TRAINING ON ANTAM STANDARD CODE
For TESTING OF KNAPSACK MISTERS CUM DUSTERS

PART - 8: TESTS & CHECKS FOR PERFORMANCE 2

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TESTS AND CHECKS FOR PERFORMANCE 2

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MISTING DISCHARGE RATE (FULL TANK, VARIOUS TANK VOLUMES) AND RESIDUES

Materials and instrumentation

- This test is non-destructive and required the use of a complete mister.
- Weighing device and a measuring cylinder of 1 liter capacity
- Mount the machine as shown

Equipment		
Test bench for mounting mister cum duster	Stopwatch	Balance
		

Test procedure (Full tank)

•A device for the suction and the evacuation of exhaust gases shall be used when a mister cum duster is tested inside the testing facility

•Fill the tank of the mister with clean water up to its full tank capacity.

•Firmly place the knapsack mister on a weighing scale (or hang it),

•Set the flow regulator at a desired setting (Figure 15a)

•The mister should be run idle for some time before commencing the test to avoid initial variation in discharge

•Divide the starting and stopping of misting into 5 to 7 segments of full tank capacity (stopping is defined as irregular continuous misting).

•Measure the time and respective misting rate by weighting the mister between each segments. Conduct the horizontal and vertical misting.

•Residue -weigh or measure the residual clean water remained in the chemical tank after each test and record it in Table 15a.

•Repeat three times.

Tank filling

Mister placed on a balance

Residues measurement

Calculations and criteria:

$$Q_i = \frac{\Delta g_i}{\Delta t_i}$$

where Q_i = Average discharge rate at measure segment, kg / min
Δg_i = Amount discharged at measured segments, kg
Δt_i = Average time for discharge at measured segments, min

$$Q = \frac{1}{n}\sum_{i=1}^{n} Q_i$$

where Q = Average discharge rate, kg / min and n = Number of segment

$$S = \sqrt{\left[\frac{1}{n-1}\sum_{i=1}^{n}(Q_i - Q)^2\right]}$$

where S = Standard deviation

$$V = \frac{S}{Q} \times 100$$

where V = Coefficient of variation, %

Machine model		Rated RPM		Rated power, kW	
Instrument type and model		Environment Temperature/ Humidity		Test date	
Test site		Misting pipe condition:			
Inspector					

Test No.	Discharge segment		1	2	3	4	5	6	7
	Reduction in test materials (kg)								
Record	spray time (s)	1							
		2							
		3							
Computation	spray time (s)	1							
		2							
		3							
		Average							
	Sprayed rate, kg/min								
	Average sprayed rate, kg/min								
	Standard deviation								
	Coefficient of variation (%)								
	Residue (kg) test 1								
	Residue (kg) test 2								
	Residue (kg) test 3								
	Residue (kg) - average								

Test procedure -Tank filling variation discharge –Liquid

- Obtain the tank filling variation discharge with data from Table 15.3.

- The variation in discharge due "to tank filling at the various segments defined in Table 15.3. shall not exceed 15% of the discharge at full capacity of the tank as obtained in 15.3.

DUSTING DISCHARGE RATE (FULL TANK, VARIOUS TANK VOLUMES) AND RESIDUES

Materials and instrumentation

This test is non-destructive and required the use of a complete duster.

- Weigh device
- Mount the machine on a test rig
- Use micro granules (eg. millet of bulk density of 0.83 kg l -1).

Equipment		
Test bench for mounting mister cum duster	Stopwatch	Balance
		

Test procedure (Full tank)

•A device for the suction and the evacuation of exhaust gases shall be used when a mister cum duster is tested inside the testing facility

•Fill the tank of the duster with dust/micro granule material up to its full tank capacity.

•Firmly place the knapsack duster on a weighing scale (or hang it) (Figure 16a)

•The duster should be run idle for some time before commencing the test to avoid initial variation in discharge

•Set the flow regulator at a full discharge setting

•Measure the time and respective dusting rate by weighting the duster between segments.
•Conduct the horizontal and vertical dusting.
•Repeat three times and obtain the average discharge per minute.
•The data shall be recorded in Table 16a
•Residue -weigh or measure the residual dust remained in the chemical tank and hose after the test and record it in Table 16a.

Calculations and criteria:

$$Q_i = \frac{\Delta g_i}{\Delta t_i}$$

where Q_i = Average discharge rate at measure segment, kg / min
Δg_i = Amount discharged at measured segments, kg
Δt_i = Average time for discharge at measured segments, min

$$Q = \frac{1}{n}\sum_{i=1}^{n} Q_i$$

where Q = Average discharge rate, kg / min and n = Number of segment

$$S = \sqrt{\left[\frac{1}{n-1}\sum_{i=1}^{n}(Q_i - Q)^2\right]}$$

$$V = \frac{S}{Q} \times 100$$

where V = Coefficient of variation, %

where S = Standard deviation

Table 16a. Dusting volume, evenness and residue test

Machine model		Rated RPM		Rated power, kW	
Instrument type and model		Environment Temperature/ Humidity		Test date	
Test site			Dusting pipe condition:		
Inspector					

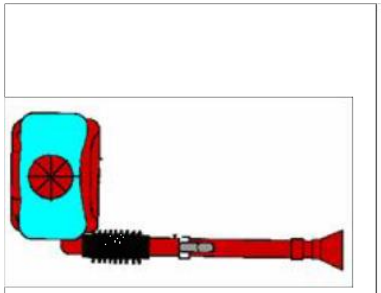
Test No.	Tank level		1/4	1/2	3/4	4/4
	Reduction in test materials (kg)					
Record	Continuous dusting time (s)	1				
		2				
		3				
Computation	Continuous dusting time (s)	1				
		2				
		3				
		Average				
	Dusting rate, kg/min					
	Average dusting rate, kg/min					
	standard deviation					
	Coefficient of variation (%)					
	Residue (kg) 1					
	Residue (kg) 2					
	Residue (kg) 3					
	Residue (kg) Average					

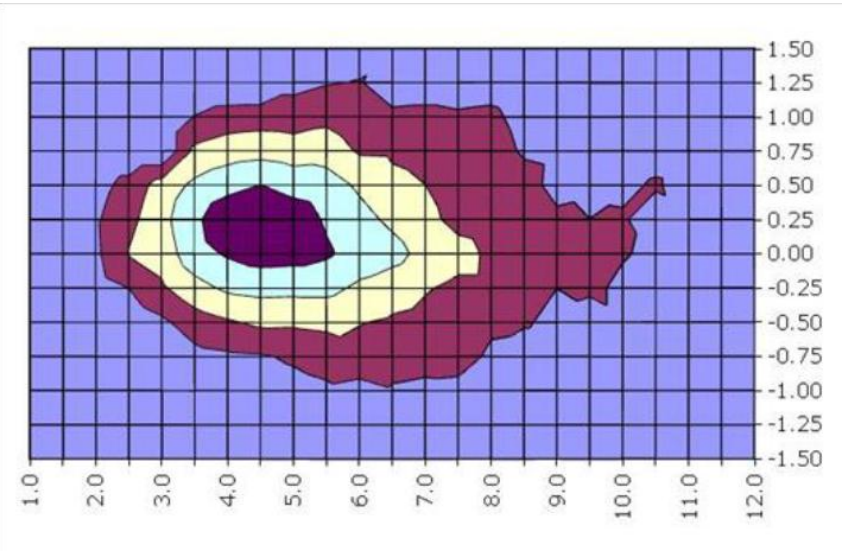
Test procedure (intermediate levels of the tank –maximum discharge rate)

- A device for the suction and the evacuation of exhaust gases shall be used when a mister cum duster is tested inside the testing facility
- Fill the tank with dust up to one-fourth of its full tank capacity. Operate the duster at its rated speed and set the flow regulator to maximum discharge. The variation in speed, if any, shall be not more than 5 percent.
- Run the engine until the dust/micro granule in tank is emptied. Record the starting and stopping time accurately. Calculate the discharge rate per minute.
- Repeat the above test for a minimum of three times and calculate the average discharge rate.
- Conduct the above test at one-half and three-fourths of the full tank capacity.
- The provision for graduations showing 1/4, 1/2, 3/4 and full opening positions shall be made. The data shall be recorded in Table 16a.
- The variation in discharge due "to tank filling at one-fourth, one-half and three-fourths of total capacity shall not exceed 15 percent of the discharge at full tank capacity of the tank as obtained in 16.2.
- Residue -weigh or measure the residual dust remained in the chemical tank and hose after the test and record it in Table 16a.

MISTING OR DUSTING RANGE AND WIDTH DURING GROUND DEPOSITION TEST

Objective : Determine the misting/dusting range and width as the following figure.





Materials and instrumentation

- Conduct this test in an enclosed space without interferences due to wind
.
- Place the mister cum duster in an upright position.

- Lock the machine on the test bench.

Test procedure (Full tank)

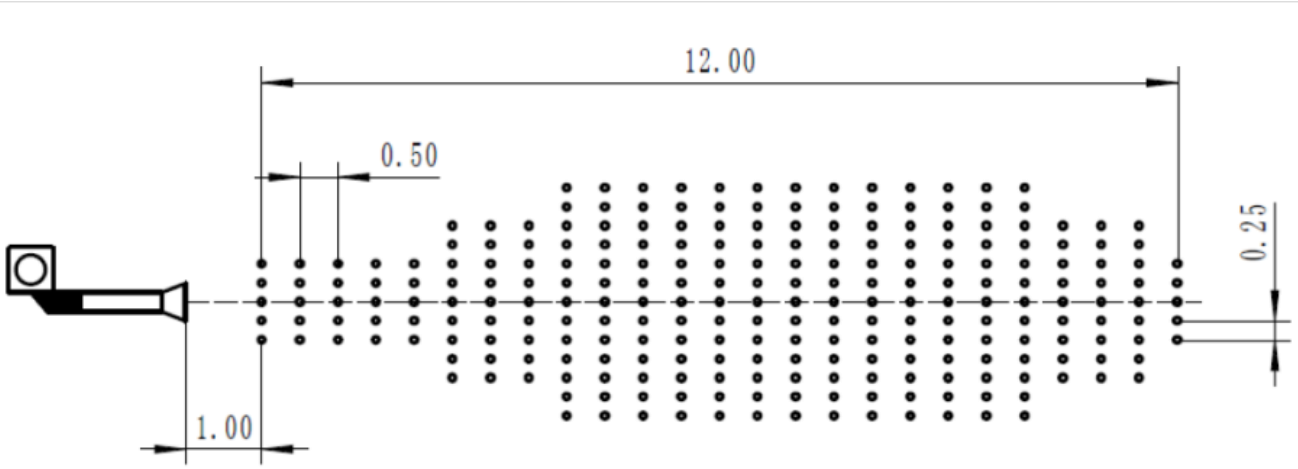
•A device for the suction and the evacuation of exhaust gases shall be used when a mister cum duster is tested inside the testing facility

•Position air duct pipe in a horizontal position such as the height of the mister cum duster outlet center is 1000 ±20 mm from the ground.

Initial trial.

•Fill the chemical tank with clean water and set engine at rated speed. Operate the misting at full throttle for 3 min.

•Visually observe the coverage of misting that will define the sample zone. (Figure 17b)



Methodology :

a. Use rows of 60 mm diameter Petri dishes to sample water droplets. Each sidewall of the indoor enclosure shall have a minimum distance of 500 ±20 mm from the outermost Petri dishes (Figure 17c).

b. Weigh and identify each Petri dish. Position the center row of Petri dishes corresponding with the symmetric axis of the air duct pipe. The first Petri dish is placed at 1000 ±20 mm from the air duct pipe outlet. The following Petri dishes shall be placed at 500 ±20 mm from one to another. Additional number of Petri dishes is placed as according to the dimension and shape of the zone defined in section 17.3 c.

c. Set the engine speed according to the rated engine speed defined by the manufacturer. This test is conducted with the shutter outlet set at the minimum and the maximum misting/dusting flow rate. Fill the mister tank to the full tank level. Conduct the test while observing the water level of each of the Petri dishes. Stop the test when one of the Petri dishes is almost full with water or the tank is empty. (Figure 17 d)

d. Number and collect all Petri dishes and weigh the mass of water taking into
e. Repeat similar procedure (1 to 4) for dusters considering water is replaced by dust/micro granules. (use preferably collectors with height of at least 100 mm)

Table 17a. Fill in the following tables

	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000 …
-2500	Dish1	dish2	dish3	…							
-2000											
-1500											
-1000											
-500											
0											
500											
1000											
1500											
2000											
2500 …											

Dish #	Initial mass, g	Mass after misting/dusting, g	Net mass , g
1			
2			
3…			

VERTICAL DEPOSITION TEST (MISTER ONLY)

Materials and instrumentation

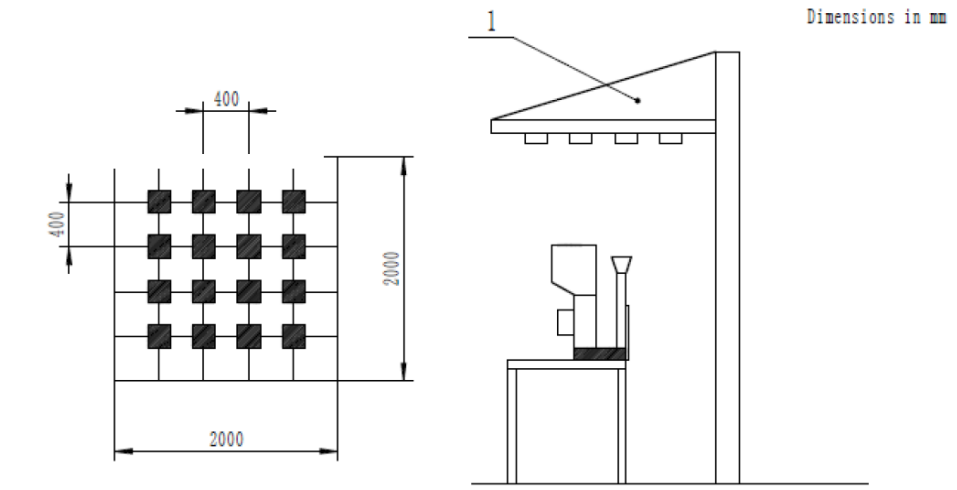
a. Conduct this test in an enclosed space without interferences due to wind.

b. Place the mister cum duster in an upright position.

c. Lock the machine as per figure below. Position air duct pipe in a vertical position such as the height of the mister cum duster outlet center is about 100 mm to 1000 ±20 mm from the ground.

d. Place a set of sponges tight to the support

Equipment
Vertical deposition test set up for mister cum duster



Key

1 device with sponges

Figure B.1-Vertical sampling device

Test procedure (Full tank)

a. A device for the suction and the evacuation of exhaust gases shall be used when a mister cum duster is tested inside the testing facility

b. A pre-test can be conducted in order to define the sampling area with sponges

c. Use rows of sponges to sample water droplets. Identify each sponge, verify it is dry before the test and weigh.

d. Position the center row of sponges corresponding with the symmetric axis of the air duct pipe. The sponges sampling grid is placed at a height of 3000 ±20 mm from the air duct pipe outlet.

e. Set the engine speed according to the rated engine speed defined by the manufacturer. This test is conducted with the shutter outlet set at the minimum and the maximum misting flow rate. Fill the mister tank to the full tank level. Conduct the test until the sponges almost get saturated.

f. Number and collect all sponges and weigh the mass of water taking into consideration the initial mass of each sponge.

	400	800	1200	1600…
400	Sponge 1	Sponge 2	Sponge 3	Sponge 4
800	Sponge 5	Sponge 6	Sponge 7	Sponge 8
1200	Sponge 9	Sponge 10	Sponge 11	Sponge 12
1600…	Sponge 13	Sponge 14	Sponge 15	Sponge 16

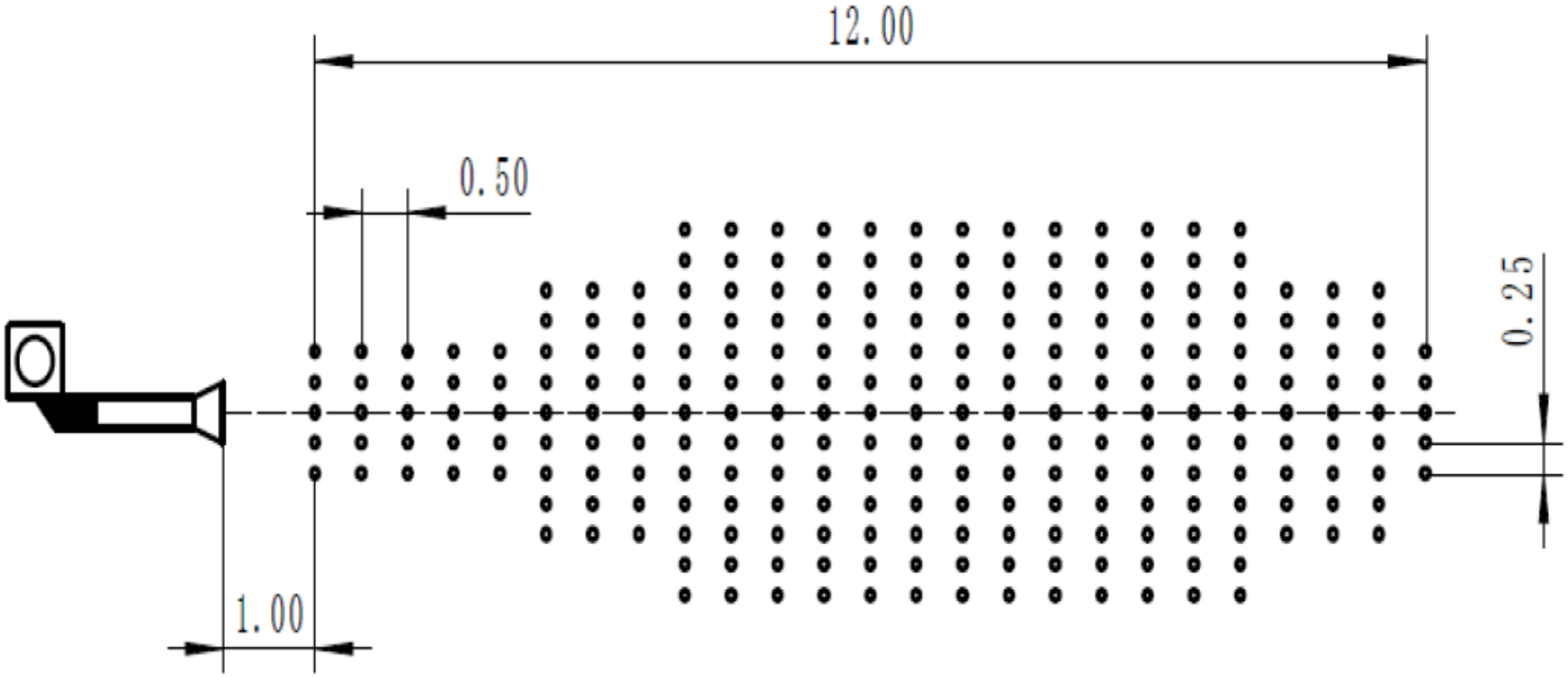
Sponge #	Dry mass (g) DM	Wet mass (g) WM	Water collected (g) W W= WM - DM
1			
2			
3…			

MEASUREMENT OF DROPLET SIZE AND DROPLET DENSITY (MISTER)

Materials and instrumentation

a. Conduct this test in an enclosed space without interferences due to wind.
b. Place the mister cum duster in an upright position.
c. Position air duct pipe in a horizontal position such as the height of the mister cum duster outlet center is 1000 ±20 mm from the ground.
d. Plan scanner
e. Paper cards or water sensitive papers and Petri dishes (Figure 19a).

Equipment
Test bench for mounting mister cum duster



12.00
0.50
0.25
1.00

Test procedure (Full tank)

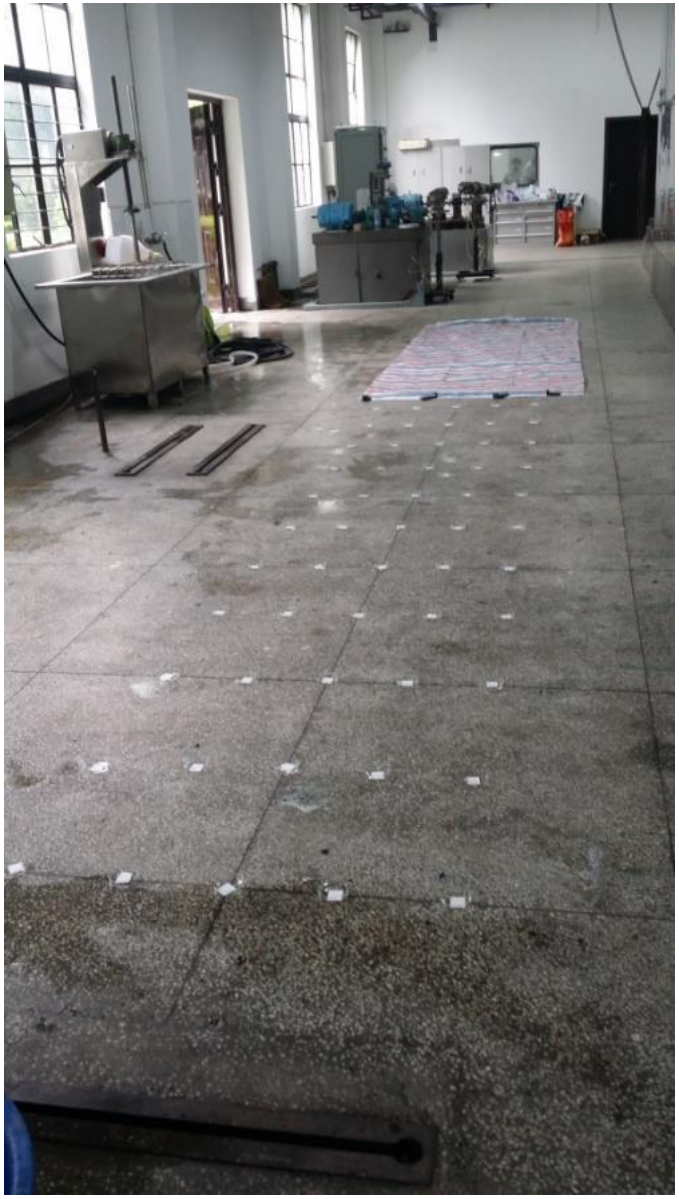
a. A device for the suction and the evacuation of exhaust gases shall be used when a mister cum duster is tested inside the testing facility

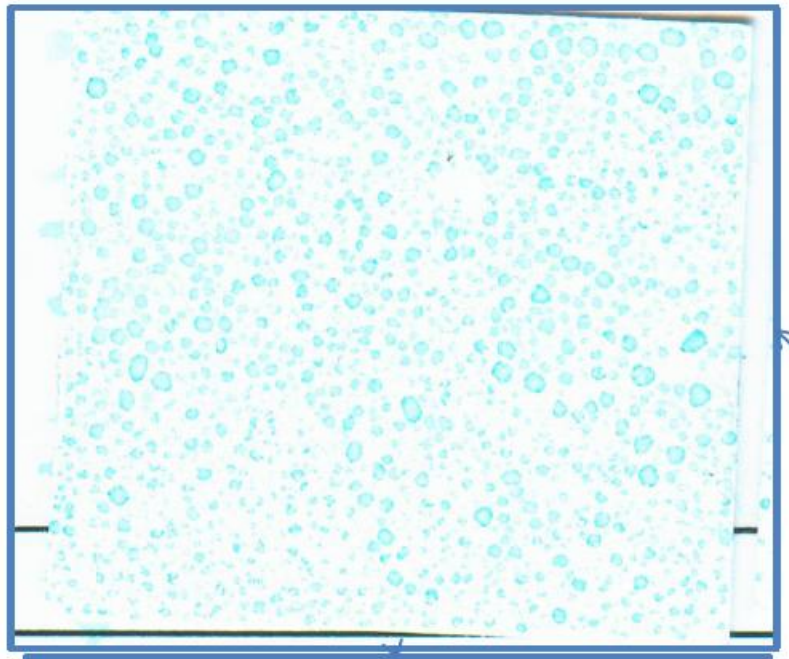
b. Fill the tank either with clean water (in case Water Sensitive Papers are used) or coloured water when a dye is used to contrast with artificial collectors such as filter papers, papers cards, etc placed in each Petri dish.

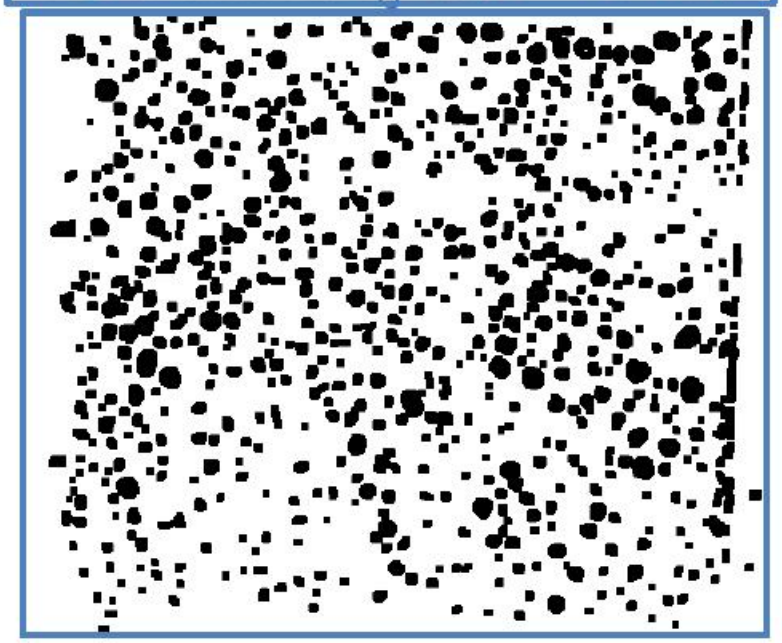
c. During a short misting time (of about 3s) the duct is moved laterally to avoid collector saturation. Cover the 1st half of the Petri dishes sprayed zone with a plastic canvas. Repeat the short misting time (of about 10s). All collectors described in the following are analyzed. After digitalization with a plan scanner, droplet sizes are directly calculated from the impact distribution by using an image analysis software[1]. At least 3 repetitions of the test are to be achieved (Figure 19 b and c).

[1] https://www.ars.usda.gov/midwest-area/wooster-oh/application-technology-research/docs/depositscan/


YONGJIA








375
374
373
371
372

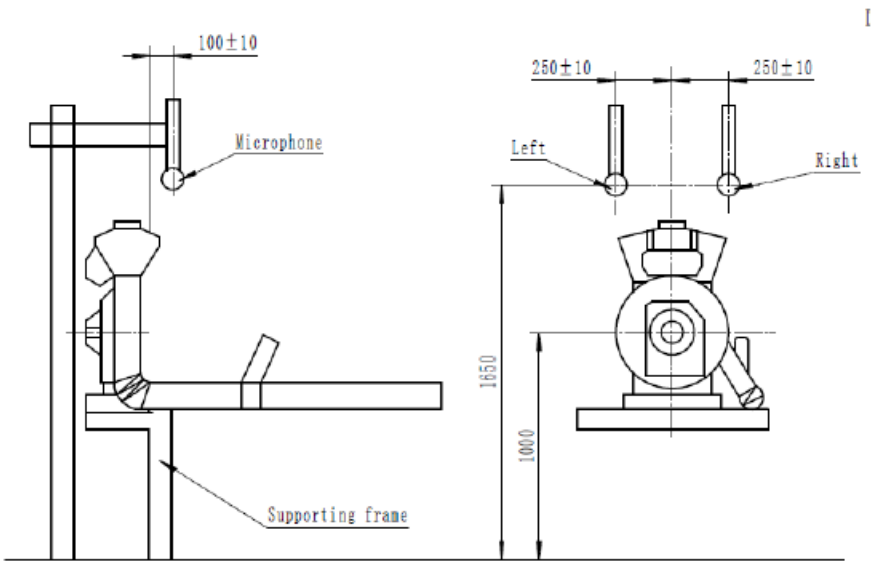
An alternative droplet sampling complete with a droplet analysing software based on light diffraction

GENERAL NOISE AND EAR LEVEL NOISE TESTS

Materials and instrumentation

a. Test equipment set up for ear side noise measurement

Equipment
Test bench for ear side noise measurement



Test procedure

a. The test of the noise of powered knapsack mister-cum-duster shall be conducted in a flat open field of radius > 20 m.

b. There shall not be any obstacles or reflective surfaces.

c. The level of the background noise and the sound pressure level of the wind shall be at least 10 dB (A) below the sound level measured during the test.

d. The natural wind speed shall be less than 5 m/s otherwise a windbreaker shall be used.

e. The mister-cum-duster shall be misting normally at its rated speed, at the highest misting rate, and it shall be standing on a stationary platform with the shaft of the engine 1000 mm height above the ground (see figure). The platform shall not resonate or reverberate with the mister-cum-duster.

Operator ear level noise measurement

a. During measurement, the microphone is placed vertically left and right at a distance of 250 ±10 mm, horizontally in front of the operator backpack cushion 100 mm ±10mm and 1650 mm above the ground level.

b. Measure the noise level. Repeat 3 times at each point.

c. Variations between two successive measurements shall not exceed 3 dB(A). Record the max value.

d. Compute the average, record readings in Table 20a.

e. Table 20a. Results of noise measurement

	Right	Left	Remarks
Background			
Test 1			
Test 2			
Test 3			

Gasoline engine rated power (kW)	Noise level at various rated engine speed, dB (A)		
	≤ 5500 rpm	➢ 5500 - 7000 rpm	> 7000 rpm
≤ 1.5	≤ 97	≤ 98	≤ 99
> 1.5 - ≤2.3	≤ 99	≤ 100	≤ 101
> 2.3 - ≤3.1	≤ 101	≤ 102	≤ 103
>3.1 – ≤3.8	≤ 103	≤104	≤ 105
>3.8 - ≤ 4.5	≤ 105	≤ 106	≤ 107
>4.5	≤ 107	≤ 108	≤ 109

VIBRATION TEST

Materials and instrumentation
a. Use a vibration accelerometers
b. See section 5 for instrumentation

Equipment
Accelerometer


Test procedure

a. Fill the chemical tank with ½ tank of clean water.

b. Fit the knapsack with 6 to 9 pieces of metal washers tapped to the backpack cushion.

c. Operate at normal misting conditions.

d. Measure the vibration at each of the 6 to 9 spots as in (b).

e. Repeat the test three times.

a. Compute the average record results in the table 21a.

b. Average vibration acceleration at the back rest shall not exceed 15 m s^{-2}.

Location	1	2	3	4	5	6	7	8	9
Test1									
Test2									
Test3									
Average									

Table 21a: Noise and vibration test

Machine model		Rated RPM		Rated power, kW	
Instrument type and model		Environment Temperature/ Humidity		Test date	
Test site			Note:		
Inspector					

Test No.	Noise level at ear, dB (A)		Vibration acceleration, ms $^{-2}$								
	Left	Left	1	2	3	4	5	6	7	8	9
1											
2											
3											
Average											

RELIABILITY AND ENDURANCE TEST

Materials and instrumentation

a. Select five (5) misters cum dusters

b. Stopwatch

Test Procedure Time To First Failure Test

Operate the misters cum duster under normal conditions, rated speed at maximum throttle during 100h (example 15 periods of 6 hours).

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Cycle 1					
Cycle 2					
Cycle 3					
Cycle 4					
Cycle 5					
Cycle 6					
Time of 1st failure					

Calculation and criteria

$$MTTFF = \frac{1}{n}\left(\sum_{i=1}^{r} t_i + \sum_{j=1}^{n-r} t_j\right)$$

where: MTTFF = Average operating time before 1st failure, h

n = total number of machines

r = no. of machine having 1st failure (when r =0 hr, n =1)

t_i = Cumulative operating hour of the i th unit of machine first failure

t_j = Cumulative operating hour of the j th machine (not having failure) at the end of 100 hr cumulative operation.