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

PART - 7 : TESTS & CHECKS FOR PERFORMANCE 1

16 - 28 October2016, Nanjing China

2nd Training of Trainers on ANTAM Codes
Organized by ANTAM and CAMTC

TESTS AND CHECKS FOR PERFORMANCE 1

BY
XC ZHANG and J.P. DOUZALS Trainers

LIST OF LAB. TESTS FOR PERFORMANCE

Verification of the information provided in Annex B-1.

1.Hose accelerating ageing test
2.Chemical tank assembly test
3.Strap drop test
4.Strap absorbance test
5.Blower air velocity and air volume
6.Misting discharge rate (full and various tank capacities) and residues
7.Dusting discharge rate (full and various tank capacities) and residues
8.Misting/dusting range
9.Vertical deposition test (mister)
10.Dropletsize and density (mister)
11.General noise and ear level noise test
12.Vibration test
13.Reliabilityand endurance test (MTTFF)

HOSE ACCELERATED AGEING TEST

Materials and instrumentation

- This test is destructive and the availability of 2 spare hoses shall be verified prior to testing.
- It requires an elongation test bench with according dimensions and strength such that a rubber hose sample can be tested.
- Attention shall be paid to safety when operating the test

Equipment	
Stove	Traction for test bench and sensor
	

Test procedure

• Prepare two identical samples from rubber hoses provided with spare parts. Samples shall have a dimension adapted to the tensile test device (ex : 20 cm x 3cm).

• Measure the maximum tensile strength (Sf1) and the maximum elongation at breakage for sample 1 (E1).

• Place the sample 2 in a stove at 70°C ±1 for a period of 72 hours (3 days) for accelerated ageing.

• Measure the maximum tensile strength (Sf2) and the maximum elongation at breakage for the sample 2 (E2).

Calculations and criteria:

Variation in maximal tensile strength: $\Delta S = 100 \times (Sf2-Sf1)/Sf1$ max.±25%
Variation in maximal elongation: $\Delta E = 100 \times (E2-E1)/E1min$ -10%;max+30%

Report

Samples		Data	Material or reference if present
Before test	Length, cm		
	Hose 1, Li1		
	Hose 2, Li2		
After test	Elongation, cm		
	Hose 1, E1		
	Hose 2, E2		
	Tensile strength, N		
	Hose 1, Sf1		
	Hose 2, Sf2		
Variation	Elongation, %		
	Tensile strength, %		

CHEMICAL TANK ASSEMBLY TEST

Materials and instrumentation

- This test is non-destructive and is operated on one complete mister.
- Attention shall be paid to safety when operating the test

Equipment
Test bench for tank assembly test

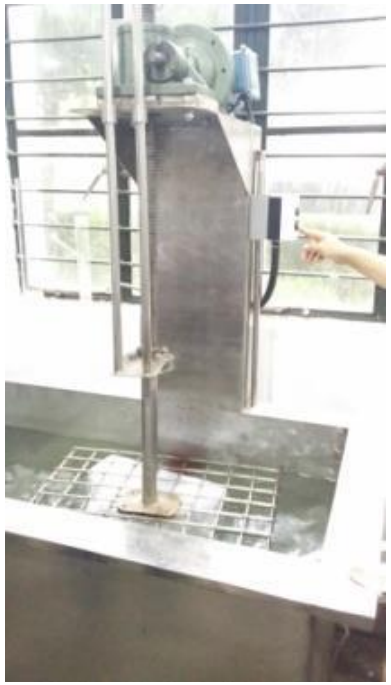

Test procedure

• Select 2 misters, conceal the end of the pressure hose,

• Place the mister cum duster upside down and immerse at the first half of the tank level (Figure 10a).

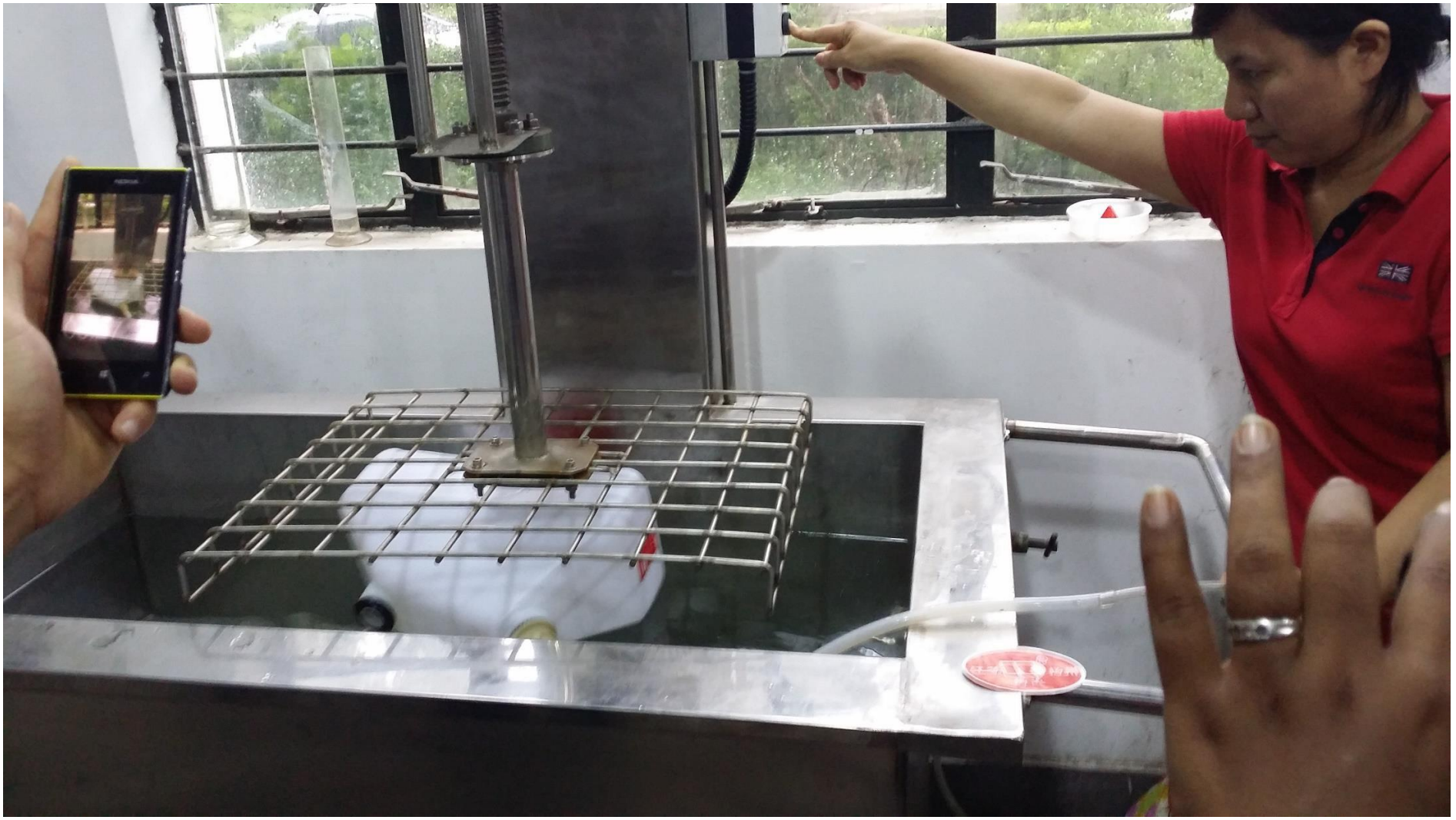
• Apply an air pressure of 0.01 Mpa (0.1 bar) at the liquid discharge hose into the chemical tank for 1 minute. (Figure 10b).

• The tank, connected hoses and air pressure hose shall not show any sign of leakage and shall not buckle.



(Figure 10a).

(Figure 10b).



STRAP DROP TEST

Materials and instrumentation

This test is normally non-destructive. It requires a support for strap drop test as in figure. WARNING: This test has an element of risk. All personnel shall either be kept out of the test area or otherwise protected from hazards such as parts displaced from the mister cum duster on test.

Equipment
Strap drop test bench and sensor

An example strap drop test set up with manual lifting mechanism

An example strap drop test set up with a pneumatic lifting mechanism

Test procedure: The straps and their assembly shall withstand the test follows:

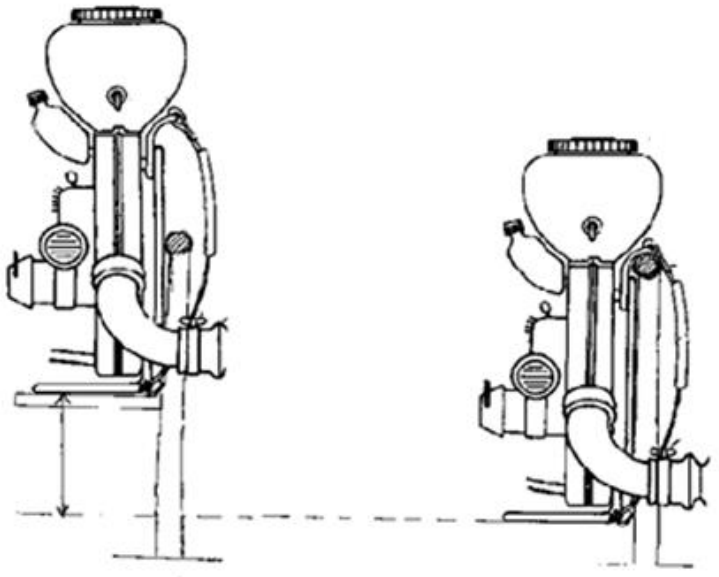
•The tank shall be filled with clean water to its full capacity.

•The mister cum duster (without discharge line) shall be hung from a solid support by its strap(s) simulating its carriage or to the shoulder of an operator.

•Raise the tank vertically to a height of 300 mm and allow to drop freely while hang by the strap (s).

•Repeat the operation 24 times.

•The assembly shall be deemed to have passed this test if none of its parts (straps, brackets, etc) break.

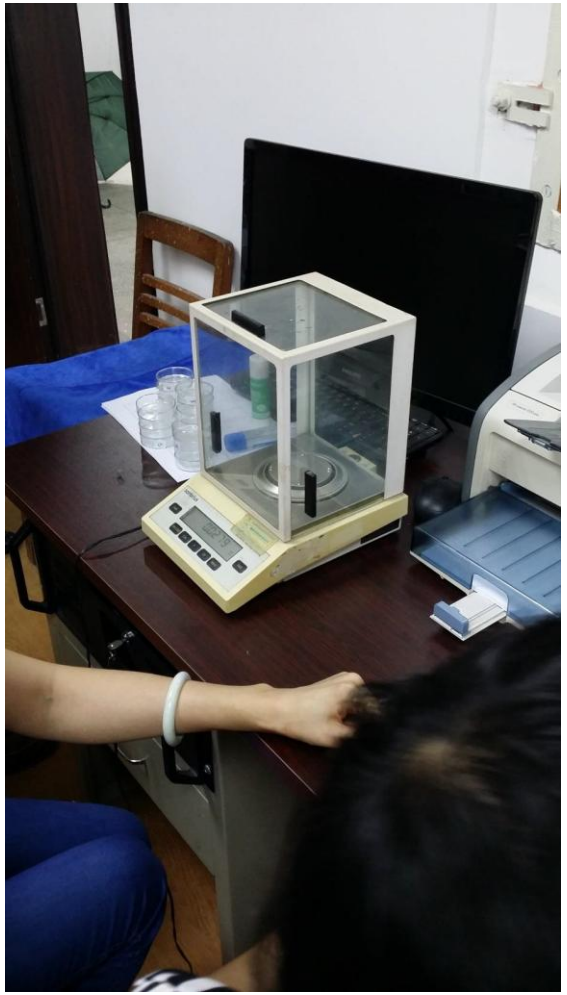


a) Release position b) Impact position

STRAPS ABSORBANCE TEST

Materials and instrumentation

- This test is non-destructive and straps shall be removed from a mister/duster.
- A bucket or tank of water
- A weighing balance of sufficient accuracy (g) (Section 5)



Test procedure

- Any padding, metal or plastic parts attached to the straps are to be removed before immersion (in order to minimize, as far as possible, the dry mass of the straps)

- Weigh the straps using a weighing device (m_b)

- Completely immerse the straps in water for 2 min.

- Remove the straps from the water, shake off surplus liquid and hang freely to drain for 10 min,

- Re-weigh straps (m_a)

	Weight (g) (to 2 decimal places)
Straps before test (m_b)	
Straps after test (m_a)	

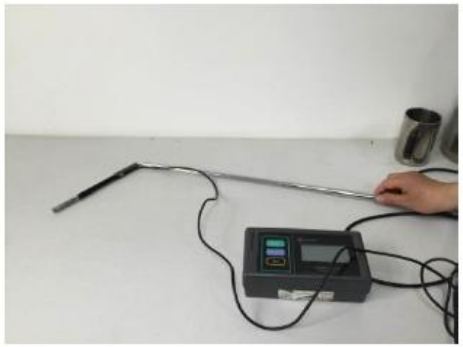
$$\Delta m = \frac{(m_a - m_b)}{m_b} \times 100$$

Max ± 30%

BLOWER AIR VELOCITY AND AIR VOLUME TEST

Materials and instrumentation

- This test is non-destructive and operated on a complete mister/duster.
- Mount the mister cum duster onto a test bench.

Equipment		
Test bench for mounting mister cum duster	Anemometer	Tachometer
		

Test procedure

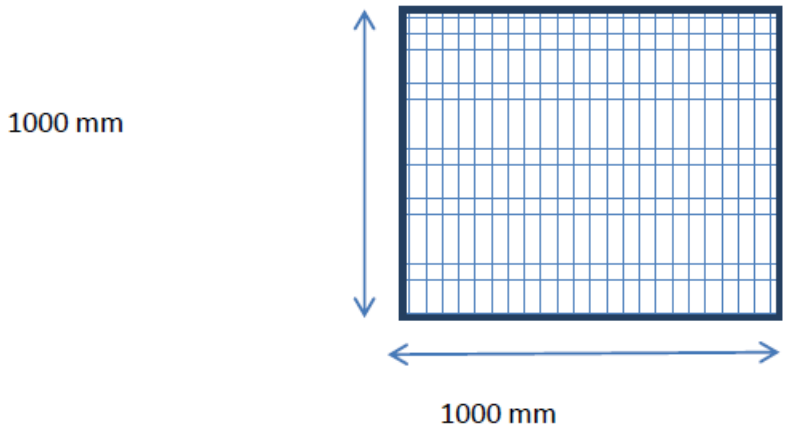
•A device for the suction and the evacuation of exhaust gases shall be used when a mister cum duster is tested inside the testing facility

•Place the mister cum duster in an operational position.

•Lock the machine as per position in Figure 13a.

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

•Prepare a sampling grid as in figure below by using thin nylon wires, strings or a net on a frame or with a motorized/wheeled 2D or 3D structure supporting the anemometer.



- Set the engine speed according to the rated engine speed defined by the manufacturer.

- Place an anemometer at the point (0, 0) correspond to the vertical and horizontal axis where (0,0) is along the axis of the blower outlet air duct pipe.

- Measure the air velocity during 15 seconds interval at distances of 3000 ±20 mm and 6 000 ±20 mm from the air duct pipe outlet based on sampling grid of 100 x 100 mm ±5 mm as per Figure 13a.

- Sample air velocities along the four lines A-A, B-B, C-C and D-D.

- Measure at each grid point (Figure 13b and c)

- Stop measuring when an air velocity lower than 2 m/s is detected..

Mister cum duster

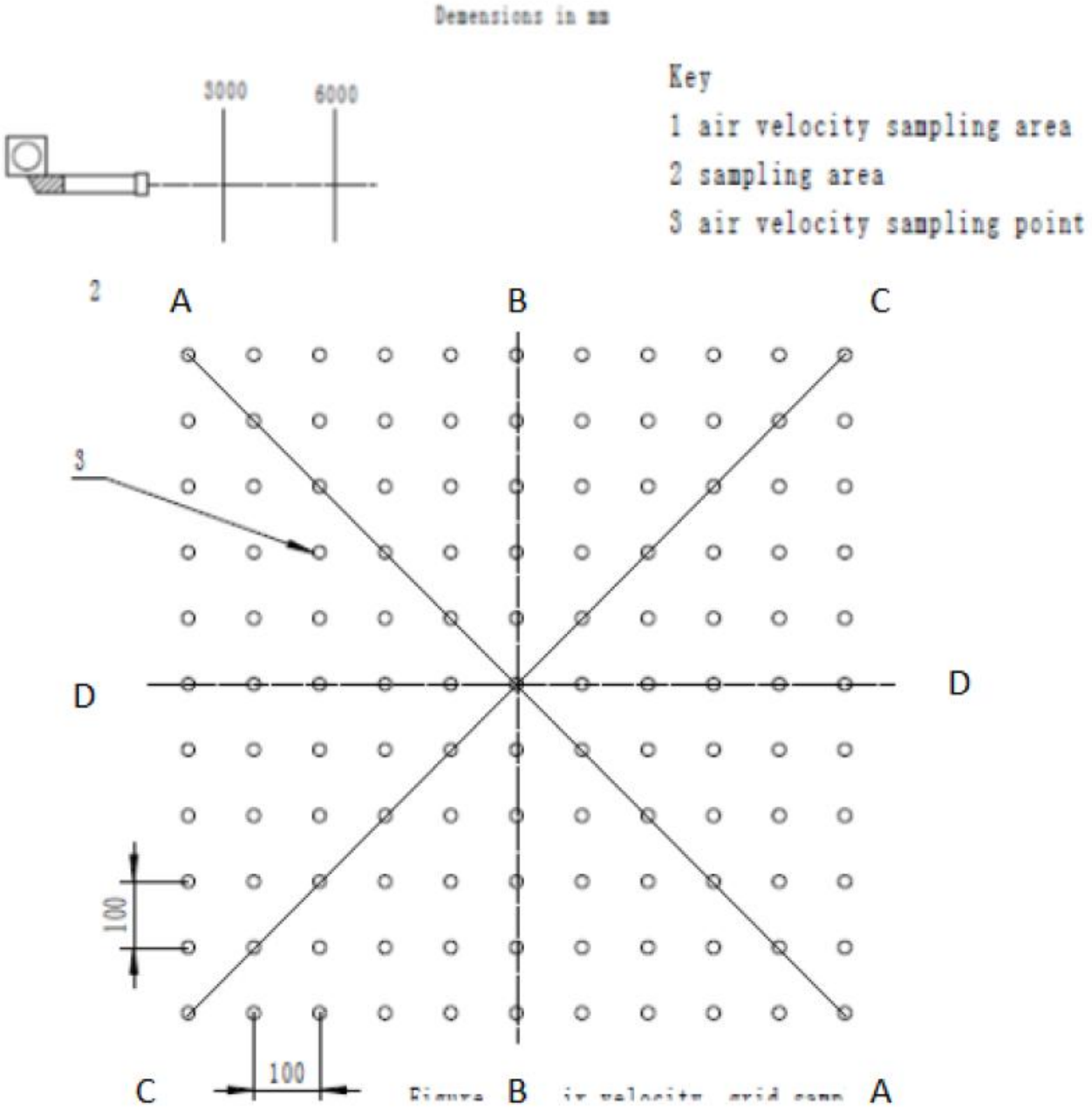


Figure 13a.


A B C D E F G H I J K
1 2 3 4 5

Fill in the following tables where the central column and line correspond to the vertical and horizontal axis and the point (0,0) is in the axis of the blower outlet.

Table 13a: Air velocity profile at 3000 ±20 mm distance

	-500	-400	-300	-200	-100	0 mm	100	200	300	400	500
500											
400											
300											
200											
100											
0 mm											
100											
200											
300											
400											
500											

Determination of the effective air volume at 3000 mm distance:

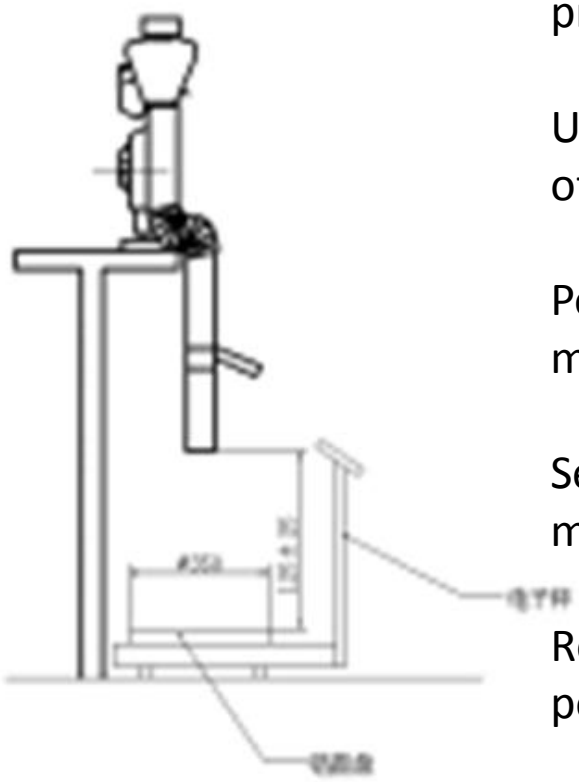
Consider the area where the air velocity is > 2 m/s (A in m^2) and position its centroid.

Calculate the mean value of velocity (V in m/s) along the air velocity profile from the centroid to the mean radius (assuming a linear variation of air velocity along the radius distance).

The effective air volume 3000= A x V in $m^3.s^{-1}$

AIR VOLUME TEST (ref ANSI/OPEI 172.5 Annex C)

This test consists on the evaluation of the blower capacity estimated through the blow force created by the air flow on a balance's plate.



Measure Air temperature, relative humidity and atmospheric pressure

Use a balance (Range 5kg, e=±10g) with an aluminium plate of minimum 35 mm

Position the blower bent pipe vertically at a distance of 125 mm ± 25 mm from the plate

Set the Mister cum duster at WOT (wide open throttle) a measure the blow force in N

Repeat the measurement 3 times while returning at idle position between each measurement

Calculate successively *(see the test report spreadsheet for details)*

- The average air velocity
- The air peak velocity
- The air flowrate

Case of round outlet tubes

$$V_{av} = \sqrt{\frac{F_b}{\rho\, A}} =$$

1) CALCULATION OF Average Velocity (V_{av})

	kg	N
Fb1	1.500	14.715
Fb2	1.500	14.715
Fb3	1.500	14.715
Fb av	1.500	14.715

ρ	air density corrected by the RH	1.167	
A	surface area of the outlet		
	0.05	0.001963	m²

V_{av}	=	80.13639	m/s

2) CALCULATION OF Reynolds number

ρ	1.1838	Re lim
μ	1.92E-05	267000
Vav	80.13639	
D	0.05	
		n
Re	246917	7.763533

$$Re = \frac{\rho\, V_{av}\, D}{\mu}$$

3) CALCULATE the Peak Velocity (V_p)

V_p	=	96.2844	m/s

$$V_p = \frac{V_{av}\,(n+1)(2n+1)}{2n^2}$$

4) CALCULATE THE FLOWRATE

Q = 3600 * V_{av} * A

Q	=	566.4507	m3/h

1 bis) Determination of air density

$$\rho(\varphi,\vartheta,p) = \frac{1}{287{,}06(\vartheta+273{,}15)}\left(p - 230{,}617\cdot\varphi\cdot\exp\left[\frac{17{,}5043\cdot\vartheta}{241{,}2+\vartheta}\right]\right)$$

with

ρ	air density in kg/m3
φ	relative humidity in %
ϑ	Temperature in °C
p	Atmospheric pressure (Pa)

ex

Temperature	23	°C	1st term	1.17629E-05
Atm pressure	101325	Pa	2nd term	149.5
RH	0.65	%	3rd term	1.523841408

ρ	1.183807603	kg/m³

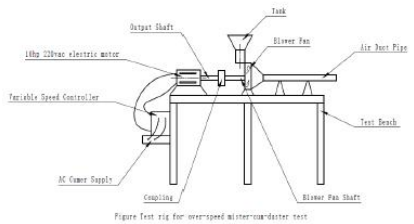
FAN IMPELLER OVER-SPEED TEST

Materials and instrumentation

• This test is non-destructive but required the use of a complete mister/duster fan impeller and housing (without engine).

• Attention shall be paid to safety when operating the test

• Mount a unit of the mister cum duster (without engine) onto the overspeed test rig

Equipment	
Test bench for fan overspeed test	Tachometer
 	

Test procedure

•Mount the test sample (without the engine) onto a test rig with a variable speed controlled electric motor.

•The impeller shall be tested at 1.3 times the rated speed for 5 minutes on the occasion of full load. Check with a tachometer.

•Stop and check that the following phenomena shall not occur to the impeller: get injured, get loose or be out of shape, etc.

•Replicate step (b) and step (c) three times.