlet carryup rates were calculated using the velocities measured at the ME outlet at the corresponding points and test conditions because of problems experienced in trying to make velocity measurements at the inlet itself. How closely the ME inlet and outlet velocity distributions match is open to conjecture, but they are probably close enough to make the calculated carryup rates reasonably realistic.

ME efficiencies were calculated from the inlet carryup rates and ME carryover rates in two ways. First the two rates were compared directly. In this case, the contributions from the washes are included in the ME outlet rates but were not included in the inlet rates for the low-load and high-load test conditions and only partially accounted for in the crossover condition inlet results. In the second set of calculations the data from the periods in which the washes appeared to be contributing heavily to the carryover were dropped, allowing "wash off" outlet data to be compared to the inlet data. This results in calculated efficiencies that truly represent the fundamental performance of the mist eliminators for the low-load and high-load tests. However, because some part of the wash contribution was included in the inlet data for the crossover condition, the efficiencies in this manner for that condition are undoubtedly higher than the true value. The Unit 1 ME inlet data were taken to be representative of that for Unit 2 (for which inlet testing was not done) in the ME efficiency calculations for Unit 2.

The results of the individual VDA traverses are summarized in Figures 5 through 24 in terms of inlet carryup and outlet carryover rates by droplet size and size distributions on cumulative percentage by volume basis. Details of the results for each test are provided in tabular form in Tables 2 through 16.

CONCLUSIONS

The performances of both mist eliminators were comparable at the low-load and high-load test conditions. The Unit 1 ME performance was clearly superior at the crossover test condition. Further, the carryover from both mist eliminators was dominated by emissions resulting from ME washing. The rate at which liquid was collected by the stack drain systems was higher for Unit 1 than for Unit 2 for comparable test conditions in all cases and the stack drain system collection rates were greater for either unit at low-load as compared to high-load or crossover mode operation. For either flue, the stack drain collection rates for high-load and crossover mode operation were comparable.

Table 1. Summary of Results from Milliken Droplet Testing, 10/01/96 - 10/09/96

Date	Unit	Test Location	Test Condition	Gas Flow from Traverse, kdscfm	Gas Flow from Plant kscfm	Stack Drain Rate, gpm	VDA Droplet Rate, gpm	Mass Median Diameter, µm	ME Eff. with Washes %	VDA Rate w/o Washes, gpm	ME Eff. w/o Washes %
10/1	2	ME Outlet	Crossover	514	514	0.56	3.1	600	99.21	0.574	99.85
	2	Stack	Crossover	520	509	0.54	4.0	490			
10/2	2	Stack	Low Load	275	270	1.16	0.06	300			
	2	Stack	High Load	310	306	0.91	0.58	670			
10/3	1	Stack	Low Load	314	308	0.77	0.32	850			
	1	Stack	High Load	374	355	NA	0.43	650			
10/4	1	Stack	Crossover	556	517	NA	0.16	600	99.952	0.017	99.9956
	1	ME Outlet	Crossover	552	523	0.10	0.19	690			
10/5	1	ME Inlet	Crossover	(washes on)		NA	385	880			
10/7	1	ME Inlet	Low Load	(washes off)		NA	32	520			
	1	ME Inlet	High Load	(washes off)		NA	74	600			
10/8	1	ME Outlet	Low Load	312	290	0.30	0.018	230	99.944	0.0027	99.9915
	1	ME Outlet	High Load	356	348	0.10	0.057	230	99.923	0.0060	99.9919
10/9	2	ME Outlet	Low Load	287	290	1.27	0.015	410	99.953	0.0045	99.986
	2	ME Outlet	High Load	325	325	0.53	0.015	400	99.979	0.0052	99.9930

Figure 1. Unit 2 ME Out Crossover Test

Concentration vs. Time

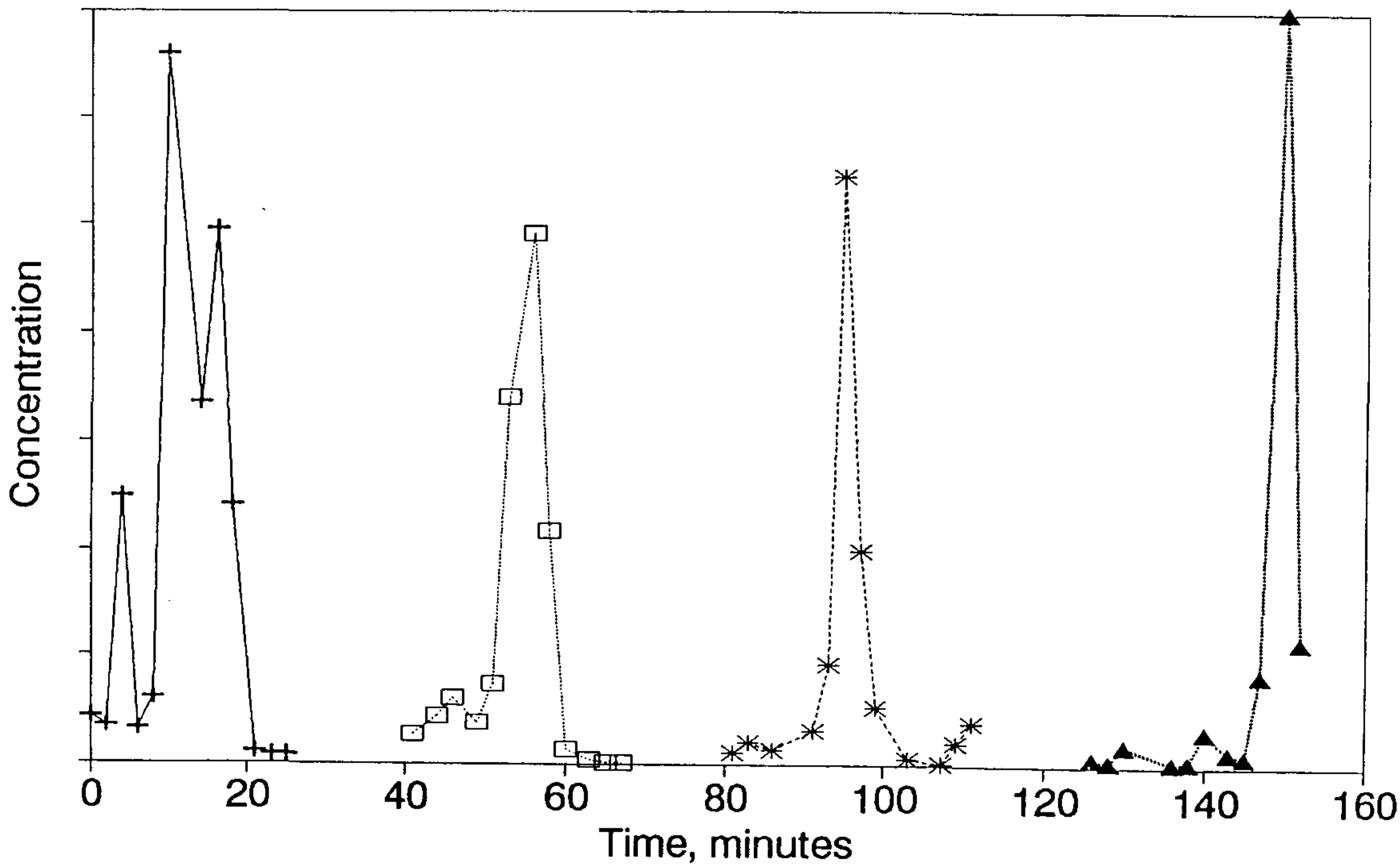

Figure 2. Unit 2 ME Outlet Tests
Concentration vs. Time

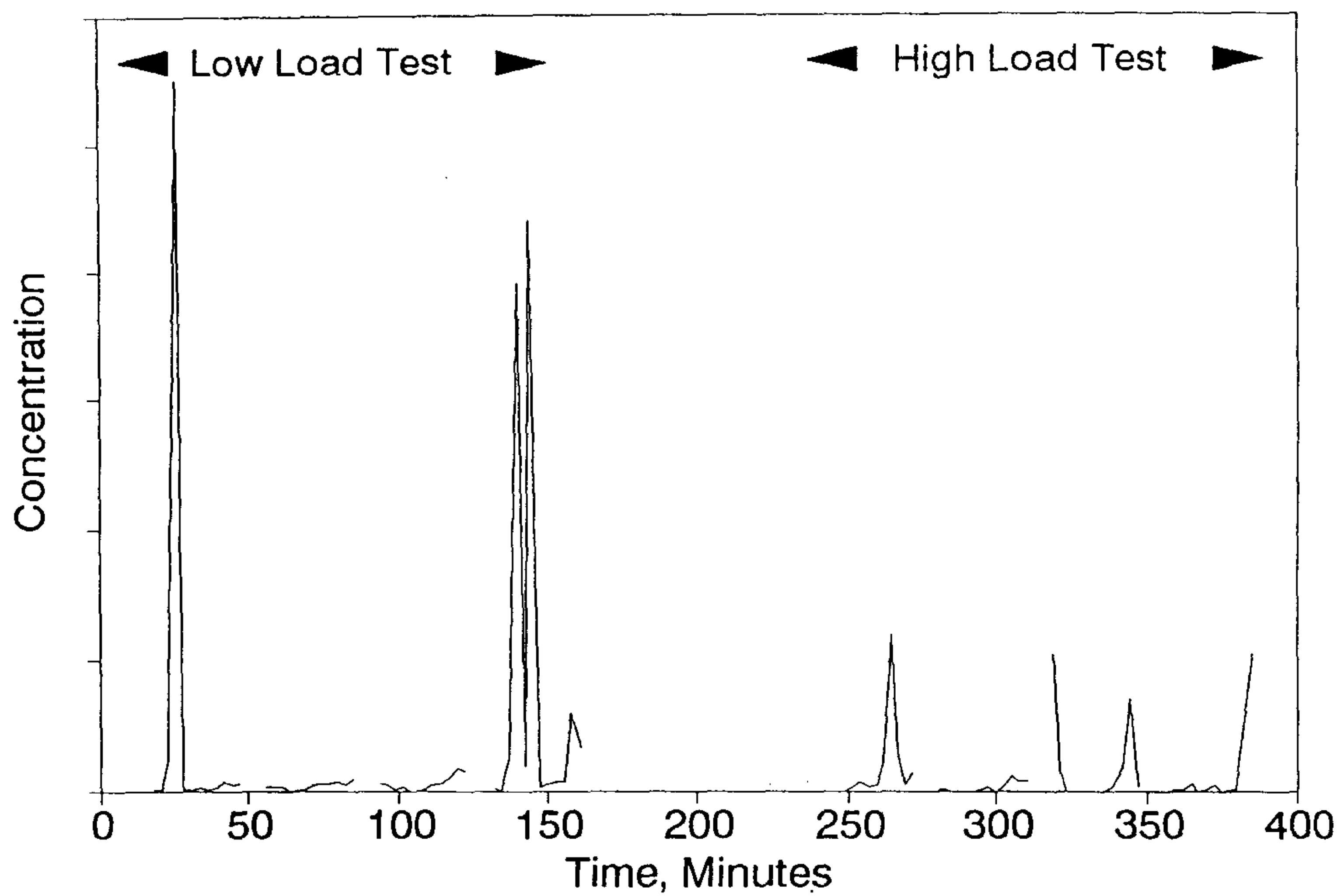

Figure 3. Unit 1 ME Outlet Tests

Concentration vs. Time

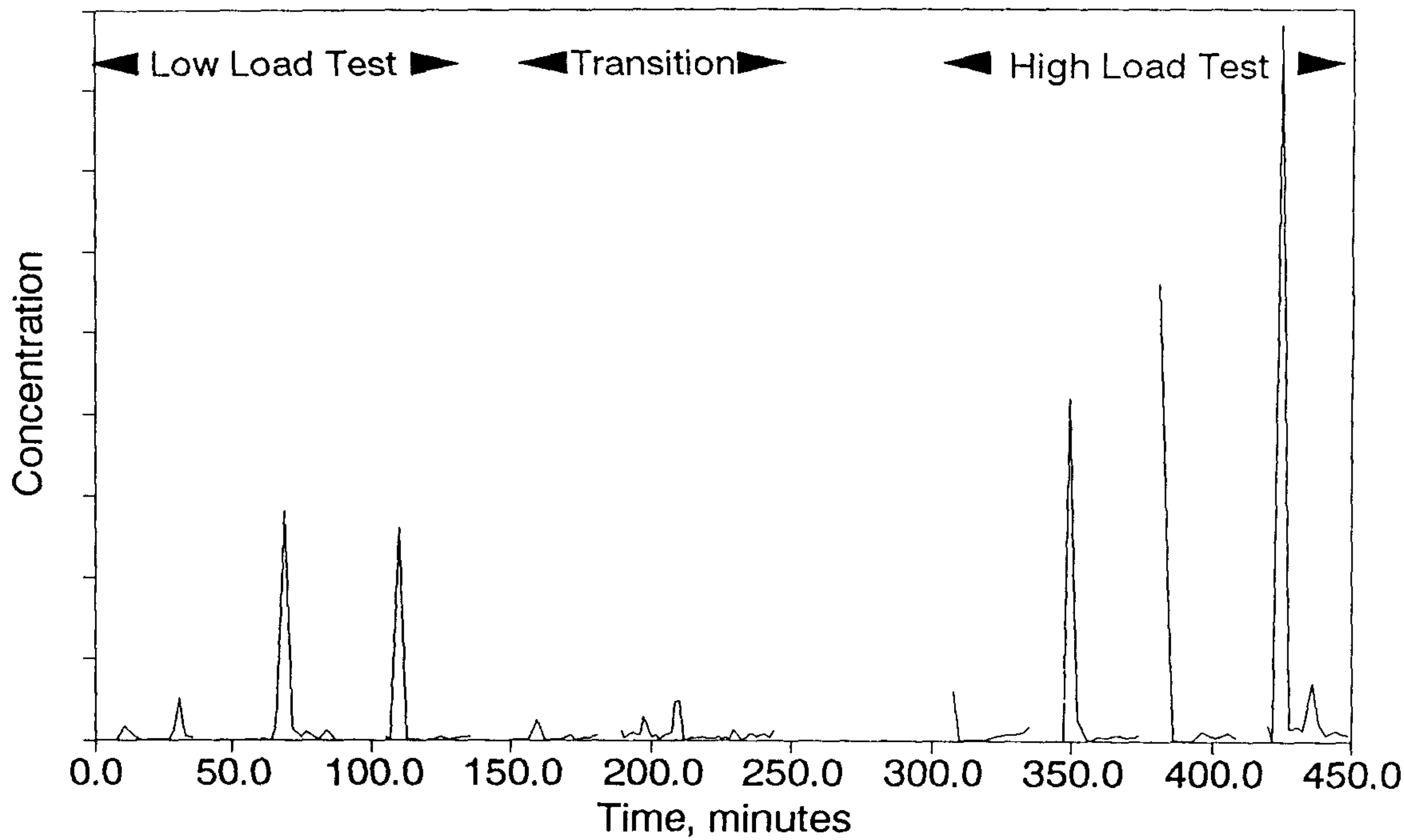

Figure 4. Unit 2 Stack at Low Load

Concentration vs. Time

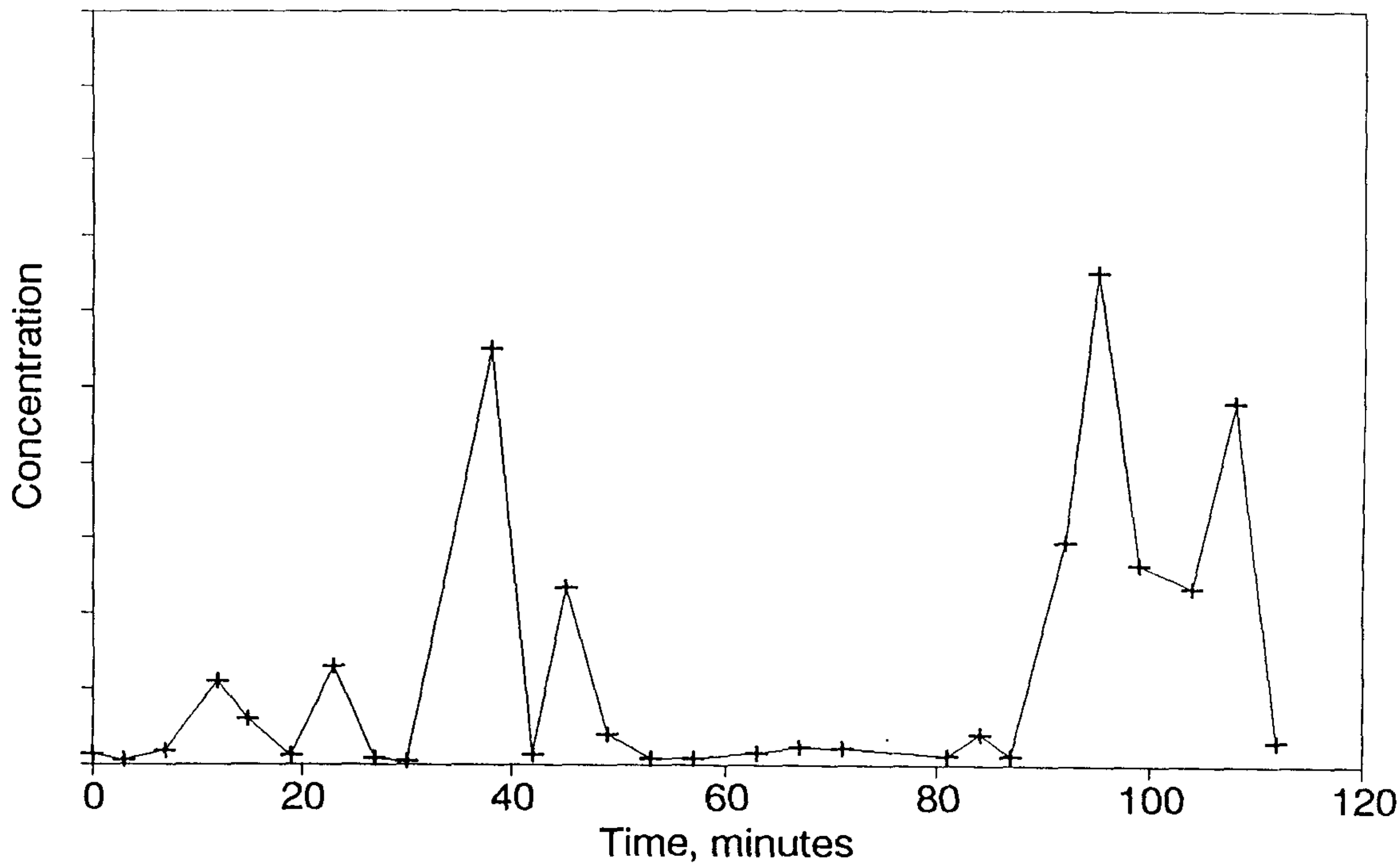

Figure 5. Unit 1 ME Inlet Low Load Test
Carryup vs. Drop Size and Depth in Duct

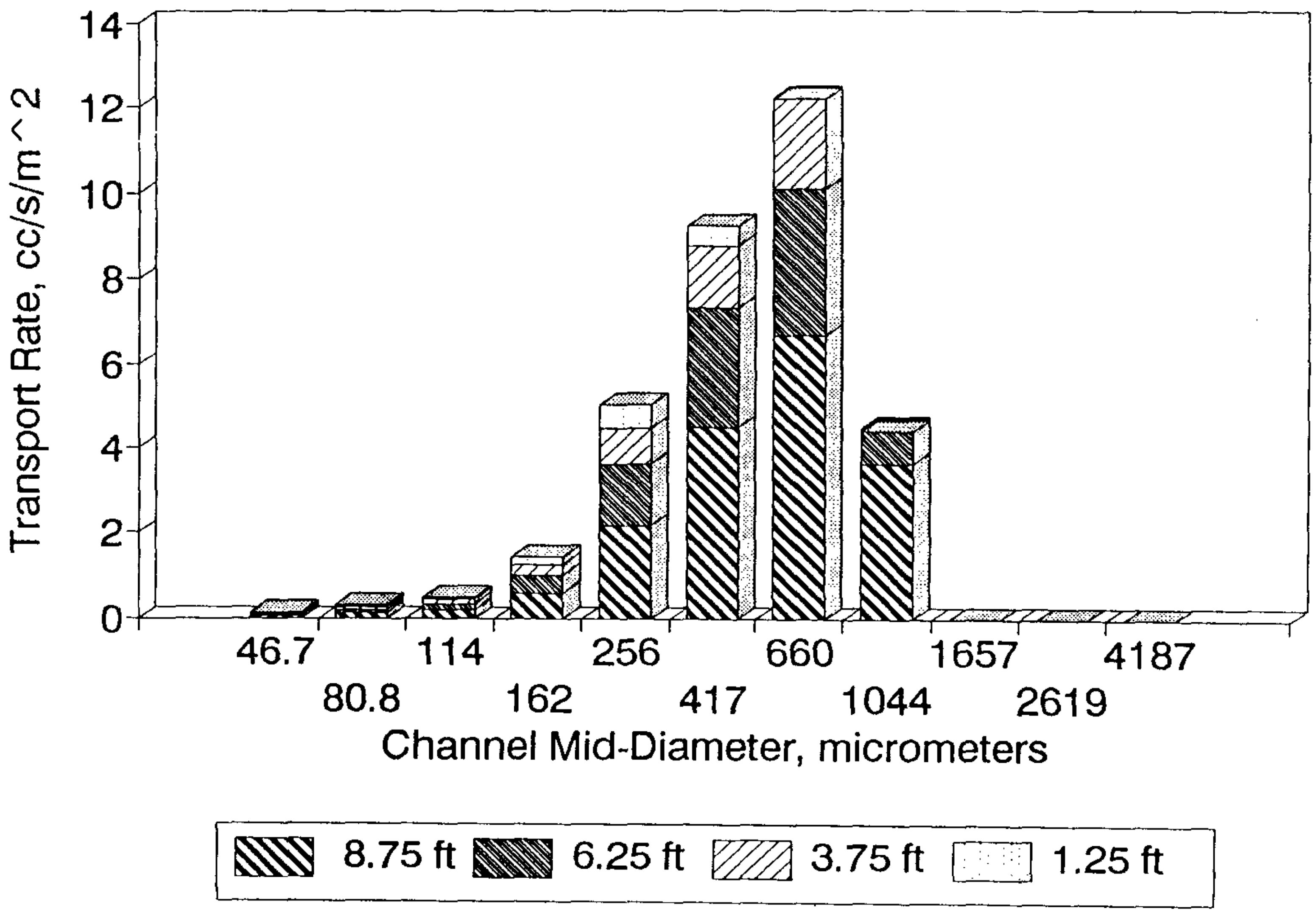

Figure 6. Unit 1 ME Inlet at High Load
Carryup Rate vs. Drop Size and Depth

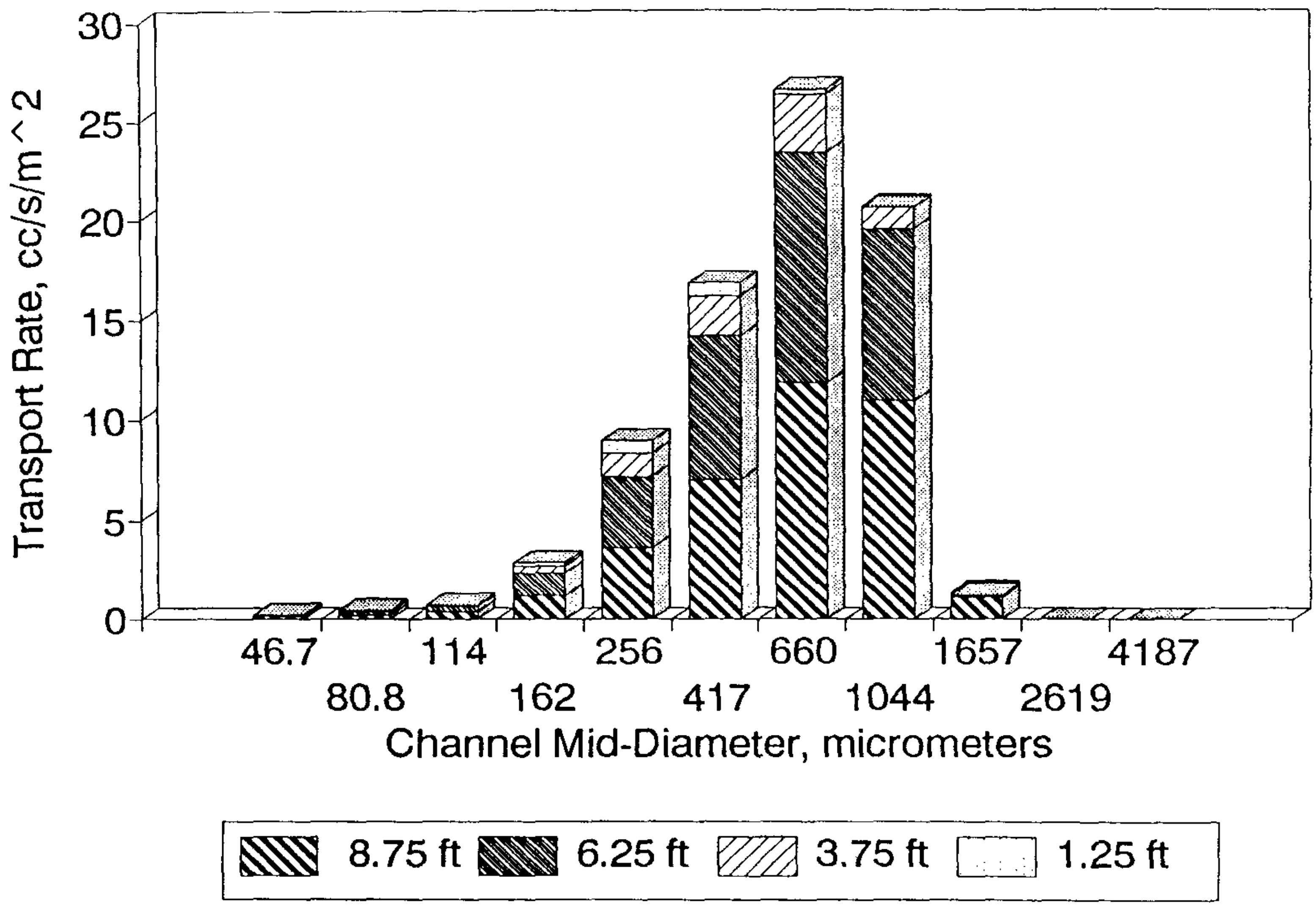

Figure 7. Unit 1 ME Inlet at Crossover
Carryup Rate vs. Drop Size and Depth

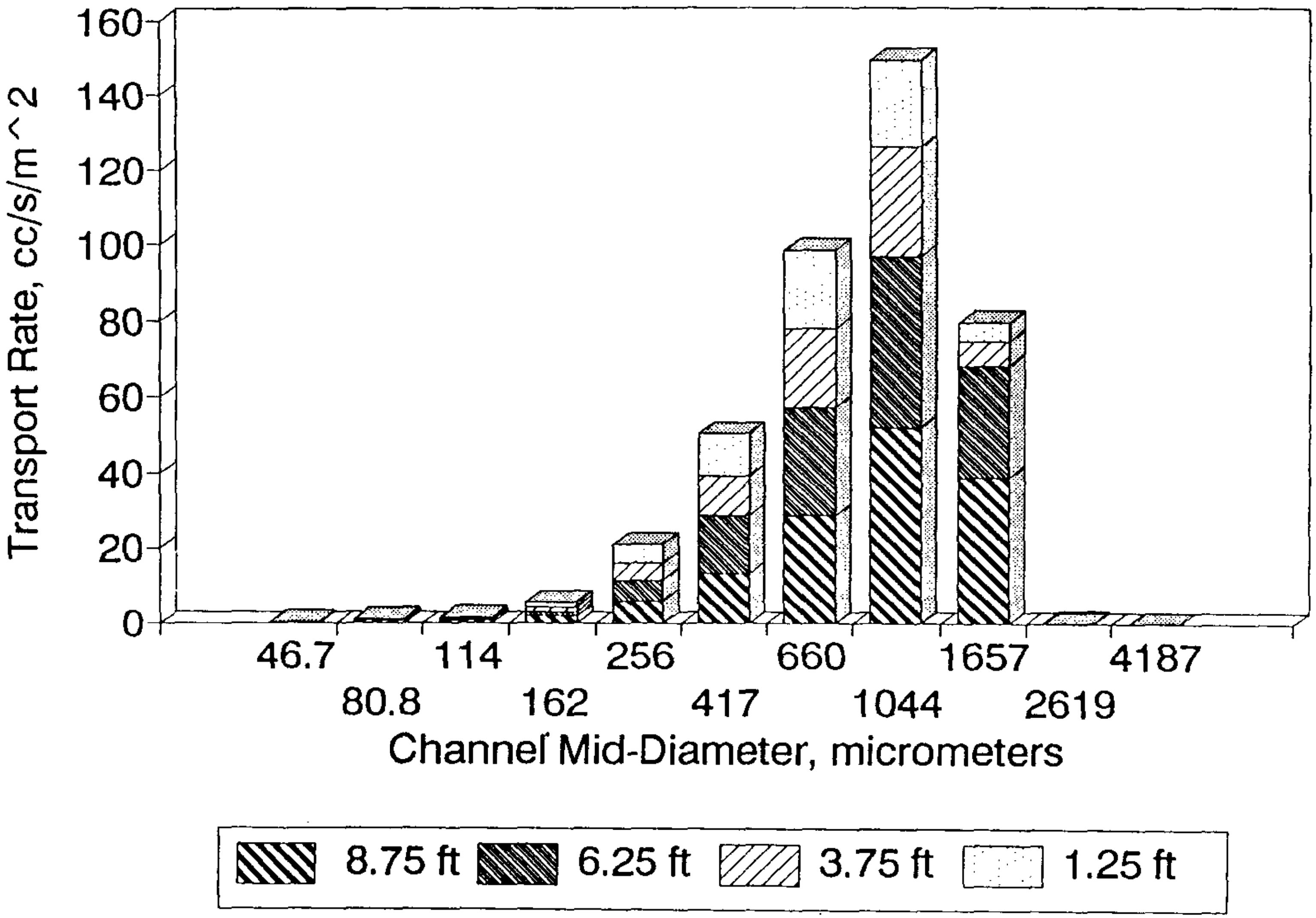

Figure 8. Unit 1 ME Outlet at Low Load
Carryover Rate vs. Drop Size and Depth

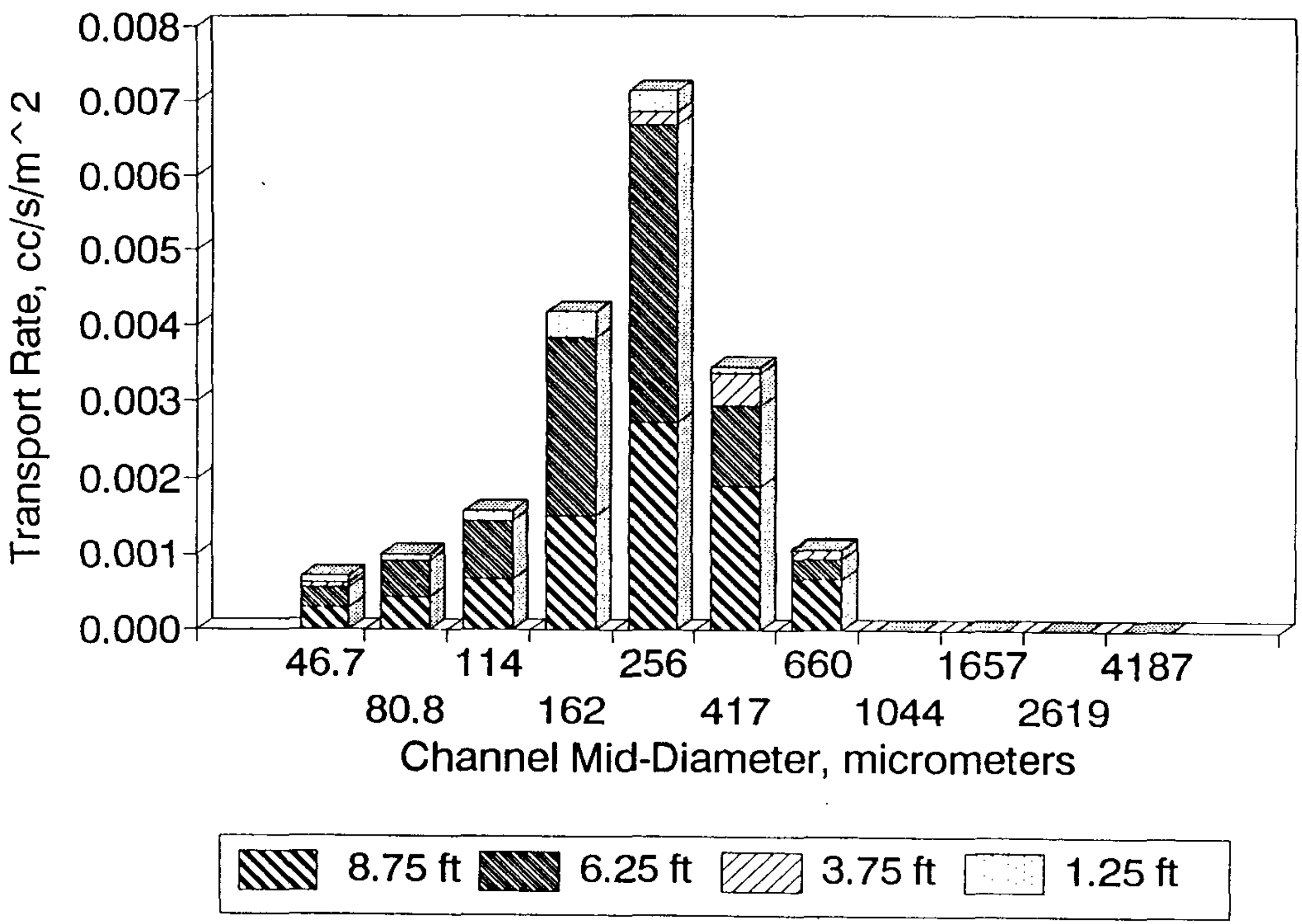

Figure 9. Unit 1 ME Outlet at High Load
Carryover Rate vs. Drop Size and Depth

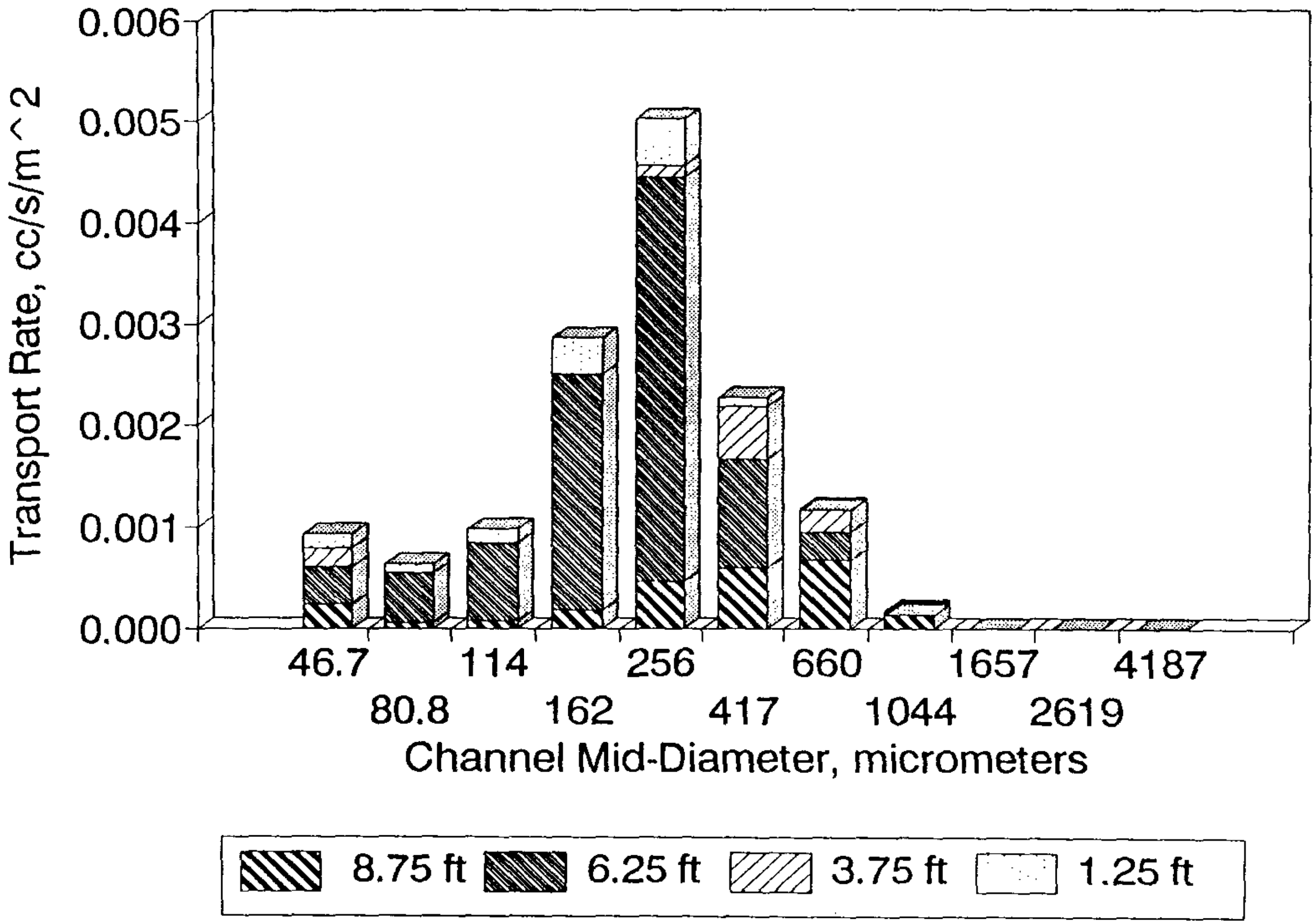

Figure 10. Unit 1 ME Out at Crossover
Carryover Rate vs. Drop Size and Depth

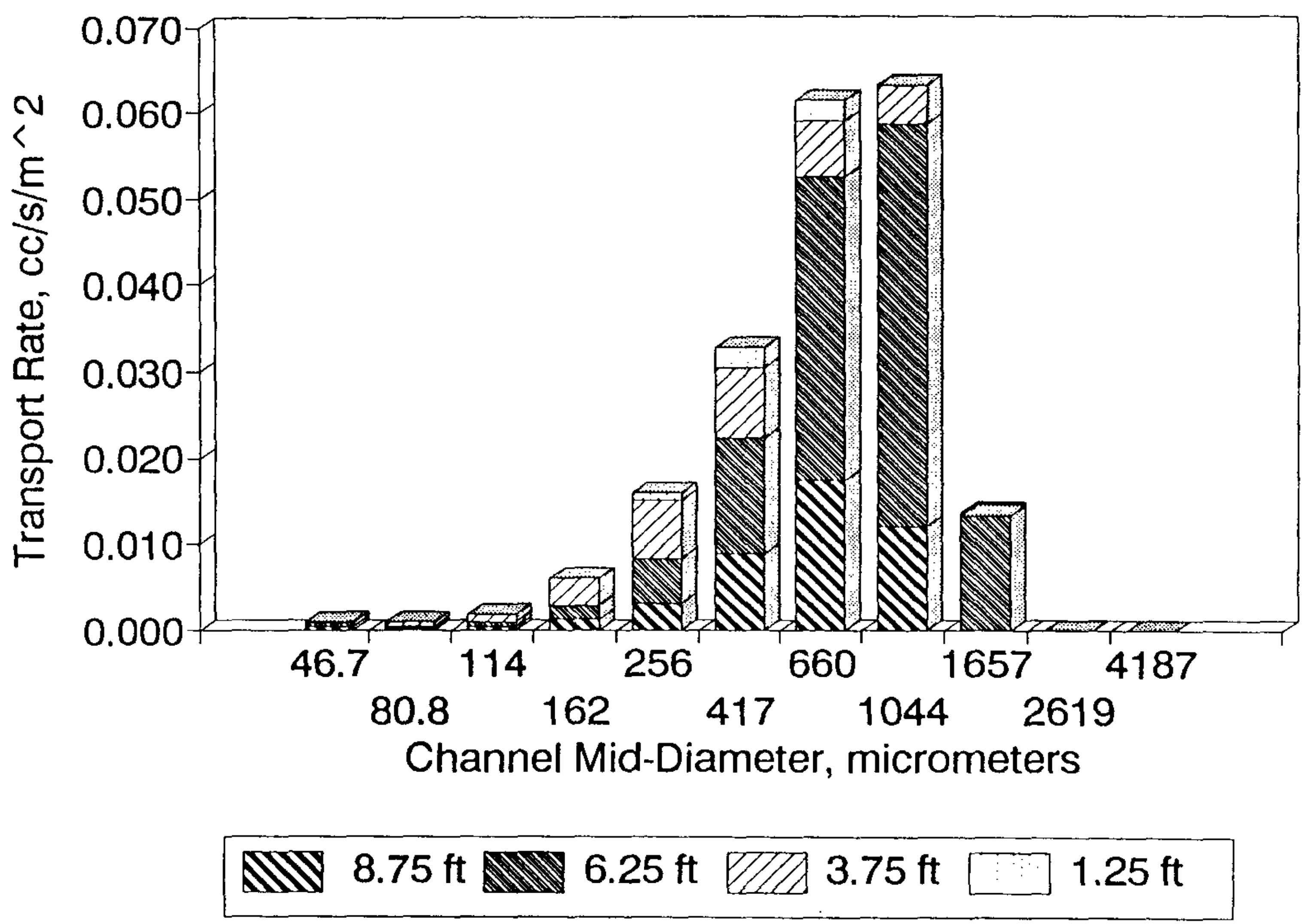

Figure 11. Unit 1 Stack at Low Load
Carryover Rate vs. Drop Size and Depth

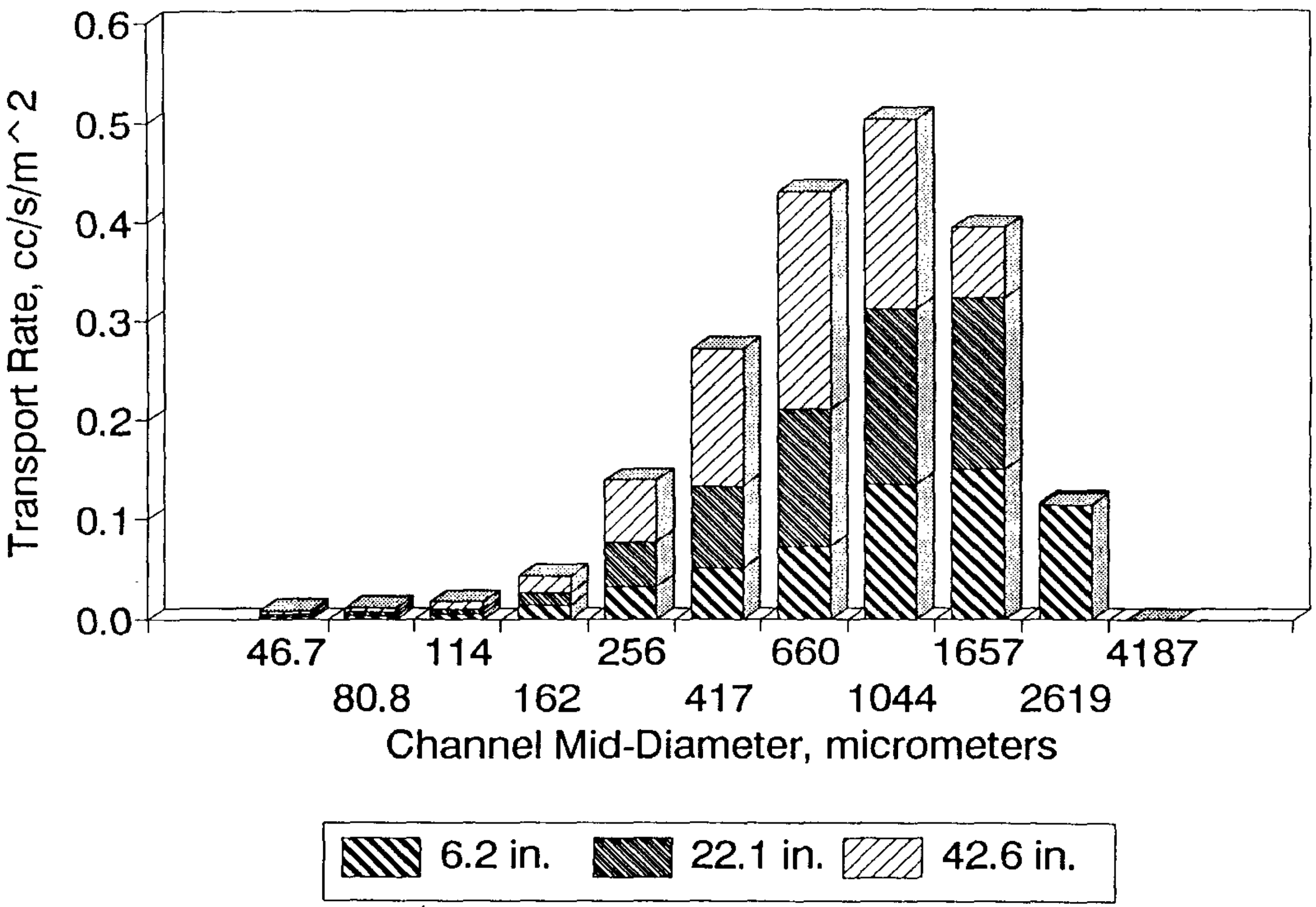

Figure 12. Unit 1 Stack at High Load
Carryover Rate vs. Drop Size and Depth

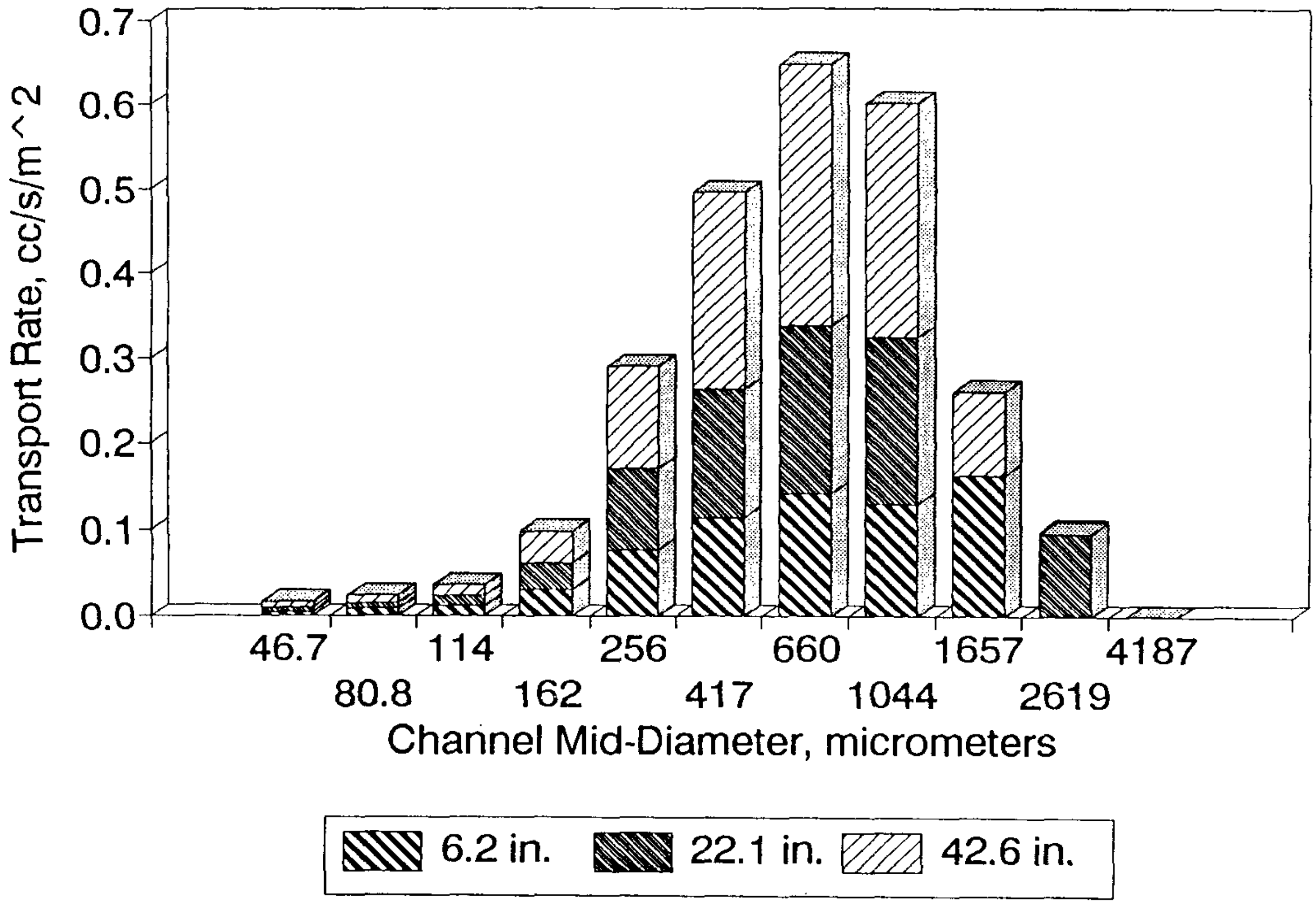

Figure 13. Unit 1 Stack at Crossover
Carryover Rate vs. Drop Size and Depth

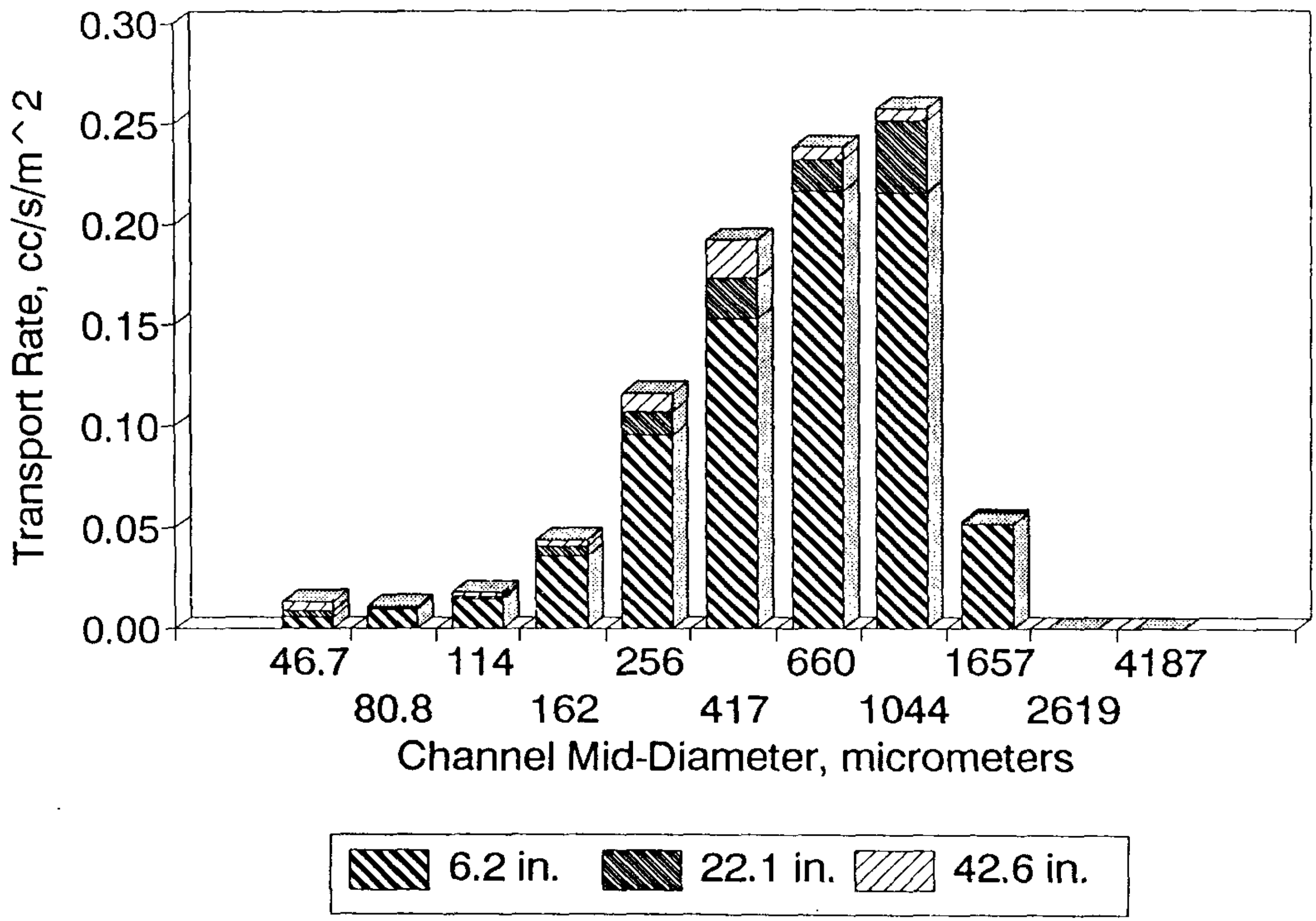

Figure 14. Unit 2 ME Outlet at Low Load
Carryover Rate vs. Drop Size and Depth

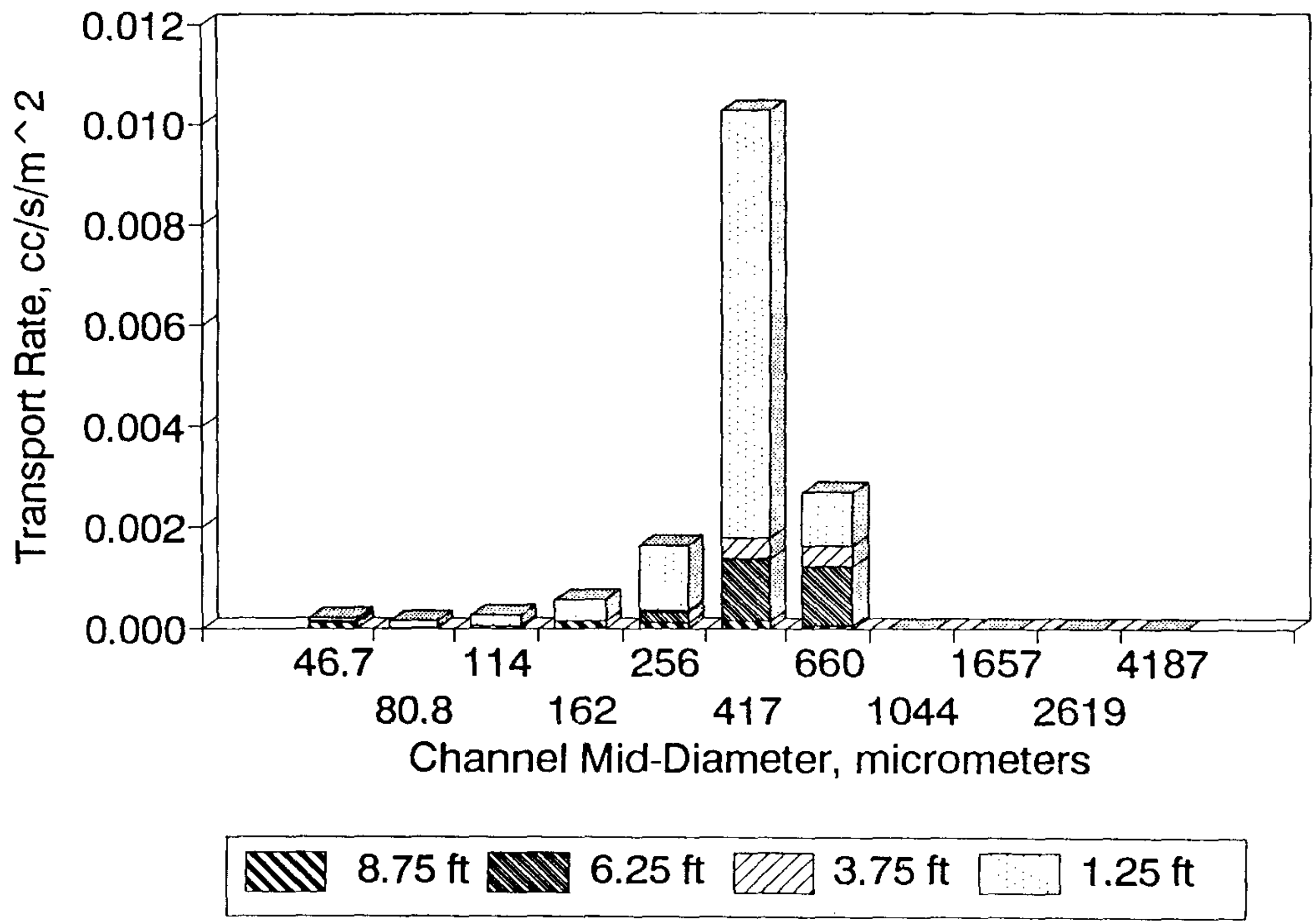

Figure 15. Unit 2 ME Out at High Load
Carryover Rate vs. Drop Size and Depth

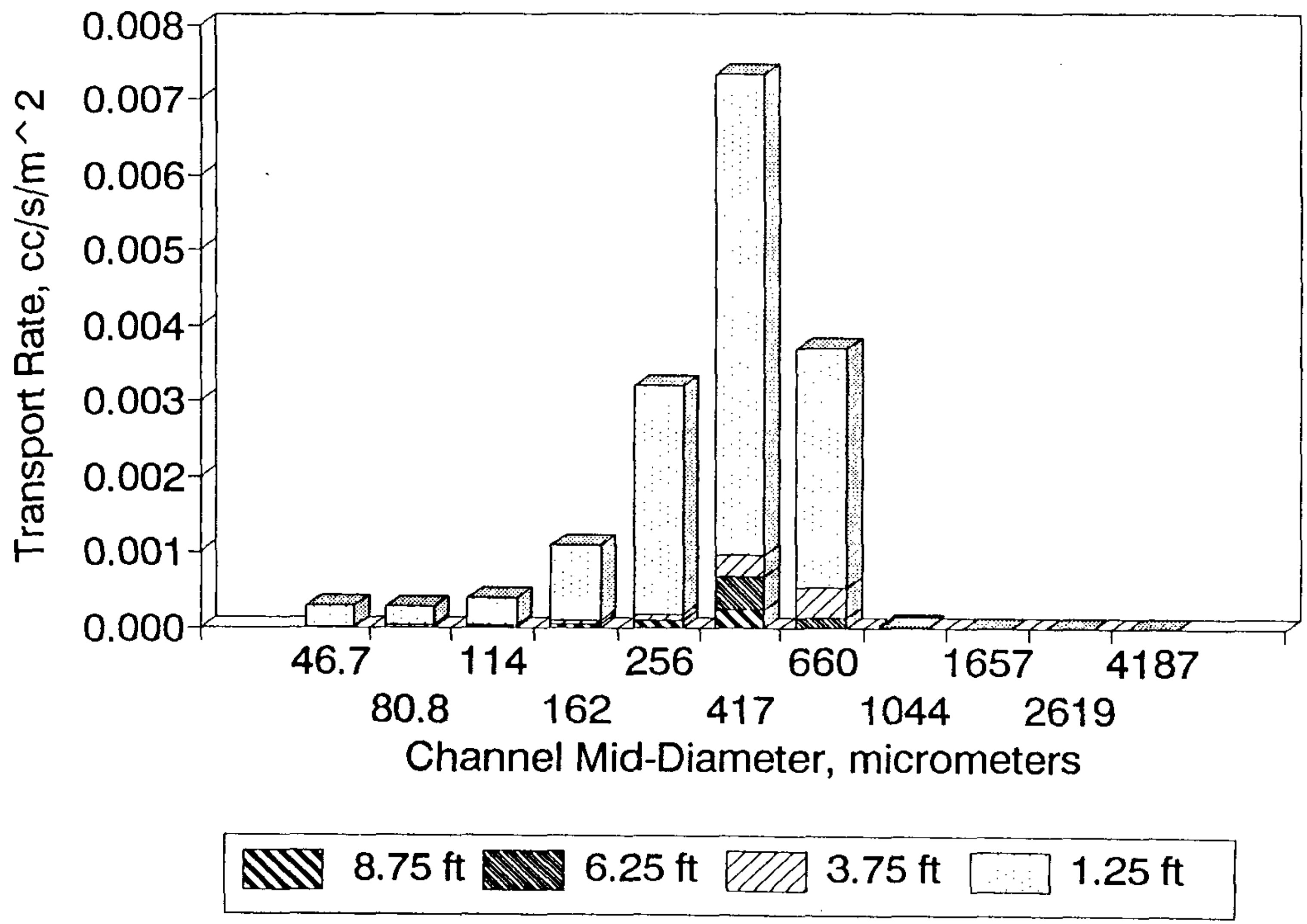

Figure 16. Unit 2 ME Out at Crossover
Carryover Rate vs. Drop Size and Depth

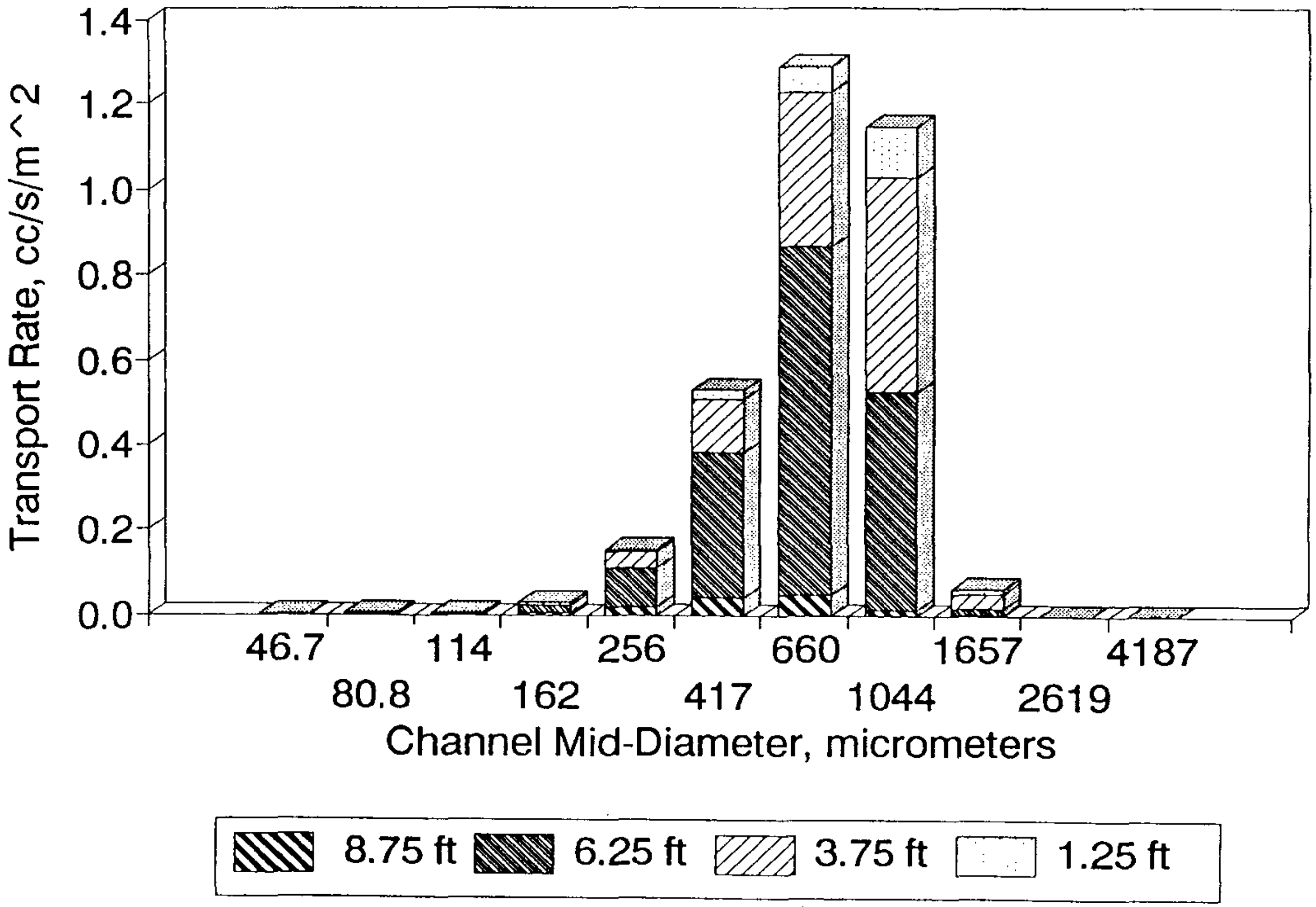

Figure 17. Unit 2 Stack at Low Load
Carryover Rate vs. Drop Size and Depth

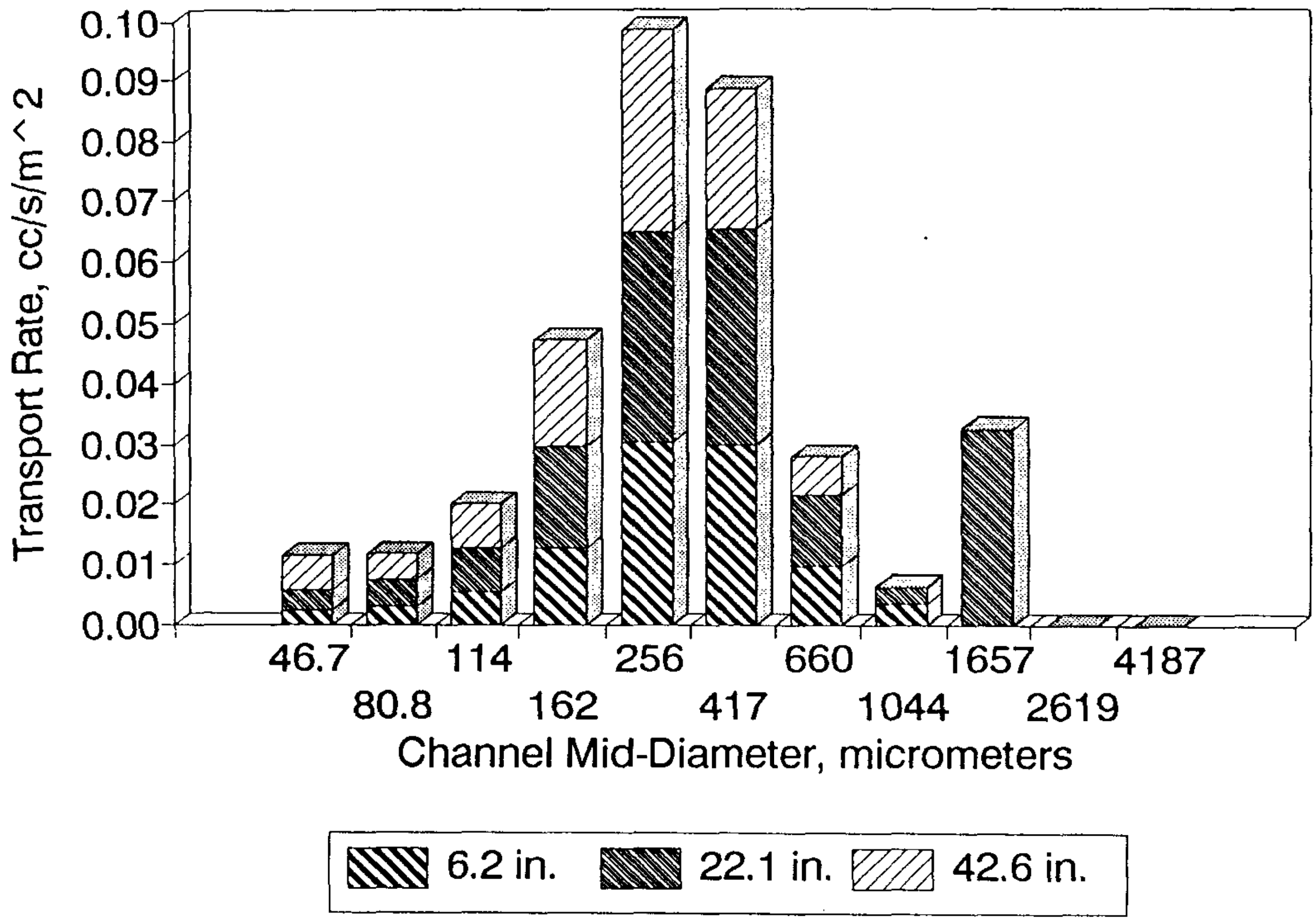

Figure 18. Unit 2 Stack at High Load
Carryover Rate vs. Drop Size and Depth

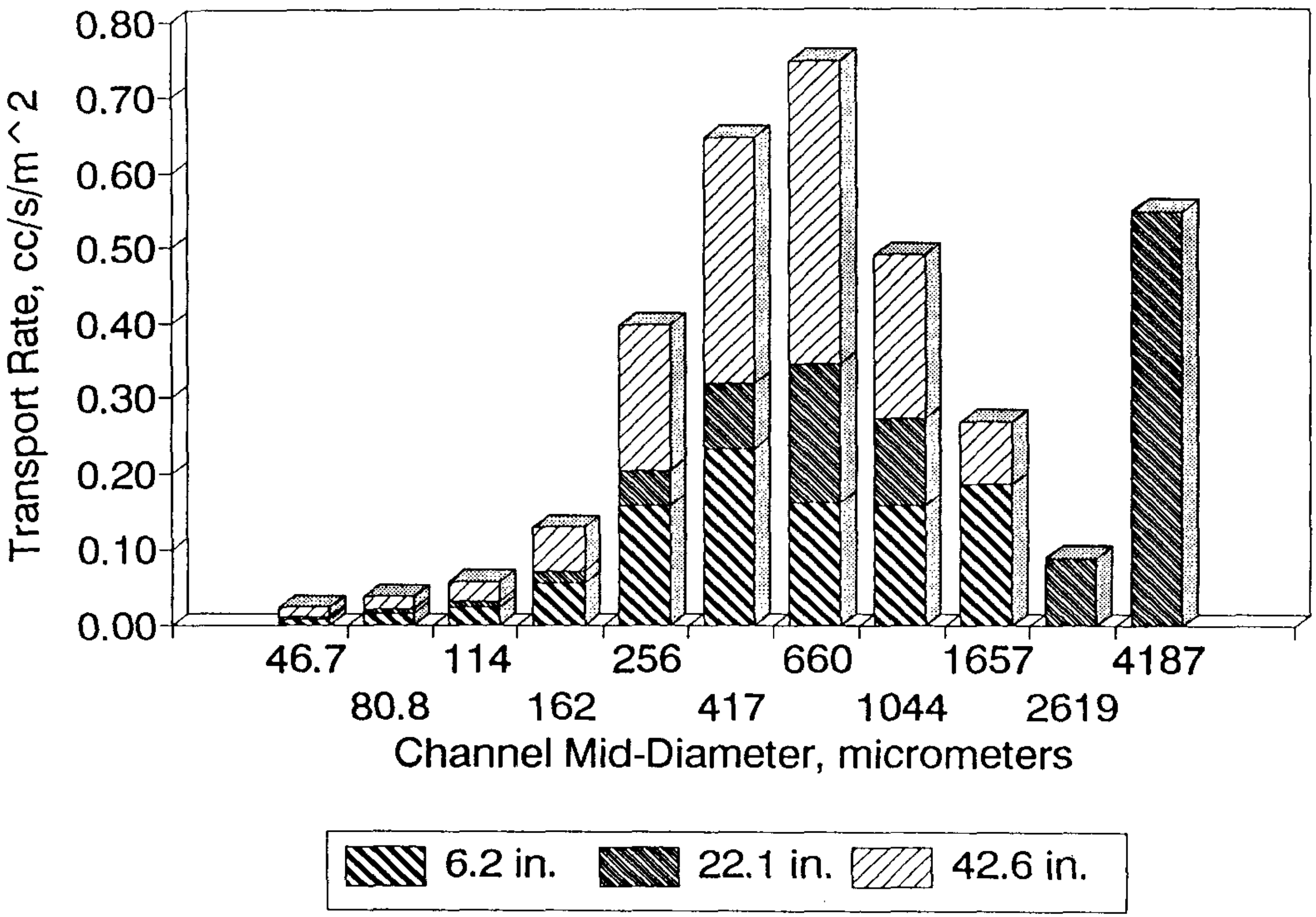

Figure 19. Unit 2 Stack at Crossover
Carryover Rate vs. Drop Size and Depth

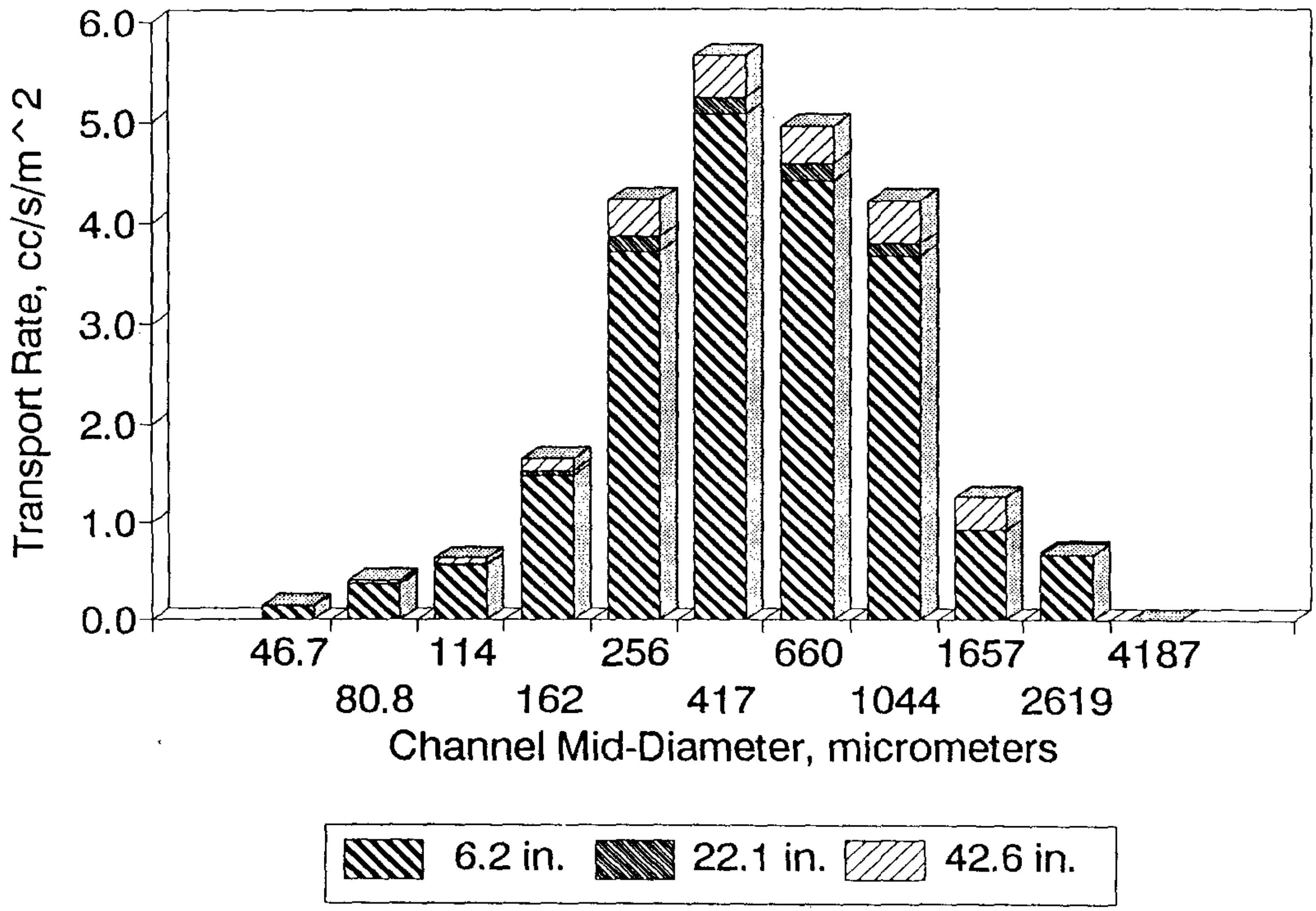

Figure 20. Unit 1 ME Inlet Tests
Cumulative Percent by Volume

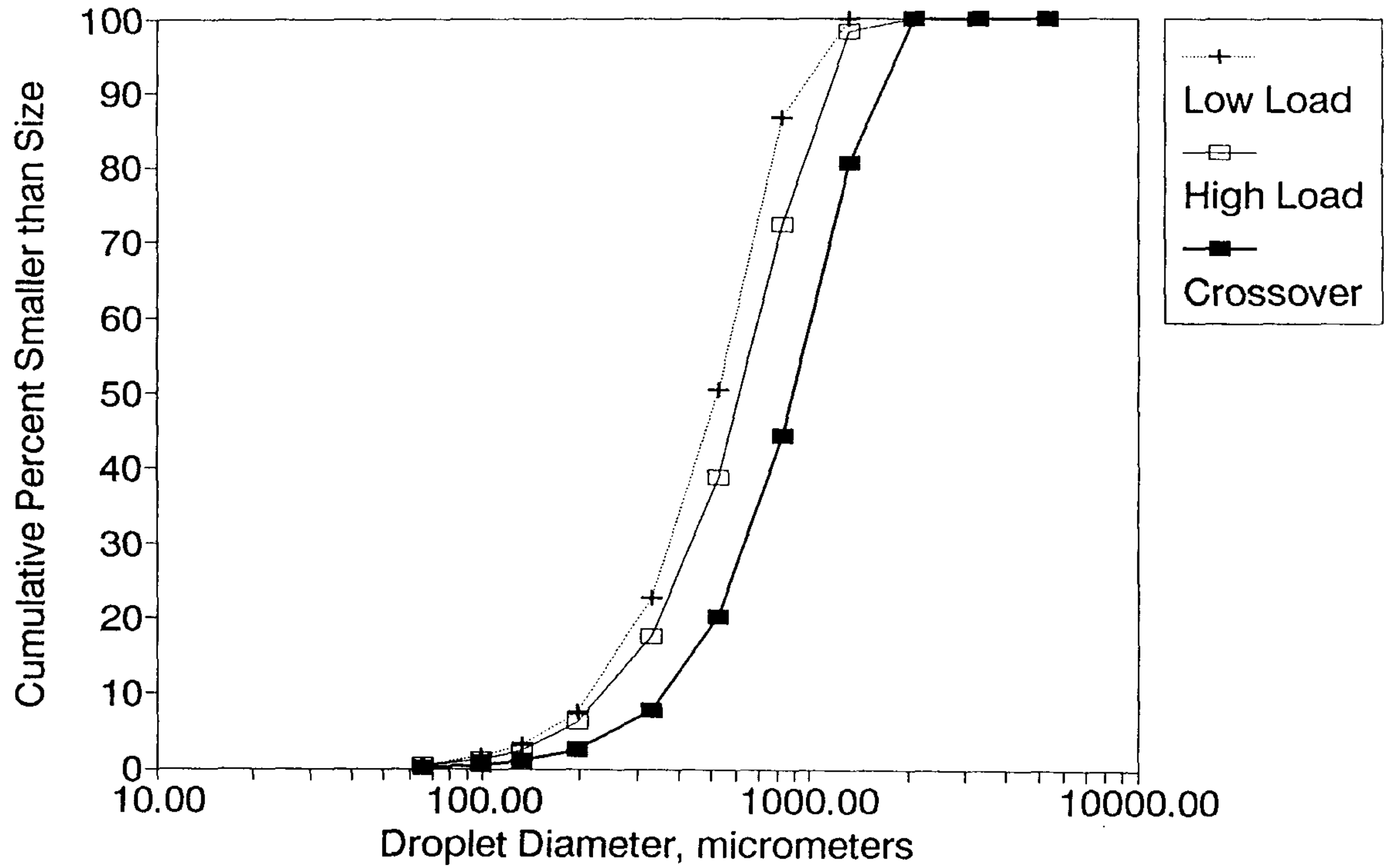

Figure 21. Unit 1 ME Outlet Tests
Cumulative Percent by Volume

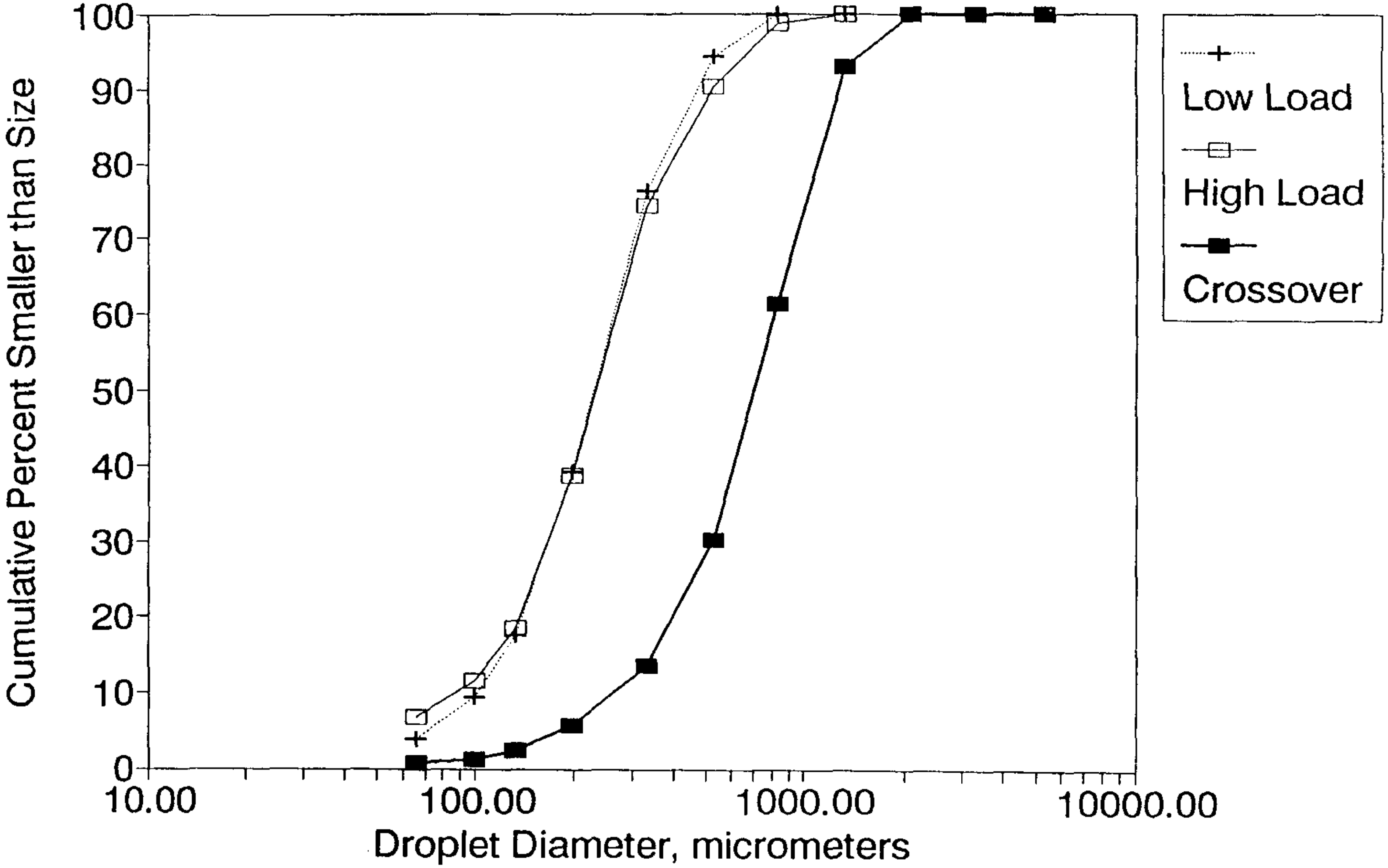

Figure 22. Unit 1 Stack Tests
Cumulative Percent by Volume

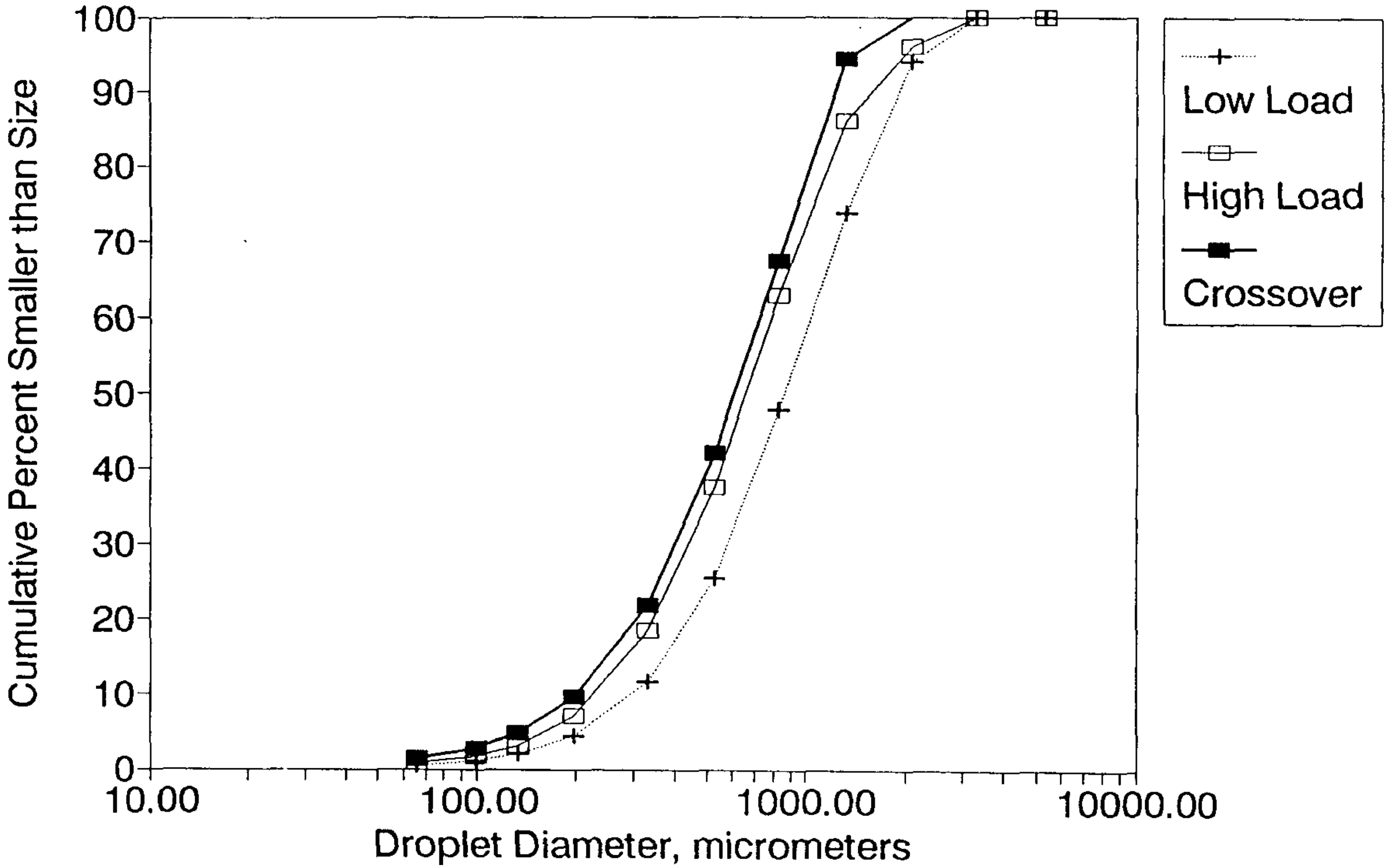

Figure 23. Unit 2 ME Outlet Tests
Cumulative Percent by Volume

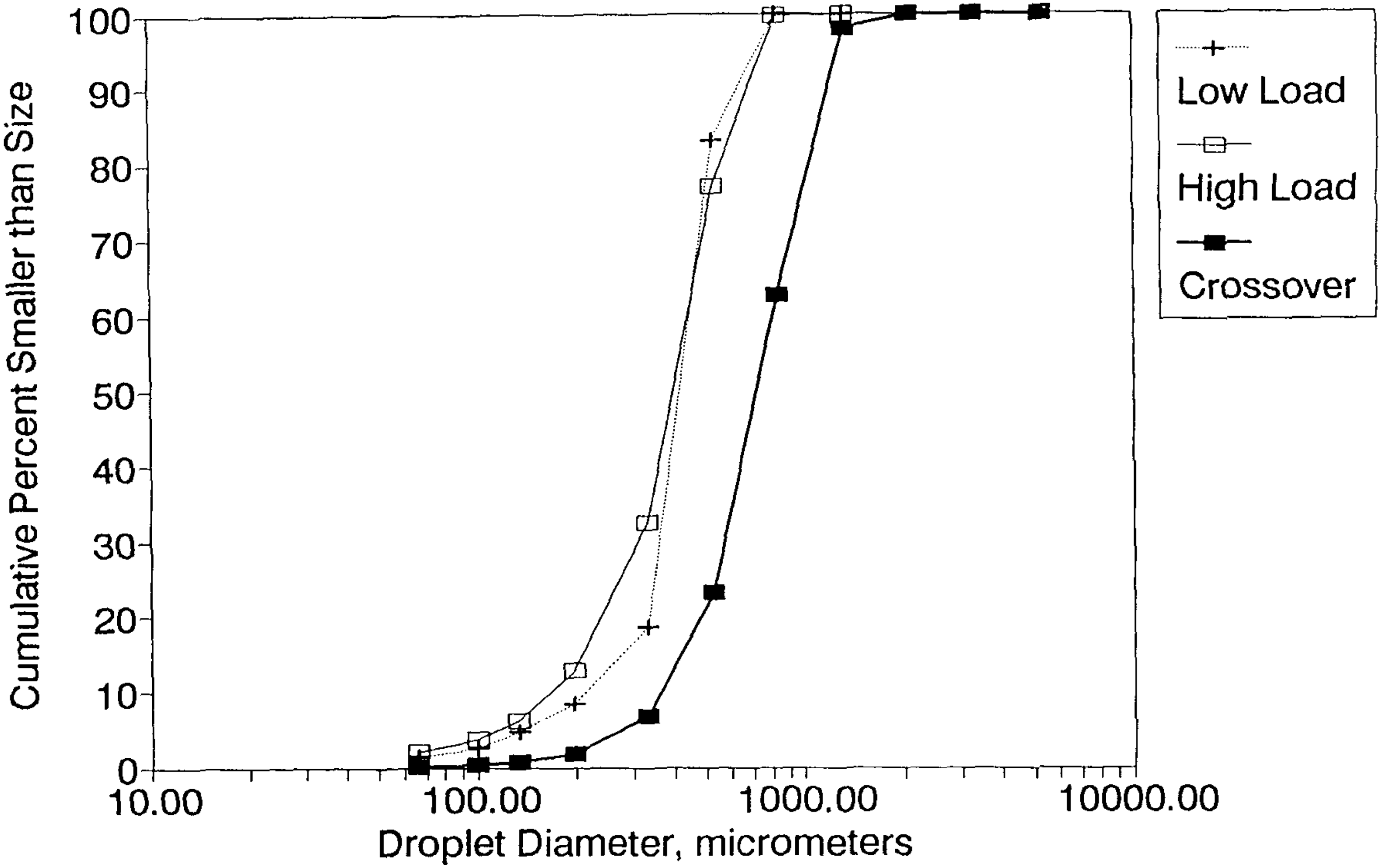

Figure 24. Unit 2 Stack Tests
Cumulative Percent by Volume

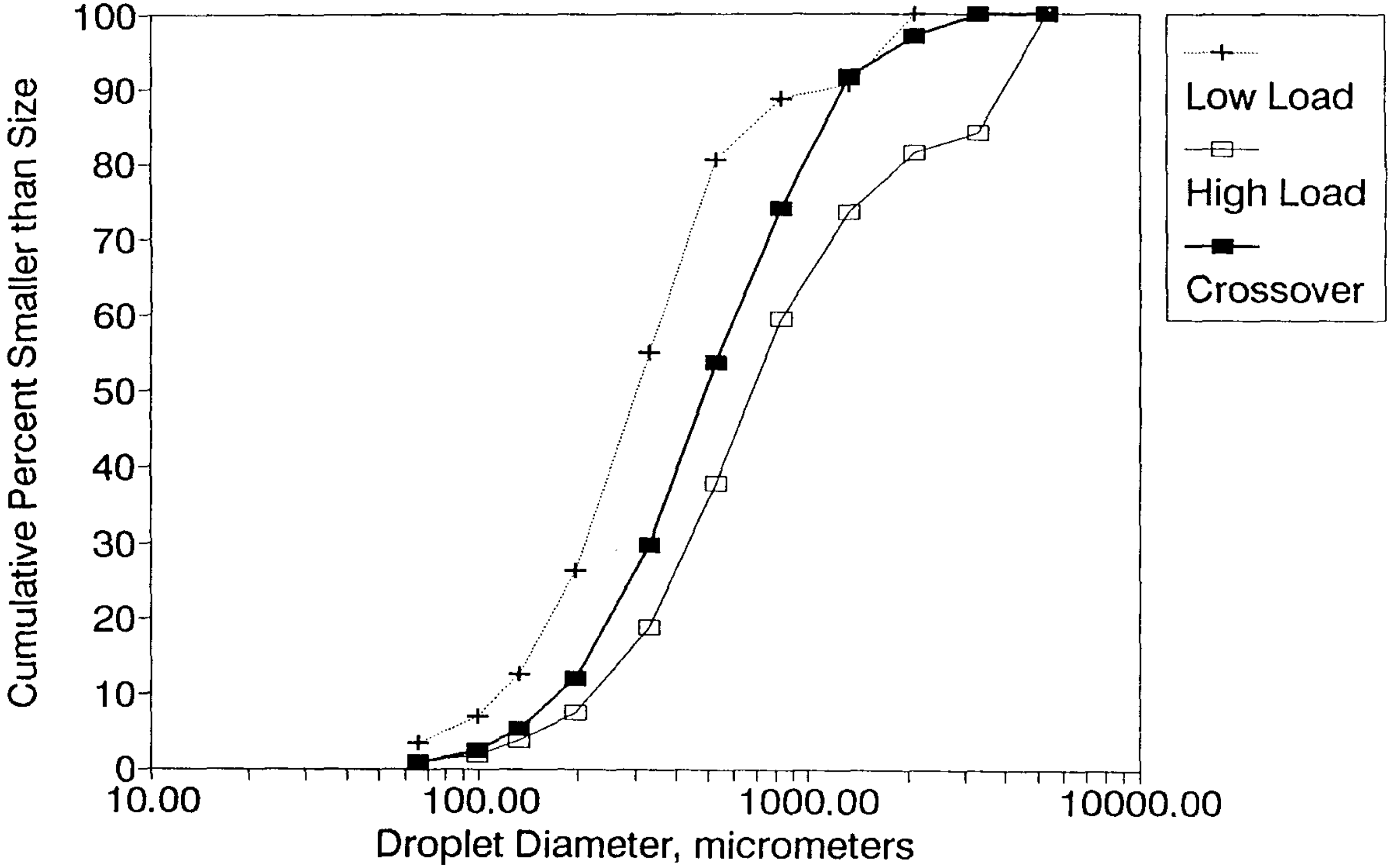

Table 2. Liquid Transport Rates by Droplet Size at Crossover Test Condition
October 1, 1996 Unit 2 ME Outlet Test

Distance n Wall ..et	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m ^ 2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
8.75	33	66	46.7	5.2E-03	3.1E-03	4.8E-04	9.3E-05	2.2E-03				
	66	99	80.8	1.2E-02	2.3E-03	9.2E-04	2.5E-04	3.8E-03				
	99	132	114	1.6E-02	3.7E-03	2.0E-03	3.0E-04	5.4E-03				
	132	198	162	5.5E-02	9.0E-03	5.7E-03	0.0E+00	1.8E-02				
	198	330	256	2.4E-01	4.4E-02	7.5E-03	1.4E-03	7.2E-02				
	330	528	417	4.9E-01	1.1E-01	2.4E-02	1.3E-02	1.6E-01				
	528	825	660	5.4E-01	1.6E-01	4.4E-02	9.6E-03	1.9E-01				
	825	1320	1044	1.2E-01	7.3E-02	8.4E-03	0.0E+00	4.9E-02				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	3.7E-03	9.3E-04				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	1.5E+00	4.1E-01	9.3E-02	2.9E-02	5.0E-01				
6.25	33	66	46.7	4.1E-04	7.2E-03	1.7E-02	1.1E-02	8.8E-03				
	66	99	80.8	1.2E-03	1.5E-02	3.4E-02	2.1E-02	1.8E-02				
	99	132	114	1.2E-03	2.4E-02	5.5E-02	3.1E-02	2.8E-02				
	132	198	162	4.0E-03	6.3E-02	1.7E-01	9.8E-02	8.3E-02				
	198	330	256	1.0E-02	3.0E-01	7.6E-01	4.3E-01	3.8E-01				
	330	528	417	4.6E-02	1.2E+00	2.7E+00	1.5E+00	1.4E+00				
	528	825	660	6.6E-02	3.0E+00	5.8E+00	4.3E+00	3.3E+00				
	825	1320	1044	9.3E-02	1.4E+00	4.3E+00	2.5E+00	2.1E+00				
	1320	2079	1657	0.0E+00	5.6E-02	1.7E-01	0.0E+00	5.7E-02				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	2.2E-01	6.1E+00	1.4E+01	8.9E+00	7.3E+00				
3.75	33	66	46.7	3.7E-04	6.1E-03	3.7E-03	4.0E-03	3.5E-03				
	66	99	80.8	1.0E-03	1.4E-02	8.2E-03	7.6E-03	7.6E-03				
	99	132	114	1.0E-03	1.7E-02	1.1E-02	1.1E-02	9.9E-03				
	132	198	162	3.5E-03	6.6E-02	3.0E-02	3.6E-02	3.4E-02				
	198	330	256	2.2E-02	3.0E-01	1.5E-01	1.7E-01	1.6E-01				
	330	528	417	6.7E-02	1.0E+00	4.2E-01	5.7E-01	5.2E-01				
	528	825	660	1.6E-01	3.3E+00	1.0E+00	1.3E+00	1.4E+00				
	825	1320	1044	1.8E-01	5.5E+00	1.3E+00	1.1E+00	2.0E+00				
	1320	2079	1657	6.0E-02	4.4E-01	1.2E-01	0.0E+00	1.5E-01				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	5.0E-01	1.1E+01	3.1E+00	3.2E+00	4.3E+00				
1.25	33	66	46.7	4.3E-04	6.8E-04	1.8E-03	6.8E-04	9.1E-04	3.9E-03	0.004	0.1	2.56E+08
	66	99	80.8	6.6E-04	8.3E-04	3.1E-03	1.7E-03	1.6E-03	7.7E-03	0.012	0.4	9.84E+07
	99	132	114	1.1E-03	2.0E-03	4.8E-03	2.3E-03	2.6E-03	1.1E-02	0.023	0.7	5.19E+07
	132	198	162	4.7E-03	3.8E-03	1.6E-02	5.9E-03	7.5E-03	3.6E-02	0.058	1.8	5.65E+07
	198	330	256	2.3E-02	2.1E-02	4.1E-02	2.0E-02	2.6E-02	1.6E-01	0.217	6.6	6.39E+07
	330	528	417	5.6E-02	6.6E-02	1.5E-01	9.6E-02	9.2E-02	5.4E-01	0.755	23.1	5.01E+07
	528	825	660	7.8E-02	1.4E-01	5.1E-01	2.6E-01	2.5E-01	1.3E+00	2.047	62.7	3.04E+07
	825	1320	1044	5.7E-02	1.6E-01	8.4E-01	8.8E-01	4.8E-01	1.2E+00	3.200	97.9	6.85E+06
	1320	2079	1657	0.0E+00	3.1E-02	1.5E-02	1.8E-01	5.6E-02	6.7E-02	3.267	*****	9.99E+04
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.267	*****	0.00E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.267	*****	0.00E+00
			Total:	2.2E-01	4.3E-01	1.6E+00	1.4E+00	9.1E-01	3.3E+00			

0.196 liters/min/m ^ 2

Flow Area 59.0 Sq. Meters

Net Rate: 11.56 liters per minute
3.056 gallons per minute

Table 3. Liquid Transport Rates by Droplet Size at Crossover Condition
October 1, 1996 Unit 2 Stack Test

...tance Wall ...ches	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m^2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
6.25	33	66	46.7			4.1E-01		4.1E-01				
	66	99	80.8			1.1E+00		1.1E+00				
	99	132	114			1.7E+00		1.7E+00				
	132	198	162			4.4E+00		4.4E+00				
	198	330	256			1.1E+01		1.1E+01				
	330	528	417			1.5E+01		1.5E+01				
	528	825	660			1.3E+01		1.3E+01				
	825	1320	1044			1.1E+01		1.1E+01				
	1320	2079	1657			2.8E+00		2.8E+00				
	2079	3300	2619			2.1E+00		2.1E+00				
	3300	5313	4187			0.0E+00		0.0E+00				
			Total:			6.3E+01		6.3E+01				
21.1	33	66	46.7			2.3E-02		2.3E-02				
	66	99	80.8			5.7E-02		5.7E-02				
	99	132	114			8.2E-02		8.2E-02				
	132	198	162			1.8E-01		1.8E-01				
	198	330	256			4.6E-01		4.6E-01				
	330	528	417			5.3E-01		5.3E-01				
	528	825	660			5.8E-01		5.8E-01				
	825	1320	1044			3.9E-01		3.9E-01				
	1320	2079	1657			0.0E+00		0.0E+00				
	2079	3300	2619			0.0E+00		0.0E+00				
	3300	5313	4187			0.0E+00		0.0E+00				
			Total:			2.3E+00		2.3E+00				
42.6	33	66	46.7			5.4E-02		5.4E-02				
	66	99	80.8			1.3E-01		1.3E-01				
	99	132	114			2.1E-01		2.1E-01				
	132	198	162			3.9E-01		3.9E-01				
	198	330	256			1.1E+00		1.1E+00				
	330	528	417			1.3E+00		1.3E+00				
	528	825	660			1.1E+00		1.1E+00				
	825	1320	1044			1.3E+00		1.3E+00				
	1320	2079	1657			1.0E+00		1.0E+00				
	2079	3300	2619			0.0E+00		0.0E+00				
	3300	5313	4187			0.0E+00		0.0E+00				
			Total:			6.6E+00		6.6E+00				
NA	33	66	46.7			NA		NA	1.6E-01	0.161	0.7	1.90E+09
	66	99	80.8			NA		NA	4.2E-01	0.578	2.4	9.52E+08
	99	132	114			NA		NA	6.5E-01	1.229	5.1	5.30E+08
	132	198	162			NA		NA	1.7E+00	2.895	12.1	4.72E+08
	198	330	256			NA		NA	4.2E+00	7.120	29.8	3.03E+08
	330	528	417			NA		NA	5.7E+00	12.785	53.4	9.41E+07
	528	825	660			NA		NA	5.0E+00	17.748	74.2	2.08E+07
	825	1320	1044			NA		NA	4.2E+00	21.974	91.8	4.47E+06
	1320	2079	1657			NA		NA	1.3E+00	23.241	97.1	3.35E+05
	2079	3300	2619			NA		NA	6.9E-01	23.931	*****	4.62E+04
	3300	5313	4187			NA		NA	0.0E+00	23.931	*****	0.00E+00
			Total:			NA		NA	2.4E+01			

1.44 liters/min/m^2

Flow Area 10.51 Sq. Meters

Net Rate: 15.09 liters per minute
3.99 gallons per minute

Table 4. Liquid Transport Rates by Droplet Size at Low Load Condition
October 2, 1996 Unit 2 Stack Test

Distance Wall inches	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m ^ 2 1	2	3	4	Average				
6.2	33	66	46.7	8.1E-03	5.7E-03	6.7E-03		6.8E-03				
	66	99	80.8	1.3E-02	3.6E-03	1.0E-02		8.7E-03				
	99	132	114	2.7E-02	3.4E-03	1.8E-02		1.6E-02				
	132	198	162	5.9E-02	1.9E-02	3.7E-02		3.8E-02				
	198	330	256	2.1E-01	1.7E-02	4.4E-02		9.1E-02				
	330	528	417	2.5E-01	0.0E+00	1.9E-02		9.0E-02				
	528	825	660	8.8E-02	0.0E+00	0.0E+00		2.9E-02				
	825	1320	1044	3.1E-02	0.0E+00	0.0E+00		1.0E-02				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00		0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00				
			Total:	6.9E-01	4.6E-02	1.3E-01		2.9E-01				
22.1	33	66	46.7	1.4E-02	6.7E-03	1.0E-02		1.0E-02				
	66	99	80.8	2.7E-02	3.1E-03	1.2E-02		1.4E-02				
	99	132	114	4.2E-02	4.7E-03	2.1E-02		2.2E-02				
	132	198	162	1.0E-01	9.5E-03	4.2E-02		5.1E-02				
	198	330	256	2.2E-01	2.1E-02	6.6E-02		1.0E-01				
	330	528	417	2.7E-01	8.3E-03	4.1E-02		1.1E-01				
	528	825	660	1.1E-01	0.0E+00	0.0E+00		3.6E-02				
	825	1320	1044	2.9E-02	0.0E+00	0.0E+00		9.5E-03				
	1320	2079	1657	3.0E-01	0.0E+00	0.0E+00		9.8E-02				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00				
			Total:	1.1E+00	5.3E-02	1.9E-01		4.5E-01				
42.6	33	66	46.7	1.1E-02	2.6E-02	1.7E-02		1.8E-02				
	66	99	80.8	2.2E-03	3.5E-02	2.4E-03		1.3E-02				
	99	132	114	3.1E-03	6.3E-02	1.3E-03		2.2E-02				
	132	198	162	1.6E-03	1.6E-01	1.7E-03		5.3E-02				
	198	330	256	1.7E-02	2.8E-01	6.4E-03		1.0E-01				
	330	528	417	1.5E-02	2.0E-01	0.0E+00		7.0E-02				
	528	825	660	1.3E-02	3.7E-02	8.1E-03		1.9E-02				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00		0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00		0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00	Standard Traverse			Approximate
			Total:	6.2E-02	7.9E-01	3.7E-02		3.0E-01	In Band	Cumulative		No./min.
										Rate	%	
84	33	66	46.7	NA				NA	1.2E-02	0.012	3.4	1.38E+08
	66	99	80.8	NA				NA	1.2E-02	0.024	6.8	2.74E+07
	99	132	114	NA				NA	2.0E-02	0.044	12.7	1.65E+07
	132	198	162	NA				NA	4.7E-02	0.091	26.4	1.35E+07
	198	330	256	NA				NA	9.9E-02	0.190	54.9	7.09E+06
	330	528	417	NA				NA	8.9E-02	0.279	80.5	1.48E+06
	528	825	660	NA				NA	2.8E-02	0.307	88.6	1.18E+05
	825	1320	1044	NA				NA	6.6E-03	0.314	90.5	6.98E+03
	1320	2079	1657	NA				NA	3.3E-02	0.347	*****	8.67E+03
	2079	3300	2619	NA				NA	0.0E+00	0.347	*****	0.00E+00
	3300	5313	4187	NA				NA	0.0E+00	0.347	*****	0.00E+00
			Total:	NA				NA	3.5E-01			

0.021 liters/min/m ^ 2

Flow Area 10.5 Sq. Meters

Net Rate: 0.22 liters per minute
0.058 gallons per minute

Table 5. Liquid Transport Rates by Droplet Size at High Load Condition
October 2, 1996 Unit 2 Stack Test

Distance Wall Inches	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m ^ 2 1	2	3	4	Average
6.2	33	66	46.7	1.2E-02	3.8E-02	2.0E-02		2.3E-02
	66	99	80.8	1.5E-02	7.5E-02	4.1E-02		4.4E-02
	99	132	114	2.6E-02	1.2E-01	6.5E-02		7.2E-02
	132	198	162	6.5E-02	3.2E-01	1.2E-01		1.7E-01
	198	330	256	2.0E-01	1.0E+00	1.9E-01		4.7E-01
	330	528	417	3.8E-01	1.6E+00	9.7E-02		6.9E-01
	528	825	660	5.7E-01	8.8E-01	0.0E+00		4.8E-01
	825	1320	1044	1.2E+00	1.7E-01	0.0E+00		4.7E-01
	1320	2079	1657	1.7E+00	0.0E+00	0.0E+00		5.6E-01
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	4.2E+00	4.2E+00	5.3E-01		3.0E+00
22.1	33	66	46.7	2.0E-02	1.3E-02	1.7E-02		1.7E-02
	66	99	80.8	3.2E-02	1.9E-02	5.5E-03		1.9E-02
	99	132	114	3.7E-02	3.2E-02	8.0E-03		2.6E-02
	132	198	162	7.2E-02	6.2E-02	1.3E-02		4.9E-02
	198	330	256	2.6E-01	1.3E-01	2.8E-02		1.4E-01
	330	528	417	6.7E-01	9.5E-02	2.5E-02		2.6E-01
	528	825	660	1.6E+00	1.0E-02	1.9E-02		5.5E-01
	825	1320	1044	1.0E+00	0.0E+00	0.0E+00		3.5E-01
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	2079	3300	2619	8.2E-01	0.0E+00	0.0E+00		2.7E-01
	3300	5313	4187	4.9E+00	0.0E+00	0.0E+00		1.6E+00
			Total:	9.5E+00	3.6E-01	1.2E-01		3.3E+00
42.6	33	66	46.7	7.6E-02	2.6E-02	1.6E-02		3.9E-02
	66	99	80.8	1.3E-01	2.5E-02	5.8E-03		5.4E-02
	99	132	114	1.9E-01	4.7E-02	9.5E-03		8.4E-02
	132	198	162	4.1E-01	9.4E-02	2.3E-02		1.8E-01
	198	330	256	1.6E+00	1.6E-01	3.8E-02		5.8E-01
	330	528	417	2.8E+00	1.3E-01	2.5E-02		9.9E-01
	528	825	660	3.6E+00	4.9E-02	2.3E-02		1.2E+00
	825	1320	1044	2.0E+00	0.0E+00	3.2E-02		6.6E-01
	1320	2079	1657	7.5E-01	0.0E+00	0.0E+00		2.5E-01
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	1.1E+01	5.3E-01	1.7E-01		4.0E+00

Distance Wall Inches	Size Band um to um		Dg um	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
84	33	66	46.7	2.6E-02	0.026	0.8	3.11E+08
	66	99	80.8	3.9E-02	0.065	1.9	8.82E+07
	99	132	114	6.0E-02	0.125	3.6	4.90E+07
	132	198	162	1.3E-01	0.256	7.4	3.71E+07
	198	330	256	4.0E-01	0.654	18.9	2.85E+07
	330	528	417	6.5E-01	1.301	37.7	1.08E+07
	528	825	660	7.5E-01	2.049	59.4	3.13E+06
	825	1320	1044	4.9E-01	2.541	73.6	5.21E+05
	1320	2079	1657	2.7E-01	2.812	81.5	7.17E+04
	2079	3300	2619	9.1E-02	2.903	84.1	6.08E+03
	3300	5313	4187	5.5E-01	3.452	*****	9.00E+03
			Total:	3.5E+00			

0.21 liters/min/m ^ 2

Flow Area 10.5 Sq. Meters

Net Rate: 2.17 liters per minute
0.57 gallons per minute

Table 6. Liquid Transport Rates by Droplet Size at Low Load Condition
October 3, 1996 Unit 1 Stack Test

Distance Wall inches	Size Band um to	um	Dg um	Liquid Rate for Port, cc/s/m ^ 2: 1	2	3	4	Average
3	33	66	46.7	1.2E-02	6.3E-03	6.8E-03		8.5E-03
	66	99	80.8	1.3E-02	7.1E-03	9.2E-03		9.6E-03
	99	132	114	1.6E-02	1.3E-02	1.7E-02		1.5E-02
	132	198	162	4.7E-02	3.9E-02	4.9E-02		4.5E-02
	198	330	256	1.3E-01	1.0E-01	5.8E-02		9.6E-02
	330	528	417	2.6E-01	1.5E-01	5.2E-02		1.5E-01
	528	825	660	5.5E-01	6.6E-02	4.1E-02		2.2E-01
	825	1320	1044	1.2E+00	0.0E+00	5.9E-02		4.0E-01
	1320	2079	1657	1.3E+00	0.0E+00	0.0E+00		4.5E-01
	2079	3300	2619	1.1E+00	0.0E+00	0.0E+00		3.5E-01
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	4.6E+00	3.8E-01	2.9E-01		1.7E+00
11	33	66	46.7	1.8E-02	1.1E-02	4.4E-03		1.1E-02
	66	99	80.8	1.4E-02	7.7E-03	6.5E-03		9.4E-03
	99	132	114	1.9E-02	1.4E-02	1.3E-02		1.6E-02
	132	198	162	5.1E-02	3.7E-02	2.7E-02		3.8E-02
	198	330	256	2.0E-01	1.5E-01	6.0E-02		1.4E-01
	330	528	417	4.3E-01	2.4E-01	7.0E-02		2.5E-01
	528	825	660	1.1E+00	9.7E-02	9.0E-02		4.2E-01
	825	1320	1044	1.5E+00	0.0E+00	8.7E-02		5.3E-01
	1320	2079	1657	1.5E+00	0.0E+00	1.1E-01		5.2E-01
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	4.8E+00	5.6E-01	4.7E-01		1.9E+00
36	33	66	46.7	2.0E-02	1.3E-02	5.0E-03		1.3E-02
	66	99	80.8	2.4E-02	1.2E-02	7.0E-03		1.4E-02
	99	132	114	3.6E-02	2.2E-02	1.3E-02		2.4E-02
	132	198	162	7.4E-02	5.1E-02	3.0E-02		5.2E-02
	198	330	256	3.5E-01	1.4E-01	7.1E-02		1.9E-01
	330	528	417	7.8E-01	3.4E-01	1.3E-01		4.2E-01
	528	825	660	1.7E+00	2.3E-01	9.0E-02		6.6E-01
	825	1320	1044	1.6E+00	0.0E+00	1.3E-01		5.8E-01
	1320	2079	1657	4.5E-01	0.0E+00	2.0E-01		2.2E-01
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	5.0E+00	8.0E-01	6.7E-01		2.2E+00

Distance Wall inches	Size Band um to	um	Dg um	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
84	33	66	46.7	1.1E-02	0.011	0.6	1.27E+08
	66	99	80.8	1.1E-02	0.022	1.1	2.54E+07
	99	132	114	1.8E-02	0.040	2.1	1.47E+07
	132	198	162	4.5E-02	0.085	4.4	1.27E+07
	198	330	256	1.4E-01	0.224	11.6	1.00E+07
	330	528	417	2.7E-01	0.496	25.6	4.51E+06
	528	825	660	4.3E-01	0.926	47.8	1.81E+06
	825	1320	1044	5.0E-01	1.431	73.7	5.33E+05
	1320	2079	1657	3.9E-01	1.825	94.0	1.04E+05
	2079	3300	2619	1.2E-01	1.942	*****	7.82E+03
	3300	5313	4187	0.0E+00	1.942	*****	0.00E+00
			Total:	1.9E+00			

0.12 liters/min/m ^ 2

Flow Area 10.5 Sq. Meters

Net Rate: 1.22 liters per minute
0.32 gallons per minute

Table 7. Liquid Transport Rates by Droplet Size at High Load Condition
October 3, 1996 Unit 1 Stack Test

Distance n Wall ..ches	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m^2 1	2	3	4	Average
6.2	33	66	46.7	2.1E-02	1.0E-02	1.4E-02		1.5E-02
	66	99	80.8	3.1E-02	1.2E-02	2.3E-02		2.2E-02
	99	132	114	4.9E-02	2.1E-02	3.9E-02		3.6E-02
	132	198	162	1.4E-01	5.3E-02	9.7E-02		9.5E-02
	198	330	256	3.8E-01	1.4E-01	1.8E-01		2.3E-01
	330	528	417	5.9E-01	2.1E-01	2.2E-01		3.4E-01
	528	825	660	8.3E-01	1.3E-01	3.2E-01		4.3E-01
	825	1320	1044	1.0E+00	3.4E-02	1.4E-01		3.9E-01
	1320	2079	1657	1.2E+00	0.0E+00	3.1E-01		4.9E-01
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	4.2E+00	6.1E-01	1.3E+00		2.0E+00
22.1	33	66	46.7	3.2E-02	1.5E-02	1.4E-02		2.0E-02
	66	99	80.8	3.4E-02	1.8E-02	1.8E-02		2.3E-02
	99	132	114	5.3E-02	3.6E-02	2.4E-02		3.8E-02
	132	198	162	1.3E-01	1.0E-01	6.4E-02		9.9E-02
	198	330	256	3.9E-01	3.0E-01	1.6E-01		2.8E-01
	330	528	417	7.5E-01	3.3E-01	2.8E-01		4.5E-01
	528	825	660	1.3E+00	1.1E-01	3.2E-01		5.9E-01
	825	1320	1044	1.4E+00	0.0E+00	3.3E-01		5.8E-01
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	2079	3300	2619	8.9E-01	0.0E+00	0.0E+00		3.0E-01
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	5.0E+00	9.0E-01	1.2E+00		2.4E+00
42.6	33	66	46.7	3.1E-02	2.0E-02	2.1E-02		2.4E-02
	66	99	80.8	4.1E-02	2.1E-02	2.1E-02		2.8E-02
	99	132	114	5.4E-02	3.6E-02	3.3E-02		4.1E-02
	132	198	162	1.3E-01	1.1E-01	9.5E-02		1.1E-01
	198	330	256	5.2E-01	3.1E-01	2.6E-01		3.6E-01
	330	528	417	1.3E+00	4.5E-01	3.4E-01		7.0E-01
	528	825	660	2.3E+00	1.1E-01	3.9E-01		9.3E-01
	825	1320	1044	2.0E+00	0.0E+00	5.0E-01		8.3E-01
	1320	2079	1657	5.8E-01	1.5E-01	1.4E-01		2.9E-01
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	6.9E+00	1.2E+00	1.8E+00		3.3E+00

Size Band um to um		Dg um	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
33	66	46.7	2.0E-02	0.020	0.8	2.33E+08
66	99	80.8	2.4E-02	0.044	1.7	5.56E+07
99	132	114	3.8E-02	0.082	3.2	3.11E+07
132	198	162	1.0E-01	0.184	7.1	2.88E+07
198	330	256	2.9E-01	0.477	18.4	2.10E+07
330	528	417	5.0E-01	0.973	37.6	8.24E+06
528	825	660	6.5E-01	1.622	62.8	2.72E+06
825	1320	1044	6.0E-01	2.224	86.0	6.37E+05
1320	2079	1657	2.6E-01	2.486	96.2	6.94E+04
2079	3300	2619	9.8E-02	2.585	*****	6.60E+03
3300	5313	4187	0.0E+00	2.585	*****	0.00E+00
		Total:	2.6E+00			

0.15508 liters/min/m^2

Flow Area 10.51 Sq. Meters

Net Rate: 1.63 liters/min
0.43 gallons per minute

Table 8. Liquid Transport Rates by Droplet Size at Crossover Condition
October 4, 1996 Unit 1 Stack Test

Distance from Wall, inches	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m ^ 2: 1	2	3	4	Average
6.2	33	66	46.7	8.5E-03	9.7E-03	3.3E-02		1.7E-02
	66	99	80.8	8.4E-03	8.2E-03	7.2E-02		2.9E-02
	99	132	114	1.2E-02	1.8E-02	1.1E-01		4.5E-02
	132	198	162	3.3E-02	3.1E-02	2.6E-01		1.1E-01
	198	330	256	5.8E-02	7.7E-02	7.2E-01		2.9E-01
	330	528	417	7.3E-02	5.5E-02	1.2E+00		4.6E-01
	528	825	660	8.5E-02	2.5E-02	1.8E+00		6.5E-01
	825	1320	1044	5.5E-02	5.8E-02	1.8E+00		6.4E-01
	1320	2079	1657	0.0E+00	0.0E+00	4.7E-01		1.6E-01
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	3.3E-01	2.8E-01	6.6E+00		2.4E+00
22.1	33	66	46.7	1.0E-02	9.9E-03	1.1E-02		1.0E-02
	66	99	80.8	3.2E-03	1.2E-03	7.7E-03		4.0E-03
	99	132	114	4.5E-03	2.0E-03	1.2E-02		6.2E-03
	132	198	162	6.5E-03	2.1E-03	3.6E-02		1.5E-02
	198	330	256	1.6E-02	9.0E-03	8.2E-02		3.6E-02
	330	528	417	4.4E-02	5.5E-02	8.9E-02		6.2E-02
	528	825	660	1.2E-01	0.0E+00	2.0E-02		4.8E-02
	825	1320	1044	1.9E-01	0.0E+00	1.3E-01		1.1E-01
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	4.0E-01	7.9E-02	3.9E-01		2.9E-01
42.6	33	66	46.7	2.3E-02	5.6E-03	1.3E-02		1.4E-02
	66	99	80.8	2.8E-03	3.6E-03	5.6E-03		4.0E-03
	99	132	114	4.1E-03	7.9E-03	7.4E-03		6.5E-03
	132	198	162	1.1E-03	1.4E-02	1.5E-02		1.0E-02
	198	330	256	7.3E-03	2.9E-02	5.2E-02		2.9E-02
	330	528	417	1.8E-02	1.0E-01	5.6E-02		5.8E-02
	528	825	660	0.0E+00	0.0E+00	5.6E-02		1.9E-02
	825	1320	1044	0.0E+00	5.6E-02	0.0E+00		1.9E-02
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00		0.0E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00		0.0E+00
			Total:	5.6E-02	2.2E-01	2.1E-01		1.6E-01

Size Band um to um		Dg um	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
33	66	46.7	1.4E-02	0.014	1.4	1.62E+08
66	99	80.8	1.2E-02	0.026	2.8	2.85E+07
99	132	114	1.9E-02	0.045	4.8	1.56E+07
132	198	162	4.4E-02	0.090	9.5	1.26E+07
198	330	256	1.2E-01	0.206	21.8	8.38E+06
330	528	417	1.9E-01	0.399	42.1	3.19E+06
528	825	660	2.4E-01	0.637	67.3	9.96E+05
825	1320	1044	2.6E-01	0.894	94.4	2.72E+05
1320	2079	1657	5.3E-02	0.946	*****	1.39E+04
2079	3300	2619	0.0E+00	0.946	*****	0.00E+00
3300	5313	4187	0.0E+00	0.946	*****	0.00E+00
		Total:	9.5E-01			

0.057 liters/min/m ^ 2

Flow Area 10.5 Sq. Meters

Net Rate: 0.60 liters per minute
0.16 gallons per minute

Table 9. Liquid Transport Rates by Droplet Size at Crossover Condition
October 4, 1996 Unit 1 ME Outlet Test

Distance m Wall . feet	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m ^ 2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
8.75	33	66	46.7	0.0E+00	1.6E-03	7.6E-05	4.3E-03	1.5E-03				
	66	99	80.8	0.0E+00	2.1E-03	0.0E+00	4.0E-05	5.4E-04				
	99	132	114	0.0E+00	6.0E-03	1.5E-04	7.6E-05	1.5E-03				
	132	198	162	0.0E+00	2.0E-02	3.1E-04	3.2E-04	5.2E-03				
	198	330	256	0.0E+00	4.9E-02	0.0E+00	8.6E-04	1.2E-02				
	330	528	417	0.0E+00	1.4E-01	0.0E+00	3.3E-03	3.6E-02				
	528	825	660	0.0E+00	2.8E-01	0.0E+00	0.0E+00	7.0E-02				
	825	1320	1044	0.0E+00	1.9E-01	0.0E+00	0.0E+00	4.8E-02				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	0.0E+00	6.9E-01	5.3E-04	8.8E-03	1.8E-01				
6.25	33	66	46.7	9.5E-06	0.0E+00	0.0E+00	8.2E-03	2.1E-03				
	66	99	80.8	0.0E+00	0.0E+00	0.0E+00	7.3E-03	1.8E-03				
	99	132	114	0.0E+00	0.0E+00	0.0E+00	1.0E-02	2.5E-03				
	132	198	162	0.0E+00	2.5E-04	0.0E+00	2.8E-02	7.0E-03				
	198	330	256	0.0E+00	6.7E-04	0.0E+00	8.5E-02	2.1E-02				
	330	528	417	0.0E+00	0.0E+00	0.0E+00	2.2E-01	5.4E-02				
	528	825	660	0.0E+00	0.0E+00	7.4E-03	5.5E-01	1.4E-01				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	7.5E-01	1.9E-01				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	2.2E-01	5.5E-02				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	9.5E-06	9.2E-04	7.4E-03	1.9E+00	4.7E-01				
3.75	33	66	46.7	1.3E-03	0.0E+00	3.0E-03	1.2E-03	1.4E-03				
	66	99	80.8	2.9E-03	0.0E+00	6.4E-03	0.0E+00	2.3E-03				
	99	132	114	3.9E-03	0.0E+00	1.1E-02	0.0E+00	3.8E-03				
	132	198	162	1.8E-02	0.0E+00	3.8E-02	0.0E+00	1.3E-02				
	198	330	256	5.2E-02	0.0E+00	5.6E-02	0.0E+00	2.7E-02				
	330	528	417	9.5E-02	0.0E+00	3.7E-02	0.0E+00	3.3E-02				
	528	825	660	6.2E-02	5.4E-03	2.6E-02	1.2E-02	2.7E-02				
	825	1320	1044	3.7E-02	4.2E-03	3.3E-02	0.0E+00	1.9E-02				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	2.7E-01	9.6E-03	2.1E-01	1.3E-02	1.3E-01				
1.25	33	66	46.7	1.3E-04	5.2E-04	0.0E+00	8.9E-04	3.8E-04	1.3E-03	0.001	0.7	8.75E+07
	66	99	80.8	2.6E-04	1.6E-04	0.0E+00	3.6E-05	1.2E-04	1.2E-03	0.003	1.3	1.54E+07
	99	132	114	1.9E-04	2.6E-04	0.0E+00	6.6E-05	1.3E-04	2.0E-03	0.005	2.3	9.15E+06
	132	198	162	1.6E-03	8.4E-04	0.0E+00	0.0E+00	6.2E-04	6.4E-03	0.011	5.5	1.02E+07
	198	330	256	9.2E-03	3.9E-03	2.4E-04	1.4E-03	3.7E-03	1.6E-02	0.027	13.6	6.49E+06
	330	528	417	1.0E-02	1.8E-02	0.0E+00	9.6E-03	9.3E-03	3.3E-02	0.060	30.2	3.07E+06
	528	825	660	3.1E-03	1.1E-02	0.0E+00	2.8E-02	1.1E-02	6.2E-02	0.122	61.3	1.45E+06
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.3E-02	0.185	93.1	3.76E+05
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-02	0.199	*****	2.04E+04
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.199	*****	0.00E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.199	*****	0.00E+00
			Total:	2.4E-02	3.9E-02	2.4E-04	4.0E-02	2.6E-02	2.0E-01			

0.012 liters/min/m ^ 2

Flow Area 59.0 Sq. Meters

Net Rate: 0.70 liters per minute
0.19 gallons per minute

Table 10. Liquid Transport Rates by Droplet Size at Crossover Condition
October 5, 1996 Unit 1 ME Inlet Test

Distance from Wall, feet	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m^2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
8.75	33	66	46.7	3.9E-01	3.8E-01	1.2E+00	1.2E+00	7.8E-01				
	66	99	80.8	8.4E-01	8.2E-01	2.6E+00	2.6E+00	1.7E+00				
	99	132	114	1.4E+00	1.3E+00	4.0E+00	4.0E+00	2.6E+00				
	132	198	162	5.0E+00	4.8E+00	8.2E+00	8.2E+00	6.6E+00				
	198	330	256	2.0E+01	2.0E+01	2.7E+01	2.7E+01	2.3E+01				
	330	528	417	5.2E+01	5.0E+01	5.6E+01	5.6E+01	5.3E+01				
	528	825	660	1.0E+02	9.8E+01	1.3E+02	1.3E+02	1.1E+02				
	825	1320	1044	1.5E+02	1.4E+02	2.7E+02	2.7E+02	2.1E+02				
	1320	2079	1657	4.6E+01	3.4E+01	2.6E+02	2.7E+02	1.5E+02				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	3.8E+02	3.5E+02	7.6E+02	7.7E+02	5.6E+02				
6.25	33	66	46.7	3.9E-01	3.6E-01	1.1E+00	1.2E+00	7.6E-01				
	66	99	80.8	8.4E-01	7.8E-01	2.5E+00	2.6E+00	1.7E+00				
	99	132	114	1.4E+00	1.3E+00	3.8E+00	4.0E+00	2.6E+00				
	132	198	162	5.0E+00	4.6E+00	7.8E+00	8.2E+00	6.4E+00				
	198	330	256	2.0E+01	1.9E+01	2.5E+01	2.7E+01	2.3E+01				
	330	528	417	5.2E+01	9.0E+01	5.2E+01	5.6E+01	6.2E+01				
	528	825	660	1.0E+02	1.2E+02	1.2E+02	1.3E+02	1.2E+02				
	825	1320	1044	1.5E+02	6.2E+01	2.4E+02	2.7E+02	1.8E+02				
	1320	2079	1657	4.6E+01	0.0E+00	1.6E+02	2.7E+02	1.2E+02				
	2079	3300	2619	0.0E+00	0.0E+00	6.0E+00	0.0E+00	1.5E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	3.8E+02	2.9E+02	6.1E+02	7.7E+02	5.1E+02				
3.75	33	66	46.7	3.6E-01	7.3E-01	4.6E-01	1.0E+00	6.5E-01				
	66	99	80.8	7.6E-01	1.5E+00	1.2E+00	2.8E+00	1.5E+00				
	99	132	114	1.2E+00	2.3E+00	1.9E+00	3.5E+00	2.2E+00				
	132	198	162	4.5E+00	7.2E+00	3.4E+00	7.3E+00	5.6E+00				
	198	330	256	1.8E+01	2.1E+01	1.5E+01	2.4E+01	1.9E+01				
	330	528	417	4.5E+01	3.7E+01	3.8E+01	4.8E+01	4.2E+01				
	528	825	660	8.6E+01	5.6E+01	8.8E+01	1.0E+02	8.3E+01				
	825	1320	1044	1.1E+02	3.8E+01	1.3E+02	2.0E+02	1.2E+02				
	1320	2079	1657	1.0E+01	0.0E+00	1.2E+01	8.5E+01	2.7E+01				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	2.7E+02	1.6E+02	2.9E+02	4.7E+02	3.0E+02				
1.25	33	66	46.7	2.9E-01	7.0E-01	4.5E-01	4.0E-01	4.6E-01	6.6E-01	0.660	0.2	4.38E+10
	66	99	80.8	6.4E-01	1.4E+00	1.0E+00	8.6E-01	9.8E-01	1.5E+00	2.135	0.5	1.69E+10
	99	132	114	1.0E+00	2.3E+00	1.6E+00	1.4E+00	1.6E+00	2.3E+00	4.393	1.1	1.03E+10
	132	198	162	4.0E+00	7.0E+00	6.6E+00	5.1E+00	5.7E+00	6.1E+00	10.451	2.5	9.63E+09
	198	330	256	1.5E+01	2.0E+01	2.7E+01	2.1E+01	2.1E+01	2.1E+01	31.932	7.7	8.66E+09
	330	528	417	3.1E+01	3.6E+01	6.5E+01	5.3E+01	4.6E+01	5.1E+01	82.926	20.1	4.75E+09
	528	825	660	3.7E+01	5.2E+01	1.4E+02	1.1E+02	8.4E+01	9.9E+01	182.120	44.2	2.33E+09
	825	1320	1044	1.0E+00	3.1E+01	1.9E+02	1.6E+02	9.4E+01	1.5E+02	332.045	80.6	8.91E+08
	1320	2079	1657	0.0E+00	0.0E+00	1.7E+01	6.1E+01	1.9E+01	8.0E+01	411.765	99.9	1.18E+08
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.8E-01	412.140	*****	1.41E+05
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	412.140	*****	0.00E+00
			Total:	9.1E+01	1.5E+02	4.4E+02	4.1E+02	2.7E+02	4.1E+02			

24.7 liters/min/m^2

Flow Area 59.0 Sq. Meters

Net Rate: 1459 liters per minute
385 gallons per minute

Table 11. Liquid Transport Rates by Droplet Size at Low Load Condition
October 7, 1996 Unit 1 ME Inlet Test

Distance m Wall feet	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m ^ 2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
8.75	33	66	46.7	9.3E-02	1.6E-01	2.0E-01	6.4E-01	2.7E-01				
	66	99	80.8	2.4E-01	3.3E-01	4.0E-01	1.3E+00	5.5E-01				
	99	132	114	3.9E-01	5.3E-01	3.6E-01	1.9E+00	8.0E-01				
	132	198	162	1.3E+00	2.0E+00	2.4E+00	3.6E+00	2.3E+00				
	198	330	256	3.2E+00	8.2E+00	1.1E+01	1.3E+01	8.7E+00				
	330	528	417	4.8E+00	1.8E+01	2.6E+01	2.4E+01	1.8E+01				
	528	825	660	2.2E+00	2.1E+01	3.7E+01	4.7E+01	2.7E+01				
	825	1320	1044	0.0E+00	0.0E+00	1.5E+01	4.3E+01	1.4E+01				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	1.2E+01	5.0E+01	9.1E+01	1.3E+02	7.2E+01				
6.25	33	66	46.7	9.2E-02	1.1E-01	1.7E-01	3.8E-01	1.9E-01				
	66	99	80.8	2.4E-01	2.7E-01	3.4E-01	7.5E-01	4.0E-01				
	99	132	114	3.8E-01	4.4E-01	5.5E-01	1.1E+00	6.3E-01				
	132	198	162	1.3E+00	1.5E+00	2.0E+00	2.3E+00	1.8E+00				
	198	330	256	3.2E+00	3.8E+00	6.5E+00	8.2E+00	5.9E+00				
	330	528	417	4.7E+00	6.1E+00	1.9E+01	1.6E+01	1.1E+01				
	528	825	660	2.1E+00	3.8E+00	2.4E+01	2.5E+01	1.4E+01				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	1.4E+01	3.5E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	1.2E+01	1.6E+01	5.5E+01	6.7E+01	3.7E+01				
3.75	33	66	46.7	2.5E-02	2.5E-02	4.9E-02	5.0E-01	1.5E-01				
	66	99	80.8	6.7E-02	6.6E-02	9.4E-02	9.8E-01	3.0E-01				
	99	132	114	1.2E-01	1.2E-01	1.6E-01	1.5E+00	4.7E-01				
	132	198	162	4.4E-01	4.3E-01	5.2E-01	2.8E+00	1.0E+00				
	198	330	256	1.3E+00	1.3E+00	2.0E+00	9.4E+00	3.5E+00				
	330	528	417	1.6E+00	1.5E+00	3.6E+00	1.7E+01	5.8E+00				
	528	825	660	6.8E-01	6.4E-01	1.6E+00	3.2E+01	8.6E+00				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	4.2E+00	4.1E+00	8.0E+00	6.3E+01	2.0E+01				
1.25	33	66	46.7	9.0E-02	1.6E-02	8.3E-02	1.1E-01	7.4E-02	1.7E-01	0.171	0.5	1.13E+10
	66	99	80.8	1.9E-01	3.5E-02	1.7E-01	2.0E-01	1.5E-01	3.5E-01	0.522	1.5	4.50E+09
	99	132	114	3.2E-01	4.7E-02	2.9E-01	2.9E-01	2.3E-01	5.3E-01	1.055	3.1	2.44E+09
	132	198	162	1.1E+00	1.1E-01	9.4E-01	7.7E-01	7.2E-01	1.5E+00	2.524	7.5	2.33E+09
	198	330	256	3.6E+00	1.1E-01	3.0E+00	2.7E+00	2.3E+00	5.1E+00	7.630	22.7	2.06E+09
	330	528	417	3.0E+00	0.0E+00	1.7E+00	3.2E+00	2.0E+00	9.3E+00	16.946	50.3	8.69E+08
	528	825	660	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+01	29.194	86.7	2.88E+08
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E+00	33.678	*****	2.86E+07
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	33.678	*****	0.00E+00
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	33.678	*****	0.00E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	33.678	*****	0.00E+00
			Total:	8.2E+00	3.2E-01	6.2E+00	7.2E+00	5.5E+00	3.4E+01			

2.0 liters/min/m ^ 2

Flow Area 59.0 Sq. Meters

Net Rate: 119 liters per minute
32 gallons per minute

Table 12. Liquid Transport Rates by Droplet Size at High Load Condition
October 7, 1996 Unit 1 ME Inlet Test

Distance m Wall feet	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m ^ 2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
8.75	33	66	46.7	3.9E-01	3.4E-01	3.9E-01	6.5E-01	4.4E-01				
	66	99	80.8	8.4E-01	7.3E-01	7.3E-01	1.3E+00	9.1E-01				
	99	132	114	1.4E+00	1.2E+00	1.1E+00	2.2E+00	1.5E+00				
	132	198	162	4.5E+00	3.9E+00	3.9E+00	6.4E+00	4.7E+00				
	198	330	256	1.1E+01	9.3E+00	1.7E+01	2.0E+01	1.4E+01				
	330	528	417	1.7E+01	1.3E+01	4.6E+01	3.7E+01	2.8E+01				
	528	825	660	2.1E+01	1.5E+01	8.6E+01	6.7E+01	4.7E+01				
	825	1320	1044	9.5E+00	2.4E+00	7.4E+01	8.9E+01	4.4E+01				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	1.8E+01	4.5E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	6.6E+01	4.6E+01	2.3E+02	2.4E+02	1.4E+02				
6.25	33	66	46.7	3.7E-01	3.2E-01	4.8E-01	6.1E-01	4.4E-01				
	66	99	80.8	7.9E-01	6.9E-01	9.0E-01	1.3E+00	9.1E-01				
	99	132	114	1.3E+00	1.1E+00	1.3E+00	2.0E+00	1.4E+00				
	132	198	162	4.3E+00	3.7E+00	4.8E+00	6.0E+00	4.7E+00				
	198	330	256	1.0E+01	8.7E+00	2.1E+01	1.9E+01	1.5E+01				
	330	528	417	1.5E+01	1.2E+01	5.4E+01	3.4E+01	2.9E+01				
	528	825	660	1.9E+01	1.2E+01	9.8E+01	5.8E+01	4.7E+01				
	825	1320	1044	5.9E+00	8.5E-01	6.4E+01	6.8E+01	3.5E+01				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	4.0E+00	1.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	5.7E+01	3.9E+01	2.4E+02	1.9E+02	1.3E+02				
3.75	33	66	46.7	3.4E-01	1.0E-01	2.4E-01	1.5E-01	2.1E-01				
	66	99	80.8	7.2E-01	2.2E-01	3.1E-01	3.4E-01	4.0E-01				
	99	132	114	1.2E+00	3.5E-01	3.5E-01	5.3E-01	6.0E-01				
	132	198	162	3.8E+00	9.0E-01	9.5E-01	1.3E+00	1.7E+00				
	198	330	256	9.2E+00	2.0E+00	3.1E+00	4.9E+00	4.8E+00				
	330	528	417	1.3E+01	2.7E+00	6.0E+00	1.0E+01	8.0E+00				
	528	825	660	1.6E+01	1.6E+00	1.0E+01	2.0E+01	1.2E+01				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	1.8E+01	4.6E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	4.4E+01	7.9E+00	2.1E+01	5.6E+01	3.2E+01				
1.25	33	66	46.7	7.8E-02	7.7E-02	1.6E-01	1.7E-01	1.2E-01	3.0E-01	0.303	0.4	2.01E+10
	66	99	80.8	1.2E-01	1.2E-01	2.4E-01	3.5E-01	2.1E-01	6.1E-01	0.908	1.1	7.76E+09
	99	132	114	1.5E-01	1.4E-01	3.1E-01	5.4E-01	2.8E-01	9.4E-01	1.852	2.3	4.31E+09
	132	198	162	4.4E-01	3.9E-01	1.0E+00	1.5E+00	8.3E-01	3.0E+00	4.836	6.1	4.74E+09
	198	330	256	9.7E-01	8.4E-01	3.4E+00	5.2E+00	2.6E+00	9.1E+00	13.905	17.5	3.65E+09
	330	528	417	7.2E-01	0.0E+00	2.8E+00	8.5E+00	3.0E+00	1.7E+01	30.868	38.8	1.58E+09
	528	825	660	0.0E+00	0.0E+00	0.0E+00	3.9E+00	9.8E-01	2.7E+01	57.455	72.3	6.25E+08
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+01	78.138	98.3	1.23E+08
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+00	79.513	*****	2.04E+06
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	79.513	*****	0.00E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	79.513	*****	0.00E+00
			Total:	2.5E+00	1.6E+00	8.0E+00	2.0E+01	8.1E+00	8.0E+01			

4.8 liters/min/m ^ 2

Flow Area 59.0 Sq. Meters

Net Rate: 281 liters per minute
74 gallons per minute

Table 13. Liquid Transport Rates by Droplet Size at Low Load Condition
October 8, 1996 Unit 1 ME Outlet Test

Distance ¬ Wall	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m^2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Estimated No./min.
8.75	33	66	46.7	5.0E-04	3.0E-03	1.1E-03	2.0E-04	1.2E-03				
	66	99	80.8	0.0E+00	6.9E-03	7.8E-05	3.1E-05	1.7E-03				
	99	132	114	0.0E+00	1.1E-02	0.0E+00	5.8E-05	2.7E-03				
	132	198	162	0.0E+00	2.4E-02	0.0E+00	0.0E+00	6.0E-03				
	198	330	256	0.0E+00	4.3E-02	2.6E-04	5.2E-04	1.1E-02				
	330	528	417	0.0E+00	3.0E-02	0.0E+00	0.0E+00	7.5E-03				
	528	825	660	0.0E+00	0.0E+00	0.0E+00	1.1E-02	2.7E-03				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	5.0E-04	1.2E-01	1.4E-03	1.2E-02	3.3E-02				
6.25	33	66	46.7	8.9E-04	2.5E-05	3.5E-03	2.1E-05	1.1E-03				
	66	99	80.8	6.6E-04	1.8E-05	7.3E-03	0.0E+00	2.0E-03				
	99	132	114	1.1E-03	0.0E+00	1.2E-02	0.0E+00	3.2E-03				
	132	198	162	2.7E-03	1.3E-04	3.4E-02	2.0E-04	9.3E-03				
	198	330	256	3.2E-03	0.0E+00	6.0E-02	5.1E-04	1.6E-02				
	330	528	417	1.2E-03	0.0E+00	1.6E-02	0.0E+00	4.3E-03				
	528	825	660	0.0E+00	0.0E+00	4.4E-03	0.0E+00	1.1E-03				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	9.7E-03	1.7E-04	1.4E-01	7.3E-04	3.7E-02				
3.75	33	66	46.7	1.1E-03	2.9E-05	8.9E-06	7.9E-05	3.0E-04				
	66	99	80.8	7.2E-05	1.8E-05	0.0E+00	4.8E-05	3.5E-05				
	99	132	114	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	132	198	162	0.0E+00	0.0E+00	1.2E-04	0.0E+00	2.9E-05				
	198	330	256	0.0E+00	1.2E-03	2.0E-03	0.0E+00	8.0E-04				
	330	528	417	1.5E-03	1.7E-03	3.6E-03	0.0E+00	1.7E-03				
	528	825	660	0.0E+00	0.0E+00	0.0E+00	2.3E-03	5.7E-04				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	2.6E-03	2.9E-03	5.8E-03	2.4E-03	3.4E-03				
1.25	33	66	46.7	5.0E-04	1.3E-05	1.3E-04	1.1E-03	4.4E-04	7.6E-04	0.001	3.9	5.05E+07
	66	99	80.8	1.2E-04	4.3E-05	5.8E-05	1.3E-03	3.7E-04	1.0E-03	0.002	9.3	1.33E+07
	99	132	114	5.6E-05	0.0E+00	3.4E-05	2.0E-03	5.2E-04	1.6E-03	0.003	17.6	7.26E+06
	132	198	162	4.1E-04	9.7E-05	6.3E-05	5.0E-03	1.4E-03	4.2E-03	0.008	39.3	6.67E+06
	198	330	256	1.1E-03	1.3E-04	7.1E-05	3.5E-03	1.2E-03	7.2E-03	0.015	76.4	2.89E+06
	330	528	417	1.1E-04	0.0E+00	1.7E-05	1.3E-03	3.5E-04	3.5E-03	0.018	94.3	3.23E+05
	528	825	660	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-03	0.019	*****	2.57E+04
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.019	*****	0.00E+00
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.019	*****	0.00E+00
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.019	*****	0.00E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.019	*****	0.00E+00
			Total:	2.3E-03	2.8E-04	3.8E-04	1.4E-02	4.3E-03	1.9E-02			
116	33	66	46.7									
	66	99	80.8									
	99	132	114									
	132	198	162									
	198	330	256									

0.0012 liters/min/m^2

Flow Area 59.0 Sq. Meters

Net Rate: 0.07 liters per minute
0.018 gallons per minute

Table 14. Liquid Transport Rates by Droplet Size at High Load Condition
October 8, 1996 Unit 1 ME Outlet Test

Distance ›m Wall ›t	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m^2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
8.75	33	66	46.7	1.9E-03	5.0E-04	1.1E-03	2.0E-04	9.1E-04				
	66	99	80.8	6.6E-04	0.0E+00	7.8E-05	3.1E-05	1.9E-04				
	99	132	114	1.1E-03	0.0E+00	0.0E+00	5.8E-05	3.0E-04				
	132	198	162	2.7E-03	0.0E+00	0.0E+00	0.0E+00	6.8E-04				
	198	330	256	6.7E-03	0.0E+00	2.6E-04	5.2E-04	1.9E-03				
	330	528	417	9.6E-03	0.0E+00	0.0E+00	0.0E+00	2.4E-03				
	528	825	660	0.0E+00	0.0E+00	0.0E+00	1.1E-02	2.7E-03				
	825	1320	1044	2.8E-03	0.0E+00	0.0E+00	0.0E+00	7.1E-04				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	2.6E-02	5.0E-04	1.4E-03	1.2E-02	9.7E-03				
6.25	33	66	46.7	1.9E-03	8.9E-04	3.5E-03	2.1E-05	1.6E-03				
	66	99	80.8	2.4E-05	6.6E-04	7.3E-03	0.0E+00	2.0E-03				
	99	132	114	0.0E+00	1.1E-03	1.2E-02	0.0E+00	3.2E-03				
	132	198	162	0.0E+00	2.7E-03	3.4E-02	2.0E-04	9.3E-03				
	198	330	256	0.0E+00	3.2E-03	6.0E-02	5.1E-04	1.6E-02				
	330	528	417	0.0E+00	1.2E-03	1.6E-02	0.0E+00	4.3E-03				
	528	825	660	0.0E+00	0.0E+00	4.4E-03	0.0E+00	1.1E-03				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	1.9E-03	9.7E-03	1.4E-01	7.3E-04	3.7E-02				
3.75	33	66	46.7	1.8E-03	1.1E-03	8.9E-06	7.9E-05	7.3E-04				
	66	99	80.8	0.0E+00	7.2E-05	0.0E+00	4.8E-05	3.0E-05				
	99	132	114	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	132	198	162	0.0E+00	0.0E+00	1.2E-04	0.0E+00	2.9E-05				
	198	330	256	0.0E+00	0.0E+00	2.0E-03	0.0E+00	5.1E-04				
	330	528	417	3.3E-03	1.5E-03	3.6E-03	0.0E+00	2.1E-03				
	528	825	660	1.5E-03	0.0E+00	0.0E+00	2.3E-03	9.4E-04				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	6.5E-03	2.6E-03	5.8E-03	2.4E-03	4.3E-03				
1.25	33	66	46.7	6.4E-04	5.0E-04	1.3E-04	1.1E-03	6.0E-04	9.5E-04	0.001	6.7	6.34E+07
	66	99	80.8	1.9E-04	1.2E-04	5.8E-05	1.3E-03	4.1E-04	6.6E-04	0.002	11.4	8.45E+06
	99	132	114	2.3E-04	5.6E-05	3.4E-05	2.0E-03	5.8E-04	1.0E-03	0.003	18.5	4.62E+06
	132	198	162	5.6E-04	4.1E-04	6.3E-05	5.0E-03	1.5E-03	2.9E-03	0.006	38.8	4.58E+06
	198	330	256	2.9E-03	1.1E-03	7.1E-05	3.5E-03	1.9E-03	5.0E-03	0.011	74.2	2.03E+06
	330	528	417	1.6E-04	1.1E-04	1.7E-05	1.3E-03	3.9E-04	2.3E-03	0.013	90.4	2.14E+05
	528	825	660	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	0.014	98.7	2.79E+04
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-04	0.014	*****	1.05E+03
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.014	*****	0.00E+00
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.014	*****	0.00E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.014	*****	0.00E+00
			Total:	4.6E-03	2.3E-03	3.8E-04	1.4E-02	5.3E-03	1.4E-02			

0.0009 liters/min/m^2

Flow Area 59.0 Sq. Meters

Net Rate: 0.050 liters per minute
0.013 gallons per minute

Table 15. Liquid Transport Rates by Droplet Size at Low Load Condition
October 9, 1996 Unit 2 ME Outlet Test

Distance	Size Band		Dg	Liquid Rate for Port, cc/s/m^2					Standard Traverse			Approximate
from Wall	um to um		um	1	2	3	4	Average	In Band	Cumulative		No./min.
et										Rate	%	
8.75	33	66	46.7	1.5E-03	0.0E+00	3.6E-04	3.9E-06	4.6E-04				
	66	99	80.8	1.9E-05	0.0E+00	3.5E-04	1.4E-05	9.6E-05				
	99	132	114	0.0E+00	0.0E+00	1.2E-03	0.0E+00	3.0E-04				
	132	198	162	0.0E+00	0.0E+00	2.0E-03	0.0E+00	5.0E-04				
	198	330	256	2.8E-04	0.0E+00	7.6E-04	7.0E-04	4.4E-04				
	330	528	417	0.0E+00	0.0E+00	1.1E-03	1.0E-03	5.4E-04				
	528	825	660	0.0E+00	0.0E+00	5.5E-04	0.0E+00	1.4E-04				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	1.8E-03	0.0E+00	6.3E-03	1.8E-03	2.5E-03				
6.25	33	66	46.7	5.4E-05	8.2E-05	2.1E-05	1.2E-04	6.8E-05				
	66	99	80.8	2.2E-04	0.0E+00	0.0E+00	1.2E-04	8.4E-05				
	99	132	114	1.1E-04	0.0E+00	0.0E+00	1.8E-04	7.4E-05				
	132	198	162	0.0E+00	0.0E+00	0.0E+00	6.0E-04	1.5E-04				
	198	330	256	9.2E-04	0.0E+00	0.0E+00	2.6E-03	8.8E-04				
	330	528	417	2.4E-03	0.0E+00	9.1E-04	1.7E-02	5.1E-03				
	528	825	660	3.0E-03	0.0E+00	1.0E-03	1.5E-02	4.8E-03				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	6.7E-03	8.2E-05	2.0E-03	3.6E-02	1.1E-02				
3.75	33	66	46.7	1.1E-04	4.2E-04	1.8E-05	3.9E-06	1.4E-04				
	66	99	80.8	0.0E+00	6.5E-05	3.3E-05	0.0E+00	2.4E-05				
	99	132	114	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	132	198	162	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	198	330	256	0.0E+00	2.3E-04	1.9E-04	2.1E-04	1.6E-04				
	330	528	417	1.0E-03	2.7E-03	2.8E-03	0.0E+00	1.6E-03				
	528	825	660	2.1E-04	4.5E-03	1.6E-03	4.2E-04	1.7E-03				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	1.3E-03	7.9E-03	4.6E-03	6.4E-04	3.6E-03				
1.25	33	66	46.7	2.1E-04	5.3E-05	1.4E-04	5.7E-04	2.4E-04	2.3E-04	0.000	1.4	1.50E+07
	66	99	80.8	9.5E-04	5.8E-05	8.4E-05	1.2E-03	5.7E-04	1.9E-04	0.000	2.6	2.47E+06
	99	132	114	8.8E-04	2.2E-04	7.8E-05	2.3E-03	8.8E-04	3.1E-04	0.001	4.5	1.42E+06
	132	198	162	2.2E-03	2.9E-04	0.0E+00	4.6E-03	1.8E-03	6.1E-04	0.001	8.4	9.71E+05
	198	330	256	2.5E-03	7.1E-03	2.7E-03	8.2E-03	5.1E-03	1.7E-03	0.003	18.6	6.65E+05
	330	528	417	4.1E-03	1.7E-02	3.4E-02	8.0E-02	3.4E-02	1.0E-02	0.013	83.0	9.62E+05
	528	825	660	0.0E+00	0.0E+00	1.0E-02	6.9E-03	4.3E-03	2.7E-03	0.016	*****	6.43E+04
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.016	*****	0.00E+00
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.016	*****	0.00E+00
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.016	*****	0.00E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.016	*****	0.00E+00
			Total:	1.1E-02	2.5E-02	4.8E-02	1.0E-01	4.7E-02	1.6E-02			

0.0010 liters/min/m^2

Flow Area 59.0 Sq. Meters

Net Rate: 0.057 liters per minute
0.015 gallons per minute

Table 16. Liquid Transport Rates by Droplet Size at High Load Condition
October 9, 1996 Unit 2 ME Outlet Test

Distance from Wall set	Size Band um to um		Dg um	Liquid Rate for Port, cc/s/m ^ 2 1	2	3	4	Average	Standard Traverse In Band	Cumulative Rate	%	Approximate No./min.
8.75	33	66	46.7	9.1E-05	1.3E-05	2.5E-05	0.0E+00	3.2E-05				
	66	99	80.8	0.0E+00	0.0E+00	7.0E-05	0.0E+00	1.7E-05				
	99	132	114	0.0E+00	0.0E+00	8.6E-05	0.0E+00	2.2E-05				
	132	198	162	0.0E+00	1.6E-04	5.2E-04	0.0E+00	1.7E-04				
	198	330	256	0.0E+00	8.9E-04	8.2E-04	0.0E+00	4.3E-04				
	330	528	417	0.0E+00	1.2E-03	2.4E-03	0.0E+00	9.1E-04				
	528	825	660	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	825	1320	1044	0.0E+00	1.1E-04	0.0E+00	0.0E+00	2.8E-05				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	9.1E-05	2.4E-03	3.9E-03	0.0E+00	1.6E-03				
6.25	33	66	46.7	2.4E-05	0.0E+00	0.0E+00	4.8E-06	7.2E-06				
	66	99	80.8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	99	132	114	0.0E+00	0.0E+00	0.0E+00	6.4E-05	1.6E-05				
	132	198	162	0.0E+00	0.0E+00	0.0E+00	1.3E-04	3.1E-05				
	198	330	256	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	330	528	417	0.0E+00	0.0E+00	0.0E+00	7.1E-03	1.8E-03				
	528	825	660	0.0E+00	0.0E+00	0.0E+00	2.3E-03	5.7E-04				
	825	1320	1044	8.7E-04	0.0E+00	0.0E+00	0.0E+00	2.2E-04				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	8.9E-04	0.0E+00	0.0E+00	9.6E-03	2.6E-03				
3.75	33	66	46.7	1.9E-05	1.3E-04	0.0E+00	4.2E-06	3.9E-05				
	66	99	80.8	0.0E+00	3.3E-04	0.0E+00	1.5E-05	8.5E-05				
	99	132	114	0.0E+00	4.8E-04	0.0E+00	5.6E-05	1.3E-04				
	132	198	162	0.0E+00	3.4E-04	0.0E+00	4.4E-04	2.0E-04				
	198	330	256	0.0E+00	6.9E-04	0.0E+00	6.2E-04	3.3E-04				
	330	528	417	0.0E+00	1.1E-03	1.3E-03	2.3E-03	1.1E-03				
	528	825	660	1.4E-03	0.0E+00	3.8E-03	1.4E-03	1.6E-03				
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00				
			Total:	1.4E-03	3.0E-03	5.1E-03	4.8E-03	3.6E-03				
1.25	33	66	46.7	3.1E-05	4.6E-03	3.5E-05	9.5E-05	1.2E-03	3.2E-04	0.000	1.9	2.21E+07
	66	99	80.8	4.8E-05	3.9E-03	5.2E-05	1.3E-04	1.0E-03	2.8E-04	0.001	3.6	3.75E+06
	99	132	114	0.0E+00	5.7E-03	9.8E-05	2.0E-04	1.5E-03	4.2E-04	0.001	6.2	1.99E+06
	132	198	162	1.2E-04	1.5E-02	1.9E-04	3.3E-04	4.0E-03	1.1E-03	0.002	12.8	1.82E+06
	198	330	256	1.3E-03	4.2E-02	1.9E-03	3.5E-03	1.2E-02	3.2E-03	0.005	32.4	1.36E+06
	330	528	417	4.3E-03	6.2E-02	2.5E-02	1.1E-02	2.6E-02	7.3E-03	0.013	77.0	7.14E+05
	528	825	660	2.1E-04	1.5E-02	1.7E-02	1.9E-02	1.3E-02	3.7E-03	0.016	99.6	9.13E+04
	825	1320	1044	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-05	0.016	*****	3.78E+02
	1320	2079	1657	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.016	*****	0.00E+00
	2079	3300	2619	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.016	*****	0.00E+00
	3300	5313	4187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.016	*****	0.00E+00
			Total:	6.0E-03	1.5E-01	4.4E-02	3.4E-02	5.6E-02	1.6E-02			
										0.0010	liters/min/m ^ 2	

Flow Area 59.0 Sq. Meters

Net Rate: 0.058 liters per minute
0.015 gallons per minute

APPENDIX A - TEST PLAN FOR DROPLET MEASUREMENTS AT THE MILLIKEN STATION OF NYSEG

REVISED TEST PLAN FOR DROPLET TESTING AT THE MILLIKEN STATION OF NYSEG

TEST METHODOLOGY

Southern will provide a two-man test crew and the VDA equipment to carry out the testing. Measurements will include VDA operation to determine droplet concentration and size distribution coupled with obtaining independent velocity traverse data for the areas over which droplet measurements are made. The latter are required for calculating droplet carryover rates (gpm/sq.ft. and total gpm) from the VDA droplet concentration data. Where possible the velocity measurements will be made using standard "S-type" pitots; however, if greater sensitivity is needed because of very low gas velocities, a Fluid Dynamic Devices Fluidic Flowmeter will be available. The latter provides a response of about one inch of water per foot-per-second of gas velocity and is quite useful at very low gas velocities.

The VDA system uses a video camera and synchronized high-speed strobe illuminator, both mounted on a probe which can be inserted directly into the gas stream to be sampled, to measure particles (normally droplets) within its sensing zone. The volume of the sensing zone depends on the magnification used and to some extent, because of focus limitations, on the sizes of the droplets being measured. Droplets are measured *in situ* on-the-fly as they pass through a relatively large open area centered between the illuminator and the camera. A combination of purge air and lens shrouds is used to keep the optical surfaces clean and dry. There are four standard optical magnifications for which the VDA can be configured. From the highest magnification to the lowest these provide droplet measurements over size ranges of 3 µm to 480 µm, 10 µm to 1600 µm, 20 µm to 3200 µm, and 33 to 5300 µm. In each case, the data are recorded in 160 uniformly spaced size channels. Although the droplet sizes found downstream of well-performing mist eliminators are typically smaller than 50 µm, this is not the case when carryover becomes significant. Mass median diameters (MMDs) typical of droplet size distributions downstream of mist eliminators that produce significant carryover are in the range of 300 to 1300 µm. (Half of the volume or mass of a distribution is contained in particles or droplets larger than its MMD and half in particles or droplets smaller than its MMD.) Furthermore, droplets as large as 5000 µm have been measured downstream of some poorly performing mist eliminators. Similar size distributions have been found in wet stacks in which reentrainment from the stack walls caused droplet emission problems in the stack discharge. For the Milliken Station tests the system will be set up to provide data over the size range from 33 µm to 5300 µm with a uniform step size of 33 µm per size channel.

When configured for the 33 µm to 5300 µm size range, the cross-sectional area of the sample volume is 8mm X 10mm as viewed by the camera, and the depth of field ranges from about 20mm to 74mm, depending on particle (droplet) size. The resulting volumes of the sensing zone range from about 1.5 to 5 cubic centimeters, depending on particle (droplet) size. The camera/strobe operates at a rate of 60 frames per second, resulting in an effective sampling rate of 4 to 18 liters per minute depending on droplet size. At gas velocities typical of those in the ducts to be tested, the droplets move about two to nine inches between frames, thus no droplets will be measured twice. The data for particles detected by the image analyzer circuitry are passed to a microcomputer as the particles are measured. After verifying that the images were in focus and otherwise acceptable (fully in the field of view), the results are recorded on floppy disk as counts in each in each size channel for each traverse point.

The sensor portion of the VDA probe (illuminator and video camera assembly) is essentially a cylinder 3.82 inches in diameter and 6 ½ feet long, weighing approximately 25 pounds. Using it requires that the sampling ports provide unobstructed openings of at least 4 inch pipe size through which the probe can pass freely. Additional probe sections can be added to permit traversing to depths of up to 15 feet in horizontal operation and up to 25 feet in vertical operation. The probe extension sections for horizontal operation are each approximately 2 feet long and weigh approximately 12 pounds each (including the umbilical lines). Up to eight such sections can be added, as needed. Other parts of the system include a microcomputer (approximately 10 pounds), two custom electronics packages (illuminator supply and image analyzer weighing about 15 pounds each), and a pump used to supply purge air (approximately 50 pounds). The system requires about 15 amps of 115-120 volt AC service for its operation.

The time required to perform a VDA traverse at any given test condition is usually about two to five hours depending on the droplet concentrations, the number of traverse points and ports used, and the ease of access to and movement between ports. A multi-point traverse is normally made with dwell times that are typically one to four minutes per point. The actual dwell times are dictated by the droplet concentrations as these set the amount of time needed to measure a statistically significant number of drops. If the droplets are found to be highly concentrated within a particular zone of a duct, more time can be spent in that zone than in other areas that appear to have less significance. The results are recorded on a point-by-point basis during the traverse so the dwell times at the sampling points need not be uniform. Compensation for unequal dwell times can be made when the data are analyzed. The VDA measures droplet concentrations by size directly. If carryover rates are desired, gas velocities at the sampling points must be measured independently. The latter measurements are made using standard pitot techniques.

As in any determination of particulate emissions, three replicate measurements are desirable. Although three entirely separate traverses can be made to obtain the desired replicates, Southern generally recommends that three measurements be made in succession at each traverse point. The size of the probe and the time required to perform a traverse of a port, especially in horizontal operation when probe sections must often be continually added and removed as the probe is inserted and withdrawn, make it very inefficient to do three completely independent traverses. However, three separate sets of data can be obtained at each traverse point as each is reached in succession in a single physical traverse of the sampling area. This minimizes lost time in making point-to-point and port-to-port moves while still permitting some measure of data reproducibility to be obtained. The time estimates used for costing the proposal for this work were made based on this strategy of making three sets of measurements at each traverse point as it is encountered in a single physical traverse.

The maximum traverse depth and the numbers of sampling ports that can be used at the ME outlets and inlet for these tests will be dictated largely by the actual circumstances of the layouts of the sampling areas and ports as regards access, interferences and obstructions. The probe inevitably has some sag and typically "bottoms out," at a distance of about ten to fifteen feet from the insertion point when testing is done immediately downstream of a mist eliminator (that is the outboard end touches the ME at about that distance). The actual limiting distance depends on the sampling port geometry and how high the port is above the ME exit plane. Given the purpose for which the Milliken tests are to be conducted, the ME exit dimensions, and the port arrangements, we propose that from symmetry considerations only the half of the ME exit plane nearest the ports be traversed. If the latter is done, measurements will be made at distances of 1.25 ft., 3.75 ft., 6.25 ft., and 8.75 ft. From the duct wall. (The latter are the standard traverse point distances from the wall for a ten-foot wide duct—one-half the total depth of the ME exit.) Carryover from the opposite side of the ME would be taken as being equal to that from the side measured. The complete traverse would then consist of sixteen measurement points, four each in each of the four ports along the long dimension of the ME. A complete traverse done in this fashion with six minutes of data being taken at each traverse point will then require about four hours (including the time needed for moving between ports). The six minutes of data would be taken in three two-minute segments. The total actual measurement time for a test would then be 96 minutes (16 points by 6 minutes per port). The total time needed to compete a traverse will be substantially longer than this because of the time needed to move from point to point and port to port. If time and circumstances permit, one or two more sampling points may be added to the traverse for each port, extending the traverse depth to 11.25 ft or 13.75 and/or the sampling times at each pont may be increased from six minutes to nine minutes (using three three-minute segments). If practical, velocity measurements will be made in adjacent ports while the droplet measurements are in progress, otherwise they must be made either before or after the droplet measurements are done. If the velocity measurements can be done concurrently with the droplet measurements, longer sampling times can be used for the droplet measurements. Somewhat shorter sampling dwell times will be used during the ME inlet tests as less time will be needed to obtain good counting statistics at the higher droplet concentrations that will be found there.

Traverses of the stack will be made using the standard traverse pattern for round ducts/stacks of four port by three points per port. The sampling points will be 6 1/4 inches, 21 1/8 inches, and 42 5/8 inches from the stack wall for each port. In this case the dwell times for each individual measurement will be four minutes with three sets of measurements being made at each traverse point. The total accumulated measurement time for a complete traverse will thus be 144 minutes (12 minutes/point by 12 points).

Data analysis is done off-line so results will not be available until several days after the field work is completed. However, rough preliminary indications of relative concentrations of various drop sizes and of overall concentrations can be estimated as testing proceeds. Carryover rate calculations require combining of the VDA and velocity traverse data on a point-by-point basis so the latter will not be available until after our return to Birmingham.

Routine QA/QC checks include verification of system magnification, view volume dimensions, and depth of focus in our laboratories prior to departure to the field. Spot checks to verify the view volume/depth of focus performance are made regularly in the field as the testing proceeds—typically at the start and end of each test day. Complete videotape records of the raw video from the camera, keyed to the sampling traverses, are also made on a routine basis. The latter permit examination of the video imagery from any part of the tests at a later date.

REVISED TEST SCHEDULE

Current plans are for the tests to be conducted during the period of Monday, September 30, 1996 through Thursday, October 10, 1996. The planned sequence for carrying out the measurement program is provided below. Measurements are to be made at the outlets of the mist eliminators on both units, at the stack on both units, and at the mist eliminator inlet on one unit. The plan given below is based on testing on weekdays and Saturday only; however, additional testing can be done over the weekend at the end of the first work-week if needed because of plant load scheduling problems. It will not be practical to make multiple moves from location to location in a single day. The time needed to move from one location to another (for instance ME outlet to inlet or ME outlet to the stack) will be too long to permit measurements to be made at three locations in single day. With the exception of the timing for Day 1, the starting times given below can be advanced by up to two hours if necessary to accommodate plant load requirements. The unit being tested each morning needs to be operating at stable conditions at the designated load and operating condition(s) for the scrubbers for the first test of the day at the time the test team arrives each morning. The load transitions between the morning and afternoon tests, when required, need to be made as expeditiously as possible upon conclusion of the morning's test.

Mon.: 8 am - Arrive at the plant site and set up equipment at the outlet of the first ME to be tested, check the equipment out, and make preliminary measurements.
1 pm - Perform velocity and droplet measurement traverse at the normal load test condition at the outlet of the first ME.
6 pm - Complete first test and secure equipment for the night.

The plant will need to change overnight to crossover operation of the scrubbers with the flow from both units going to the scrubber tested on Monday.

Tues.: 7 am - Arrive at plant and prepare for crossover operation test at the exit of first ME.
8 am - Begin test at exit of first ME at the crossover test condition for that unit.
1 pm - Move to stack and do crossover operation test at that location for the first unit being tested.
6 pm - End third test and secure equipment for the night.

The plant will need to switch back overnight from crossover operation of the scrubbers to normal scrubber operation.

Wed.: 7 am - Arrive at plant and prepare for low load test at the stack for the first unit.
8 am - Begin test at first unit stack at the low load test condition.
1 pm - Begin test at first unit stack at the normal load test condition.
6 pm - Secure equipment for the night.

Thurs.: 7 am - Arrive at plant and prepare for testing second stack at low load test condition.

8 am - Begin test of second stack at low load condition.
1 pm - Begin test of second stack at the normal load test condition.
6 pm - Secure equipment for the night.
The plant will need to change overnight to crossover operation of the scrubbers with the flow from both units going to the scrubber tested on Thursday.

Fri.: 7 am - Arrive at plant and prepare for testing at the stack of the second unit at the crossover test condition.
8 am - Begin crossover operation test at second stack.
1 pm - Move to ME outlet test location for second scrubber and do crossover operation test at that location
6 pm - Complete test crossover operation test at outlet of second unit and move equipment to second unit ME inlet and secure equipment for the night.

Sat: 8 am - Arrive at plant and prepare for ME inlet test at crossover operating condition.
9 am - Begin test of second ME inlet at crossover condition.
1 pm - End test at ME inlet at crossover condition and secure equipment.

Sun. Off day.

Mon.: 7 am - Arrive at plant and prepare for low load test at the ME inlet.
8 am - Begin test at ME inlet at low load test condition.
12 n - Begin test at ME inlet at normal test condition.
4 pm - End third test at ME inlet and move equipment to the ME outlet location on the second unit.
6 pm - Secure equipment for the night.

Tues.: 7 am - Arrive at plant and prepare for testing second ME at the low load test condition.
8 am - Begin test at second ME outlet at the low load test condition.
1 pm - Begin test at second ME outlet at normal load test condition.
6 pm - End testing at second ME outlet, move equipment to outlet of first ME tested and secure equipment for the night.

Wed.: 7 am - Arrive at plant and prepare for testing first ME at the low load test condition.
8 am - Begin test at first ME outlet at the low load test condition.
1 pm - All testing concluded. Begin striking equipment and loading for departure.

Thurs.: 7 am - Arrive at plant and complete packing and loading for departure. (Note: this day can be used as an extra test day if needed should moves between locations take too long to hold the planned schedule.)

APPENDIX B - VIDEO DROPLET ANALYZER

VIDEO BASED IN-SITU DROPLET CONCENTRATION AND SIZE ANALYZER

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ABSTRACT

Data concerning the droplet size distribution of liquid sprays is often needed in research and diagnostic explorations of scrubbers and mist eliminators. In addition, information concerning the spatial and temporal variability of droplet concentrations and size distribution is often desired. The methods that have been available in the past for making such measurements have been generally less than satisfactory because of problems relating to various combinations of time resolution, traverse capability, representative sampling, sizing range, size resolution, survivability of equipment in the scrubber environment, and cost. A video based droplet size and concentration measurement system has been constructed which provides a solution to most of the above problems. A description of the droplet analyzer and how it functions is provided together with exemplary data from field applications.

INTRODUCTION

One of the most difficult aspects of scrubber research and problem solving over the years has been associated with obtaining data on spatial and temporal distributions of droplet size and concentration. The sizes of the droplets in a scrubber play an important role in the performance (efficiency) of the scrubber collecting either particles or gases. The spatial distribution of the liquid similarly plays an important role. These factors, together with the gas velocity distribution, not only are major factors in determining the collection efficiency provided by a scrubber, but also in mist eliminator (ME) performance (and malperformance). Thus knowledge of spatial and temporal variations in droplet concentrations and size distributions is potentially of great value in diagnosing the causes of problems in scrubber/mist eliminator operation which in turn are needed if solutions to the problems are to found in the most expeditious way.

Several methods have been applied in the past, with varying degrees of success, for measuring or estimating droplet size distributions and concentrations. Methods for size measurement have included droplet impingement on coated slides or sensitized paper (1,2), hot wire devices (3), high speed photomicroscopy (4,5), and the use of inertial separators such as impactors or cyclones(6). Each of these has operational limits which restrict its utility. The coated slide/sensitive paper techniques are difficult to apply in high concentration streams and typically provide single point "snapshots" of the size distribution. Sampling and analysis techniques for these two methods are too labor intensive to make wide area traverses for spatial distribution or long term measurements for time resolution feasible. Inertial separators provide data only for sizes smaller than about 15 micrometers while most of the droplet spectrum of interest is in substantially larger sizes. Further, it is difficult or impossible to obtain time resolved data using the inertial devices. The photographic technique offers the possibility of spatial and time resolution but unless applied with motion picture technology has a low data rate; it also has a long analysis time, even if automated image analyzers are used to examine the resulting photomicrographs.

Automated video based droplet analyzers have been used for at least 20 years; some with online real time data analysis (7) and others with much slower offline analysis (8). Because of equipment size these techniques have generally been limited to laboratory application. However, with the advent of small light-weight solid state video cameras it became practical to construct a real time video based droplet analyzer for field application. Such a system was expected to be of great use in diagnosing problems related to mist eliminator carryover in scrubbers at electric utility power stations. Hence the Electric Power Research Institute contracted with Southern Research Institute through the Stearns-Roger Division of United Engineers and Constructors to construct such a system and provide data from it for several sites which were experiencing ME problems. This paper provides a description of the system which was constructed and some results typical of the data that has been obtained using it.

DESCRIPTION OF THE VIDEO DROPLET ANALYZER (VDA)

The droplet analyzer system consists of a sectionalized probe which provides a working length of up to 6 m (20 feet), a probe operator's console and monitor, analyzer console, and a microcomputer for data collection, storage, and analysis. The probe is designed to work through a 10 cm (four inch) or larger access port. The principal components of the system are shown in Figure 1. The probe is connected to the analyzer console by 75 m (250 feet) of cable permitting the analyzer and computer to be located well away from the sampling area.

The probe carries an illuminator, a small solid-state video camera, and its associated "macro" lens. A choice of lenses and extension tubes are available to provide particle sizing ranges from 3-450 micrometers to 45-6500 micrometers diameter with corresponding active fields of view ranging from 0.75mm x 1.0mm to 12mm x 15mm. The size resolution at any magnification is equal to the minimum measurable size for the magnification. Data are obtained in 220 equal interval size channels, although usually only the first 150 channels are retained. Back lighting is used to produce dark droplet images on a bright background. The illuminator and camera unit is shown partially disassembled in Figure 2. The illuminator is suspended from and held directly opposite the camera housing on four small tubes. The view volume is located in the center of the large open area between the camera and illuminator housings. Illumination is provided by a high intensity strobe lamp with a flash duration of 250 nanoseconds. The flash lamp is synchronized to fire during alternate vertical retrace periods of the video camera. The short flash duration effectively eliminates blur from droplet motion. The illuminator and camera lenses are protected from fouling due to entrained liquids and solids by baffled shrouds and a purge air system. The purge air is supplied via a hose from a small compressor located adjacent to the operator's console.

Data acquisition and preliminary analysis take place in real time at a rate of 30 data frames per second. Objects in the field of view are detected by analysis of the video signal level during each scan line. On detection of an object, a timing loop is started which results in the analyzer's looking for a recurrence of an object in a similar horizontal location on succeeding scan lines until it is no longer found. During this process the number of scan lines on which the object was detected is counted. The vertical height of the object is directly proportional to the number of scan lines which it intercepts. Thus the intercepted line count is a direct measure of its height (or diameter if the object is spherical as is the case with small droplets). Focus information is obtained from the shape of the video signal of the image. When a particular image is no longer detected, its intercepted line count and focus information are transmitted to a microcomputer for processing. Four parallel counting (timing loop) circuits are incorporated in the analyzer, permitting simultaneous analysis of up to four particles whose images fall on a common video scan line. After the data for an object has been transmitted to the computer the counting circuit which handled the object is cleared and freed to handle another object. Thus a large number of droplets can be measured in a single video frame. Output of data from the image analyzer to the computer is suppressed if any part of the image falls outside the active field of view. This eliminates incorrectly sizing any droplet whose entire image is not available for measurement but makes the effective field of view dependent on the drop size. Major details of the image analysis are depicted in Figure 3.

Upon receiving the image height and focus data from the analyzer the computer clears the analyzer timing loop which generated the data, freeing it for another image, determines whether or not predetermined focus criteria were met, and if so increments the number counted in the appropriate size bin. Partial data are updated once each second on the computer's video display and full data in tabular and graphical forms are available at the end of an operator selected sampling period which can range from 1 to 255 seconds. The data are also stored on floppy disk for further analysis at a later time.

Video monitors in the probe operator's console and at the image analyzer/computer location provide direct views of the camera's video output and diagnostic information on the performance of the image analyzer circuitry. The video signal from the camera can also be recorded for later inspection and analysis.

The dimensions of the active sensing volume are determined by the height and width of the field of view and the depth of field. The field height and width are fixed by the geometries of the lens and camera. However, the depth of field varies with illumination intensity and particle diameter and must be measured empirically. The dimensions of the sensing zone are small enough for all usable magnifications that, at the velocities encountered in scrubbers and ducts, the sensing zone is swept clear and a new sample is introduced between flashes. The total gas volume sampled at a point can thus be calculated from the sensing zone dimensions and the number of video scans (flashes) which were analyzed. Assuming spherical droplets, their volumes can be calculated from their measured heights (diameters). These volumes can then be summed to obtain the total volume of the particles measured, thus permitting the liquid loading (concentration) in the size range spanned by the instrument to be calculated. Assuming that no significant contribution to the liquid loading is due to droplets having diameters outside the instrument range, the calculated loading can be taken to be the actual liquid concentration in the gas stream. The shapes of plots of measured liquid volumes by size channel can be used to access the validity of the assumption that no significant droplet volume fell outside the measurement range in any given data set.

ANALYZER CALIBRATION AND PERFORMANCE VERIFICATION

Primary calibration of the system is based on glass beads of known sizes mounted on microscope slides. These beads are placed in the view volume and the line count is noted for calibration of diameter versus number of intercepted lines. The slide is then traversed through the depth of the sensing zone by means of a micrometer stage to determine the depth of focus for the size in question. The acceptable focus criteria are adjusted so that the image is considered out of focus if the indicated size differs from the true size by more than ten percent or one line count, whichever results in the greater relative error (ie. one line count for small objects and ten percent in size for large objects). This primary calibration need only be done once in the laboratory for each lens/illuminator setup. Thereafter, depth of field checks at one or two sizes suffice for obtaining corrections for any immediate application.

The measured size spectrum for a mixture of two sizes of glass beads, 450 to 550 μm and 900 to 1250 μm diameter, is shown in Figure 3. The mixture was made up to be approximately 50/50 on a weight basis. This mixture was slowly poured through the sensing zone of the analyzer as part of the verification of the system performance.

Further verification of the performance of the system was obtained by measuring droplet transport rates in the laboratory both directly and by means of the VDA. Two such trials were performed on aerosols which had mass median diameters of about 100 micrometers. The VDA was configured for measurement in the range from 3 to 450 micrometers for these tests. The VDA results showed 80% to 94% of the liquid transport rate measured by direct collection of the liquid that passed through the sensing zone. Comparisons have also been made of the size distributions of liquid sprays from nozzle types for which data were available from other techniques - Malvern optical particle size analyzers and KLD hot wire devices. In each case, the results from the VDA were similar to those from the other technique in the size ranges which they had in common.

CALCULATION OF LIQUID TRANSPORT RATES

If the gas flow is horizontal at the measurement plane and the gas velocity is known, the system also provides a direct measurement of droplet flux (or liquid transport rate). In this case, the velocities of the droplets in the direction of the gas flow can be taken to be equal to the gas velocity. However, if the gas flow is vertical the situation becomes more complex. In the latter case, the droplet flux (in the size range measured) is given by the equation:

$$\text{Flux} = \int_{D_{min}}^{D_{max}} c(D) \times (V_{gas} - V_s(D))\,dD$$

where D_{min} = minimum measurement diameter

D_{max} = maximum measurement diameter

$c(D)$ = concentration of drops having diameter, D

V_{gas} = local gas velocity (positive for flow upward)

and $V_s(D)$ = settling velocity for drops of diameter, D.

For vertical gas flow in the upward direction, small droplets will be moving upward at approximately the velocity of the gas. As the drop size increases the upward velocity of the drops will decrease until the size of the droplets becomes large enough that the settling velocity equals the gas velocity. Droplets having this size, defined as the limiting droplet diameter, will remain virtually suspended until they either decrease in diameter from evaporation or grow by agglomeration. Droplets having diameters greater than the limiting diameter will fall back against the gas flow. The instantaneous values of the limiting diameters will vary with time because of moment to moment velocity fluctuations but values based on local average velocities should be representative. The calculation of liquid fluxes for the case of vertical gas flow thus requires information on the droplet concentration by size, the local gas velocity at each sampling location, and the settling velocities of the droplets by droplet size. The droplet settling velocities can be calculated but the local gas velocities must be separately measured.

Traverses of a sampling plane can be made in two ways. In the first, the probe is inserted through conventional 10 cm (four inch or larger) sampling ports and data is obtained at points along horizontal lines whose spacing is set by the port locations. Because mist eliminator entrainment problems may be associated with highly localized areas across their faces, it was deemed desirable to have the ability to perform a continuous scan over large areas in order to locate trouble spots. Consequently a swiveling probe mount was constructed to provide such a capability. The swiveling mount permits the probe to be swung through an arc slightly greater than 90 degrees while moving in or out over its full 20 foot length. Thus a continuous survey of an area having a 20 foot radius and a slightly more than 90 degree included angle can be obtained. Potentiometers installed in the mount provide information on the position of the particle sensing zone to the computer; this data is logged with the droplet data. This permits accurate repositioning of the probe to obtain more detailed data after identifying areas of special interest. Operation with the swiveling mount does require a large amount of free space around the sampling area and an access port much larger than is commonly used (12 inch or greater in diameter in order to use the full angular swing capability of the mount). The probe is sectionalized in lengths of about 60 cm (22 inches) to minimize free space requirements and access problems in the sampling area. Because of problems in keeping the optical surfaces clean and dry, the probe must be kept horizontal during operation.

By removing the illuminator from the probe, replacing it with a flood light type illumination system, and replacing the "macro" lens with a conventional lens, the probe can be used to examine interior surfaces, etc. within the duct while the scrubber is in operation.

FIELD RESULTS

To date the system has been used at five sites, making measurements around mist eliminators on seven scrubbers and characterizing the spatial distribution of droplets under a variety of conditions in a spray dryer application. It has also been used to measure the droplet size distribution produced by several nozzles being used for spray dry applications.

Figure 5 shows a typical data set taken at the inlet to a mist eliminator on a scrubber installation at a large utility pulverized coal boiler. Measured droplet concentrations by size are shown on the left in the figure. The volumes are in terms of the volume of the droplets in liters per cubic meter found in each of the measured size intervals. In this instance, the droplet size distribution appears to be multimodal with much of the volume in droplets in the one to three millimeter size range. Even larger droplets were present but not shown in the limited size span of the illustration. At the time these data were taken the gas velocity in the sampling zone was such that the limiting droplet diameter was about 1300 micrometers. That is, droplets smaller than 1300 micrometers (1.3 mm) would be carried upward by the gas flow while those larger than this were either falling back against the gas flow or would eventually do so. The liquid transport rate at the measurement plane is shown on the right side of the figure. The transport rate is given as cubic centimeters of droplets per second per square meter of tower cross-section. As droplet sizes increase the net upward velocity of the droplets decreases with small droplets moving at the gas velocity while those near the limiting diameter have near zero velocity. Thus although in terms of concentration, the distribution is dominated by droplets larger than 1000 micrometers, the actual carryover to the mist eliminator is dominated by droplets in the 200 to 900 micrometer size range. If there were no sources injecting large droplets upward into the gas stream below the mist eliminator and no sources above the mist eliminator, the total negative flux, or fallback, should equal the total positive flux, or carryover, if the mist eliminator operated at 100% efficiency.

Figures 6 and 7 show results obtained at the outlet of a ME under two load conditions (40% of full load and full load). As would be expected, the carryover rate was much larger at high load than at low load. The liquid influx to the ME was lower at low load and the mechanisms that cause entrainment from the ME are not as effective at the lower velocities that result from the reduced gas flow. At the high load condition the total carryover from this module was about two liters per minute (0.5 gallons per minute). A companion module to the one from which the data in Figures 6 and 7 were taken had a measured total carryover rate of 12 liters per minute (3 gallons per minute) when the unit was operating at 85% of full load. In terms of detailed spatial distributions, the carryover rates varied by more than a factor of 100 over the zones mapped in each of these two scrubbers and the zones with high carryover rates tended to zones of much greater than average superficial velocity. Thus improvements in the uniformity of flow distribution might be expected to result in reduced carryover rates. In addition, inspection of the ME structure in regions of high carryover can reveal mechanical causes for high entrainment rates in some instances.

In some instances temporal variations can reveal important information as illustrated in Figure 8. This figure shows the variation in concentration at a single location above the exit of a ME through three ME underspray wash cycles. As can be seen, the droplet concentrations increased dramatically when one specific zone of the ME was being washed. That zone in this instance was located approximately 8 m (25 feet) from the measurement location which was itself less than 50 cm (2 feet) above the ME face. Because the area producing the carryover was located so far from the measurement point, only a small part of the actual carryover would have been seen. It was in fact surprising that any was seen, and the true carryover must have been many fold greater than that measured at the selected location. Conservative estimates of the average droplet carryover from this and another similar scrubber tower were of the order of 150 liters per minute (40 gallons per minute) each.

CONCLUSIONS

The Video Droplet Analyser has proven to be a field usable system capable of providing data that is virtually unobtainable in any other fashion regarding droplet size distributions, concentrations, and transport rates. Useful information has been obtained to date for purposes of mist eliminator problem diagnostics and in quantifying processes in spray dry SO_2 control applications. Other applications might include fundamental research on scrubber performance, verification of design predictions for scrubber spray distributions, and verification of mist eliminator performance.

ACKNOWLEDGMENTS

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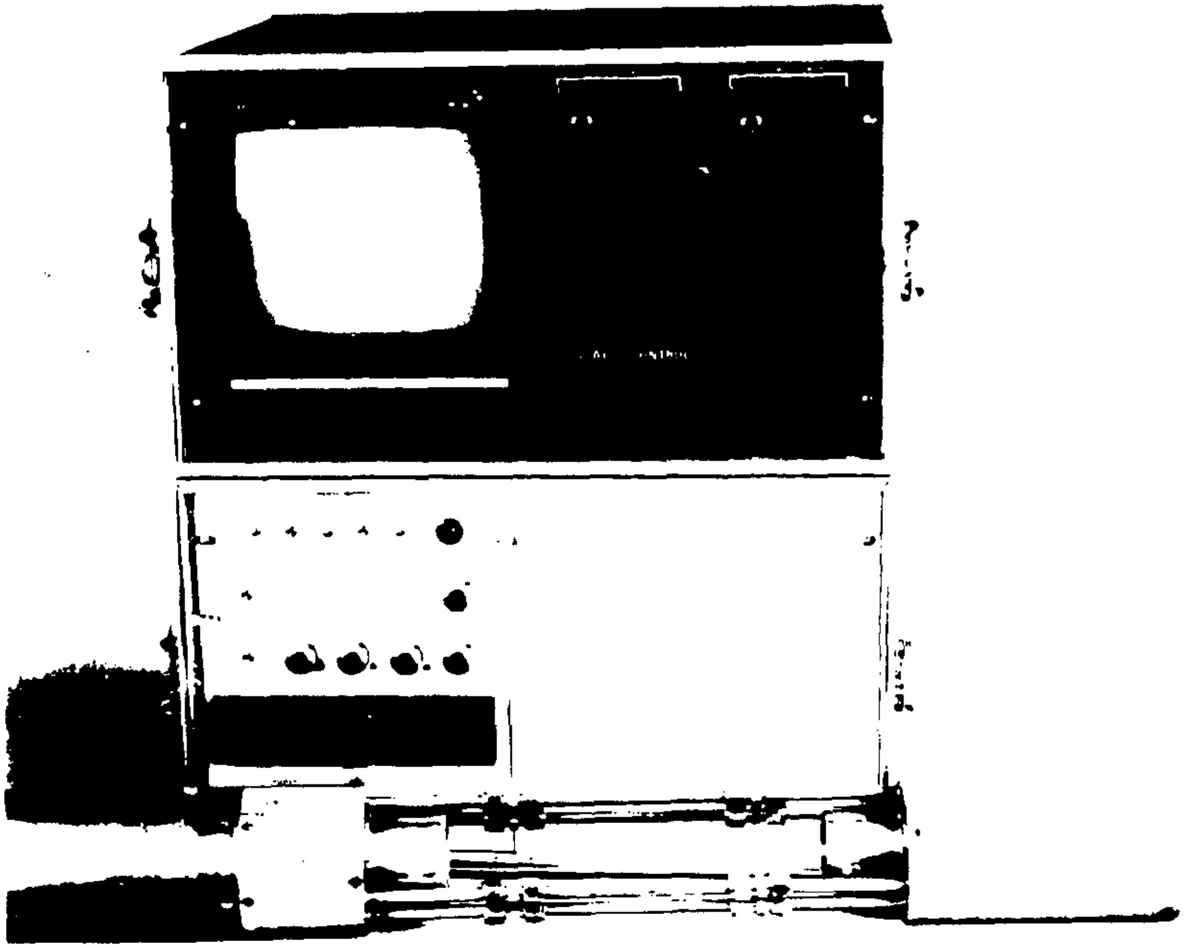

Figure 1. Video droplet analyzer electronics and probe end.

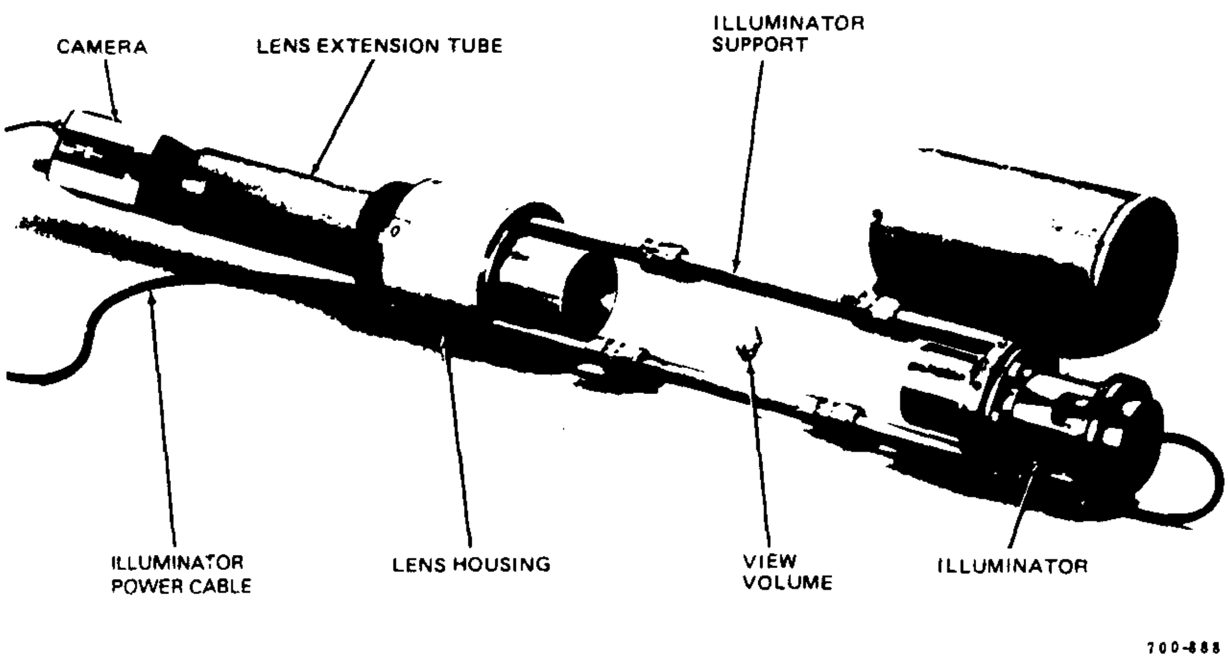

Figure 2. Video Droplet Analyzer Probe end partially disassembled showing camera, lens extension, illuminator and illuminator power cable.

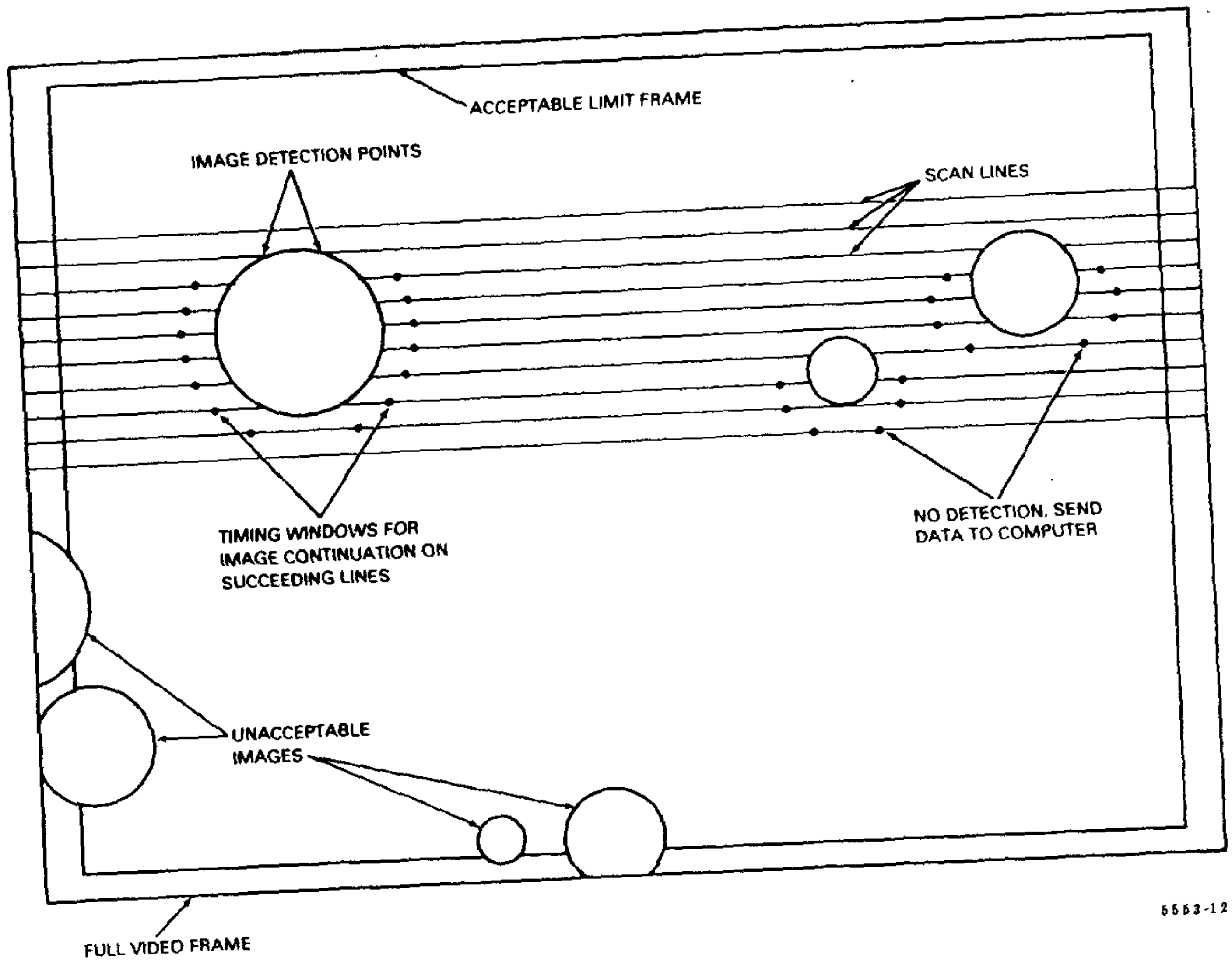

Figure 3. Depiction of image analysis details for the SRI Video Droplet Analyzer.

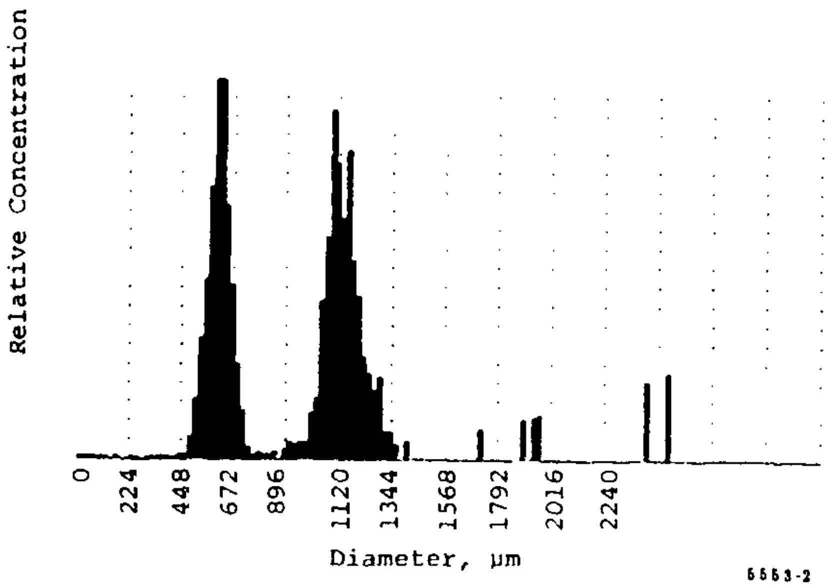

Figure 4. *Size spectrum of a mixture of glass beads of two size classes, 450 to 550 µm and 900 to 1250 µm, as measured with the Video Droplet Analyzer.*

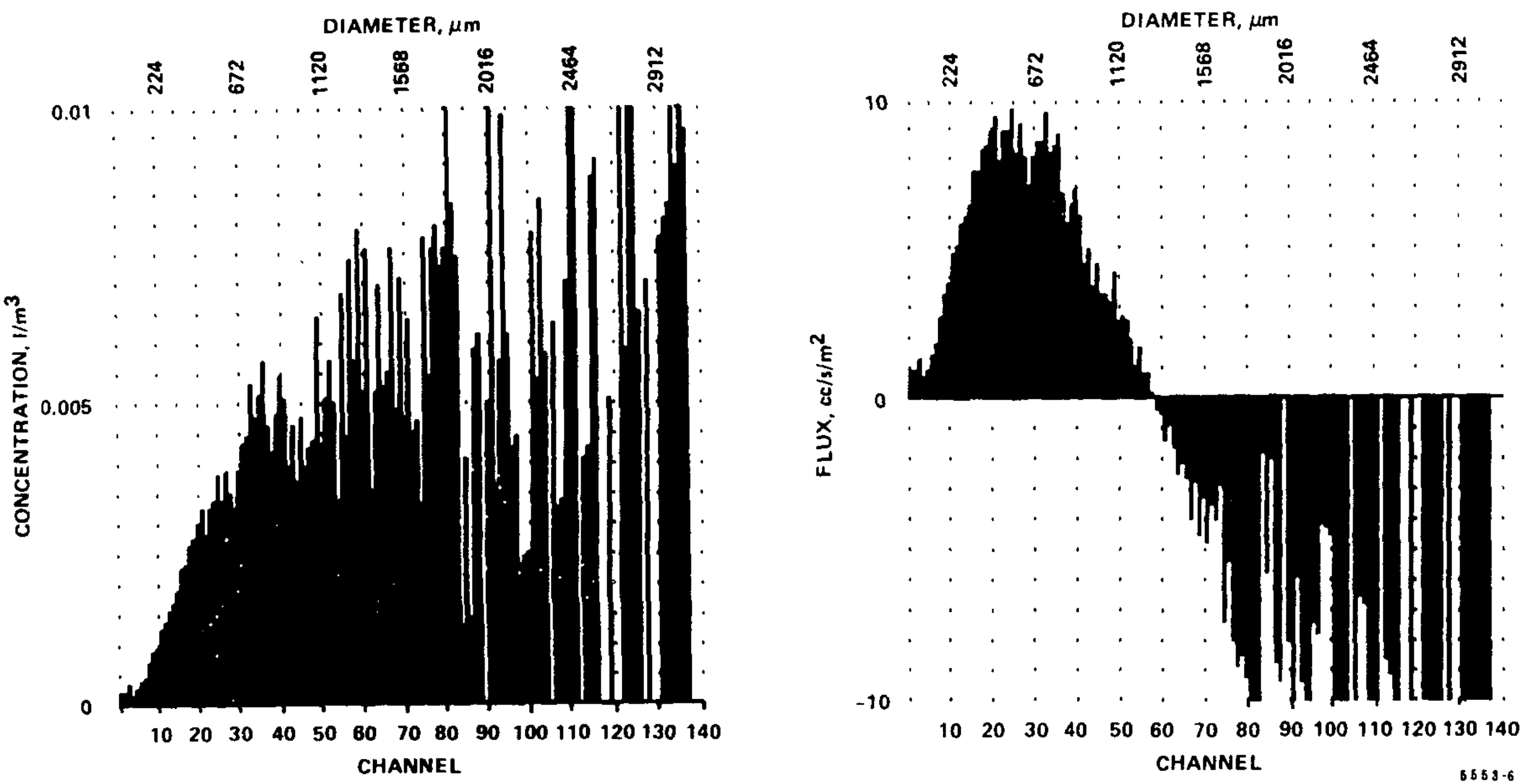

Figure 5. *Concentrations and liquid fluxes by channel for a twelve minute sampling period at a ME inlet. Channel width is 22.4 μm. Positive fluxes represent carryover and negative fluxes represent fallback.*

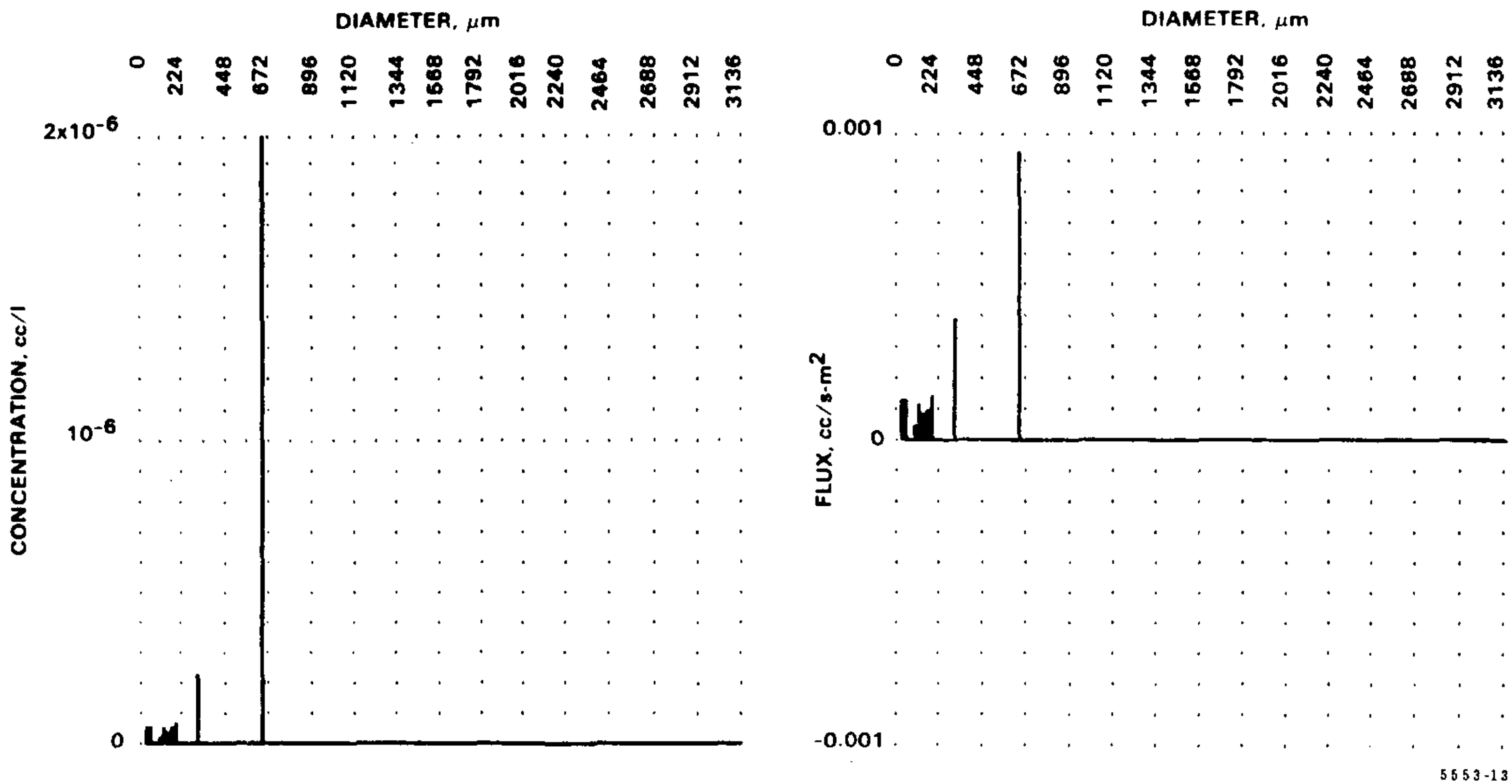

Figure 6. VDA results on a channel by channel basis for the carryover from a scrubber module outlet at a low load test condition.

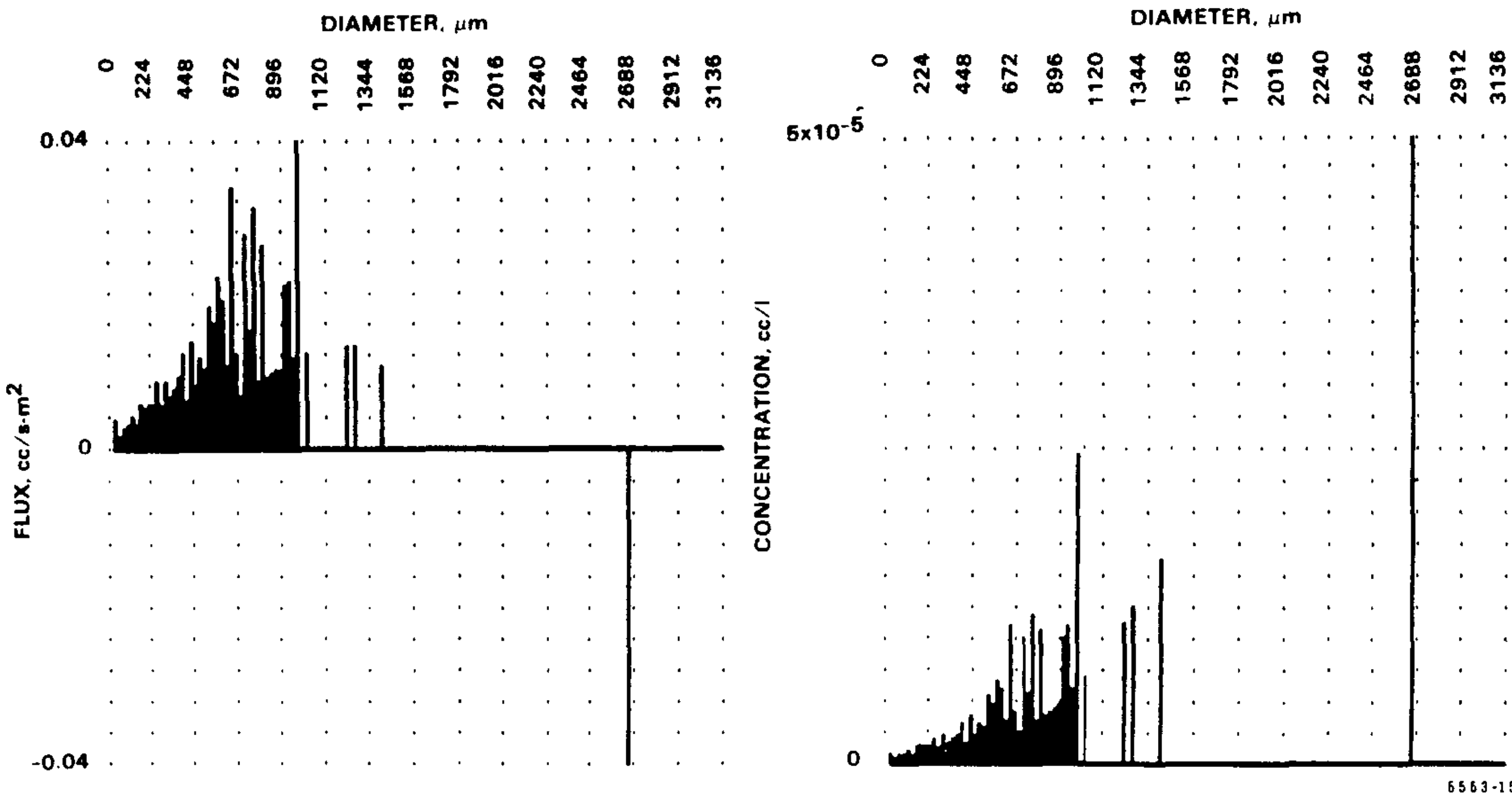

Figure 7. VDA data on a channel by channel basis for the ME outlet of the same module as in Figure 6 at the high load test condition.

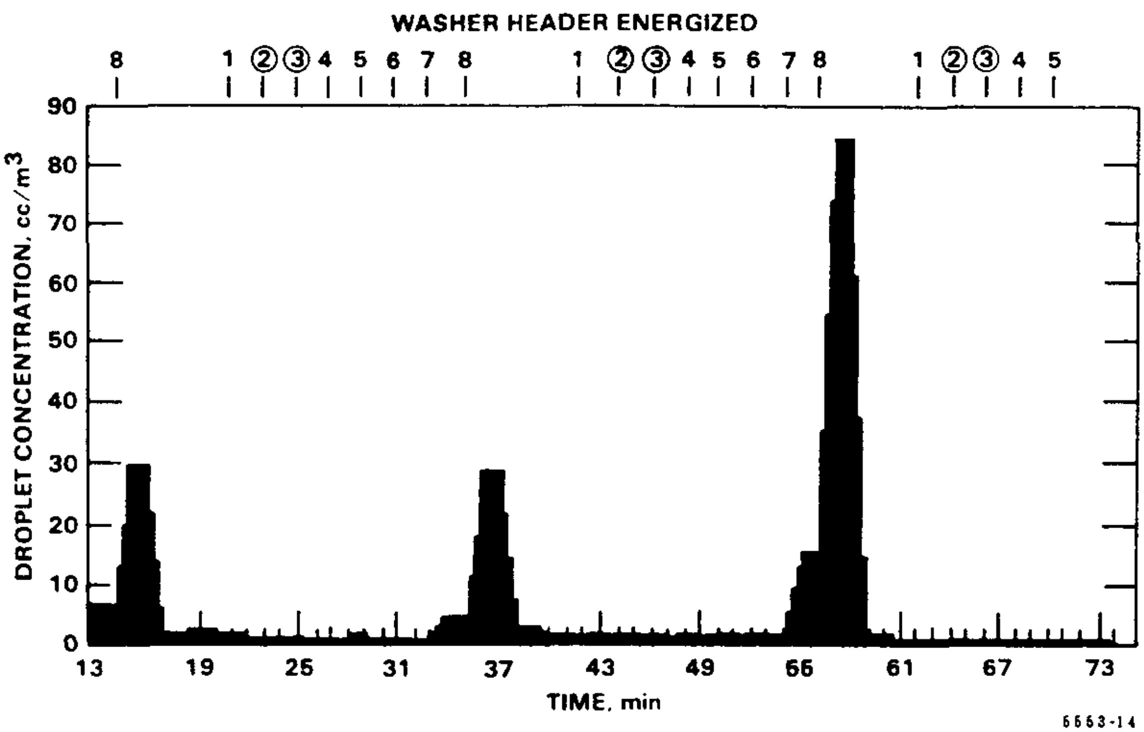

Figure 8. Variation of droplet concentration with time at a single location above a mist eliminator outlet. Timings of ME washes are shown by wash header. The sampling location was above an area washed by headers 2 and 3.

Appendix C - Velocity Data for Milliken Droplet Tests

Velocity Data for Unit 2 Mist Eliminator Outlet Crossover Test 10/1/96

%O2 :	5.0	%H20	14.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	3.0	DUCT ft2 :	635.3

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	0.092	125	0.11	125	0.09	124	0.13	124		
POINT 2	0.15	125	0.131	125	0.1	124	0.09	124		
POINT 3	0.085	125	0.136	125	0.097	124	0.085	124		
POINT 4	0.05	125	0.07	125	0.048	124	0.091	124		
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

-------------------------COMPUTED VELOCITY DATA-------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	17.1	125	18.7	125	16.9	124	20.3	124		
POINT 2	21.8	125	20.4	125	17.8	124	16.9	124		
POINT 3	16.4	125	20.8	125	17.5	124	16.4	124		
POINT 4	12.6	125	14.9	125	12.3	124	17.0	124		
POINT 5										
POINT 6										
AVERAG	17.0	125	18.7	125	16.1	124	17.6	124	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	17.4	GAS VOL FLOW, kacfm :	661.5
AVG STACK TEMPERATURE, F :	125	GAS VOL FLOW,kdscfm :	513.9

Velocity Data for Unit 2 Stack Crossover Test 10/1/96

%O2 :	5.0	%H20	13.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	-0.5	DUCT ft2 :	113.1

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	2.6	123	2.75	123	2.9	123				
POINT 2	3.3	123	3.1	123	3.2	123				
POINT 3	3.3	123	3.1	123	3.1	123				
POINT 4										
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

-------------------------COMPUTED VELOCITY DATA-------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	90.8	123	93.4	123	95.9	123				
POINT 2	102.3	123	99.2	123	100.8	123				
POINT 3	102.3	123	99.2	123	99.2	123				
POINT 4										
POINT 5										
POINT 6										
AVERAG	98.5	123	97.3	123	98.6	123	0.0	0	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	98.1	GAS VOL FLOW, kacfm :	665.9
AVG STACK TEMPERATURE, F :	123	GAS VOL FLOW,kdscfm :	520.2

Velocity Data for Unit 2 Stack Low Load Test 10/2/96

%O2 :	5.0	%H20	14.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	-0.1	DUCT ft2 :	113.1

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	0.78	126	0.78	124	0.85	126				
POINT 2	0.92	126	0.87	124	0.92	126				
POINT 3	0.9	126	0.87	124	0.9	126				
POINT 4										
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

------------------------COMPUTED VELOCITY DATA--------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	50.0	126	49.9	124	52.2	126				
POINT 2	54.3	126	52.7	124	54.3	126				
POINT 3	53.7	126	52.7	124	53.7	126				
POINT 4										
POINT 5										
POINT 6										
AVERAG	52.6	126	51.7	124	53.4	126	0.0	0	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	52.6	GAS VOL FLOW, kacfm :	356.8
AVG STACK TEMPERATURE, F :	125	GAS VOL FLOW,kdscfm :	274.7

Velocity Data for Unit 2 Stack High Load Test 10/2/96

%O2 :	5.0	%H20	14.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	-0.2	DUCT ft2 :	113.1

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	1.06	126	1	126	0.93	126				
POINT 2	1.12	126	1.18	126	1.2	126				
POINT 3	1.12	126	1.12	126	1.14	126				
POINT 4										
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

----------------------COMPUTED VELOCITY DATA----------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	58.3	126	56.6	126	54.6	126				
POINT 2	59.9	126	61.5	126	62.0	126				
POINT 3	59.9	126	59.9	126	60.4	126				
POINT 4										
POINT 5										
POINT 6										
AVERAG	59.3	126	59.3	126	59.0	126	0.0	0	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	59.2	GAS VOL FLOW, kacfm :	401.8
AVG STACK TEMPERATURE, F :	126	GAS VOL FLOW,kdscfm :	308.9

Velocity Data for Unit 1 Stack Low Load Test 10/3/96

%O2 :	5.0	%H20	11.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	-0.1	DUCT ft2 :	113.1

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	0.85	119	1	119	0.85	120				
POINT 2	1.13	119	1.2	119	1.05	120				
POINT 3	1.2	119	1.17	119	1.1	120				
POINT 4										
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

-------------------------COMPUTED VELOCITY DATA-------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	51.5	119	55.9	119	51.6	120				
POINT 2	59.4	119	61.2	119	57.3	120				
POINT 3	61.2	119	60.4	119	58.6	120				
POINT 4										
POINT 5										
POINT 6										
AVERAG	57.4	119	59.2	119	55.8	120	0.0	0	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	57.5	GAS VOL FLOW, kacfm :	389.9
AVG STACK TEMPERATURE, F :	119	GAS VOL FLOW,kdscfm :	313.8

Velocity Data for Unit 1 Stack High Load Test 10/3/96

%O2 :	5.0	%H20	12.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	-0.1	DUCT ft2 :	113.1

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	1.3	120	1.45	119	1.35	120				
POINT 2	1.6	120	1.65	119	1.6	120				
POINT 3	1.65	120	1.6	119	1.6	120				
POINT 4										
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

------------------------COMPUTED VELOCITY DATA------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	63.9	120	67.4	119	65.1	120				
POINT 2	70.9	120	71.9	119	70.9	120				
POINT 3	72.0	120	70.8	119	70.9	120				
POINT 4										
POINT 5										
POINT 6										
AVERAG	68.9	120	70.1	119	69.0	120	0.0	0	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	69.3	GAS VOL FLOW, kacfm :	470.3
AVG STACK TEMPERATURE, F :	120	GAS VOL FLOW,kdscfm :	374.1

Velocity Data for Unit 1 Stack Crossover Test 10/4/96

%O2 :	5.0	%H20	11.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	-0.2	DUCT ft2 :	113.1

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	2.9	119	3.1	120	3	119				
POINT 2	3.3	119	3.5	120	3.6	119				
POINT 3	3.5	119	3.5	120	3.5	119				
POINT 4										
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

-------------------------COMPUTED VELOCITY DATA-------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	95.2	119	98.5	120	96.8	119				
POINT 2	101.5	119	104.6	120	106.0	119				
POINT 3	104.5	119	104.6	120	104.5	119				
POINT 4										
POINT 5										
POINT 6										
AVERAG	100.4	119	102.6	120	102.4	119	0.0	0	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	101.8	GAS VOL FLOW, kacfm :	690.8
AVG STACK TEMPERATURE, F :	119	GAS VOL FLOW,kdscfm :	556.0

Velocity Data for Unit 1 Mist Eliminator Outlet Crossover Test 10/4/95

%O2 :	5.0	%H20	11.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	3.0	DUCT ft2 :	635.3

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	0.04	120	0.07	121	0.055	120	0.12	120		
POINT 2	0.095	120	0.075	121	0.095	120	0.12	120		
POINT 3	0.115	120	0.1	121	0.135	120	0.15	120		
POINT 4	0.115	120	0.11	116	0.15	120	0.15	120		
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

-------------------------COMPUTED VELOCITY DATA-------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	11.1	120	14.8	121	13.1	120	19.3	120		
POINT 2	17.2	120	15.3	121	17.2	120	19.3	120		
POINT 3	18.9	120	17.6	121	20.5	120	21.6	120		
POINT 4	18.9	120	18.4	116	21.6	120	21.6	120		
POINT 5										
POINT 6										
AVERAG	16.5	120	16.5	120	18.1	120	20.4	120	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	17.9	GAS VOL FLOW, kacfm :	681.7
AVG STACK TEMPERATURE, F :	120	GAS VOL FLOW,kdscfm :	552.4

Velocity Data for Unit 1 Mist Eliminator Outlet Test at Low Load 10/8/96

%O2 :	5.0	%H20	11.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	0.5	DUCT ft2 :	635.3

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	0.012	121	0.0045	121	0.01	125	0.016	121		
POINT 2	0.032	122	0.031	122	0.026	125	0.056	122		
POINT 3	0.033	122	0.031	122	0.045	124	0.065	122		
POINT 4	0.034	122	0.043	122	0.063	124	0.088	122		
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

------------------------COMPUTED VELOCITY DATA-------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	6.1	121	3.8	121	5.6	125	7.1	121		
POINT 2	10.0	122	9.9	122	9.0	125	13.2	122		
POINT 3	10.2	122	9.9	122	11.9	124	14.3	122		
POINT 4	10.3	122	11.6	122	14.1	124	16.6	122		
POINT 5										
POINT 6										
AVERAG	9.2	122	8.8	122	10.2	125	12.8	122	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	10.2	GAS VOL FLOW, kacfm :	389.5
AVG STACK TEMPERATURE, F :	122	GAS VOL FLOW,kdscfm :	312.4

Velocity Data for Unit 1 Mist Eliminator High Load Outlet Test 10/8/96

%O2 :	7.8	%H20	14.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	12.0			STACK dP, H20:	0.5	DUCT ft2 :	635.3

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	0.014	125	0.008	124	0.012	125	0.027	125		
POINT 2	0.045	126	0.031	125	0.049	125	0.078	125		
POINT 3	0.054	126	0.042	125	0.068	125	0.088	126		
POINT 4	0.06	125	0.046	125	0.075	125	0.1	125		
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

-----------------------COMPUTED VELOCITY DATA-----------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	6.7	125	5.1	124	6.2	125	9.3	125		
POINT 2	12.1	126	10.0	125	12.6	125	15.9	125		
POINT 3	13.2	126	11.6	125	14.8	125	16.9	126		
POINT 4	13.9	125	12.2	125	15.6	125	18.0	125		
POINT 5										
POINT 6										
AVERAG	11.5	126	9.7	125	12.3	125	15.0	125	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	12.1	GAS VOL FLOW, kacfm :	462.1
AVG STACK TEMPERATURE, F :	125	GAS VOL FLOW,kdscfm :	356.4

Velocity Data for Unit 2 Mist Eliminator Outlet Test at Low Load 10/9/96

%O2 :	5.0	%H20	14.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	0.5	DUCT ft2 :	635.3

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	0.018	124	0.036	128	0.042	127	0.035	128		
POINT 2	0.018	127	0.026	128	0.026	127	0.02	128		
POINT 3	0.037	128	0.038	128	0.035	127	0.027	128		
POINT 4	0.034	128	0.04	128	0.036	127	0.02	121		
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

-----------------------------COMPUTED VELOCITY DATA-----------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	7.6	124	10.7	128	11.6	127	10.6	128		
POINT 2	7.6	127	9.1	128	9.1	127	8.0	128		
POINT 3	10.9	128	11.0	128	10.6	127	9.3	128		
POINT 4	10.4	128	11.3	128	10.7	127	8.0	121		
POINT 5										
POINT 6										
AVERAG	9.1	127	10.6	128	10.5	127	9.0	126	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	9.8	GAS VOL FLOW, kacfm :	373.2
AVG STACK TEMPERATURE, F :	127	GAS VOL FLOW,kdscfm :	286.9

Velocity Data for Unit 2 Mist Eliminator Outlet High Load Test 10/9/96

%O2 :	5.0	%H20	16.0	AMB PRESS, Hg:	29.70	PITOT CAL:	0.8
%CO2 :	15.0			STACK dP, H20:	2.0	DUCT ft2 :	635.3

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1	0.025	129	0.05	132	0.062	132	0.044	133		
POINT 2	0.029	129	0.032	131	0.039	132	0.023	133		
POINT 3	0.045	129	0.047	130	0.055	131	0.027	131		
POINT 4	0.046	129	0.05	130	0.05	130	0.029	130		
POINT 5										
POINT 6										

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP	VEL P	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										

-------------------------COMPUTED VELOCITY DATA-------------------------

	PORT 1		PORT 2		PORT 3		PORT 4		PORT 5	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1	9.0	129	12.7	132	14.2	132	12.0	133		
POINT 2	9.7	129	10.2	131	11.2	132	8.6	133		
POINT 3	12.1	129	12.3	130	13.3	131	9.4	131		
POINT 4	12.2	129	12.7	130	12.7	130	9.7	130		
POINT 5										
POINT 6										
AVERAG	10.7	129	12.0	131	12.9	131	9.9	132	0.0	0

	PORT 6		PORT 7		PORT 8		PORT 9		PORT 10	
	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP	VELg	TEMP
POINT 1										
POINT 2										
POINT 3										
POINT 4										
POINT 5										
POINT 6										
AVERAG	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

AVG STACK VELOCITY, ft/s :	11.4	GAS VOL FLOW, kacfm :	433.6
AVG STACK TEMPERATURE, F :	131	GAS VOL FLOW,kdscfm :	324.8