March 21, 2010

Restoration Sciences Academy *Test Labs*
Airflow Technology Test
Project No. 10011

Project Overview
Determine the evaporation and drying effectiveness of air moving technologies. Effectiveness is defined as the overall area influenced by each technology, the rate of evaporation within that area and the efficiency (as measured by power consumption) of the technology to achieve the end result.

Technologies to be tested will be the *centrifugal blower* (Sahara Pro X3), the *axial air mover* (Jet CXV, Ace) and the *thrust fan.*

Technologies Tested:

	Sahara ProX3 *Centrifugal Air Mover*	Jet CXV *Axial Air Mover*	Ace *Axial Air Mover*	Other *Thrust Fan*
Actual CFM	980	3073	1881	750
Velocity, FPM	2071	1799	1178	1799
Amperage, Tested	4	3	1.5	1.6

Background
Air movement influences evaporation by (1) rapidly removing the saturated boundary layer from the wet surface, thereby replacing moisture laden air with dryer air, (2) providing kinetic energy to water available on the surface of the material and (3) continually supplying additional heat energy to replace energy lost during evaporation.

In order for an air mover to achieve a high level of drying effectiveness, it must (a) generate a high velocity and (b) generate a wide, laminar flow. To be efficient, it must achieve these results with less power consumption (as measured in amps).

Hypothesis
The two most common technologies utilized today are the centrifugal blower (in this test, we used the Sahara Pro X3) and the axial air mover (Jet CXV and Ace). The typical centrifugal

blower generates a superior air velocity, while the axial fan generates superior volume of flow over a much larger surface with much lower power consumption. The significant velocity of the centrifugal blower will yield a rapid rate of evaporation in a very focused path. The wide footprint of the axial fan will deliver a slower drying rate, yet it will efficiently dry a significant area.

The 'thrust fan' technology delivers lower velocity and volume than a centrifugal blower, and due to its horizontal blower orientation, its air delivery is focused on a smaller surface area. Air is thrown to the right of the mover, and not directly in front of it. It will yield a slower rate of evaporation due to this lack of air flow concentration on the flooring materials. Its CFM is lower than an axial air mover by more than 70%, and thus it will cover a smaller area.

Testing Protocol

Testing was performed utilizing thermal imaging. A fixed surface was evenly wetted with a motorized, controlled misting system to provide a consistent, even wetting pattern. A fixed thermal imaging camera was then used to evaluate each technology, imaging the exact footprint of airflow through the evaporative cooling generated. Tests were repeated to ensure consistency in outcome and results.

The testing floor as seen from the fixed position thermal imaging camera, located 22 feet above the shop floor

Variables

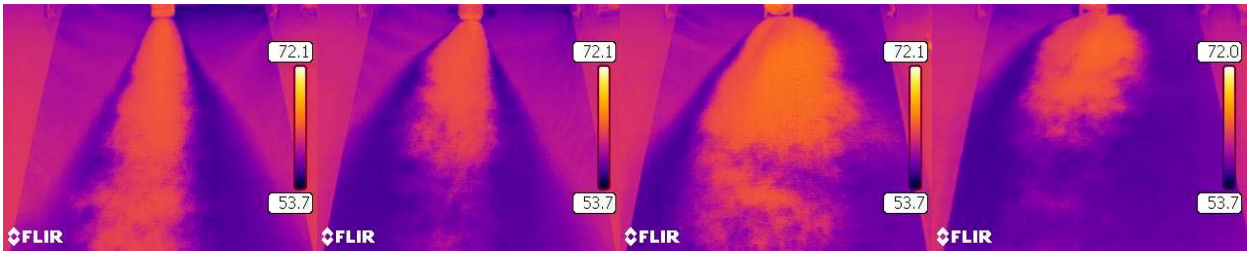
Several variables were controlled, to include:

1. Air mover position
2. Thermal imaging camera point of view
3. Wetting (rate of application, volume of application)
4. Ambient temperature and humidity
5. Flooring / surface material
6. Time between images
7. Overall length of imaging
8. Temperature of flooring at time of wetting
9. Moisture content of flooring at time of wetting
10. Post drying procedures

Testing

Surface:	12x24 ft. 23 ounce nylon cut pile carpet, installed over concrete slab
Wetting:	Two misting systems (Blastmaster fogging systems, 18 oz per minute, 20 micron droplet size) fixed to gantry system. Speed set to 60 second travel on motorized gantry across 24' flooring span. Gantry was run across flooring two times. Net result: 72 total ounces of water applied in two minutes.
Drying:	Each air mover was placed at the far end of the wetted surface, centered, blowing straight down the center. Air movers were allowed to run for a total of 5 minutes each, with infrared images captured every 10 seconds.
Results:	Using the setup described above, the test was conducted three times on each airmover. The resulting images validated consistency between each round of tests completed.

Final Results Testing
Round 4 Testing, see full log below



Sahara ProX3 Thrust Fan Jet CXV Ace

Images above were extracted at precisely 5 minutes of run time.

Conclusions
Most effective
The centrifugal blower technology (Sahara Pro X3) indeed yielded the fastest overall evaporation rate. The evaporative cooling footprint of this technology was visible significantly faster than with any other technology, indicating that the velocity was indeed superior. Further, the evaporative cooling gave way to a rapid heating of the surface area in front of the air mover outlet, indicating that all moisture had evaporated. Again, this occurred faster with this technology than all others, and for a much greater distance. This indicates that the centrifugal air mover had a far superior focus, and very laminar flow.

Most efficient

The Axial air mover (two tested: Jet CXV and Ace) generated evaporative cooling at a slower rate than the centrifugal air mover, however this technology produced the largest overall footprint. Especially when power consumption was considered (1.5 amps for the Ace), the axial fan produced the most drying for the least power. Additionally, the axial fan produced the largest dry footprint at the conclusion of all tests run.

Least effective
The Thrust Fan generated an evaporative cooling footprint larger than the centrifugal airmover, however the drying rate was slower as the air flow is less concentrated on the flooring. Additionally, the overall footprint of the thrust fan technology was inferior to the axial fan.

Summary and recommendations
The centrifugal air mover will produce the fastest drying times when focused drying is needed. Based on the pattern observed, this would be best applied when dealing with challenging areas such as the interface between a wall assembly and flooring material where wall plates and base assemblies are wet and affected.

When a larger and/or more energy efficient footprint is needed, the axial air mover is by far the most superior technology. Per amp of power consumed, the axial delivered the most drying by a factor of more than two times that of all other technologies tested.

Testing Log
Below is the full log of test cycles run throughout the project. Several initial testing rounds were performed to establish consistency in the process:

<u>Round 1</u>

Surface:	12x12 ft. 30 oz nylon cut pile carpet, over vinyl sheet goods
Wetting:	25 x .014" I.D. misting jets at every 6 in. across 12 ft. flooring span
	30 second travel on motorized gantry
	Jets mounted to directly apply water to flooring (downward spray)
	4 ft. elevation above flooring
Drying:	Studebaker Air Path used as the control air mover, run 4 times to determine if drying was consistent.
Results:	misting system did not create a consistent wetting pattern

Round 2

Surface:	12x12 ft. 30 oz nylon cut pile carpet, over vinyl sheet goods
Wetting:	25 misting jets at every 6 in. across 12 ft. flooring span (same as Round 1)
	30 second travel on motorized gantry across 12 ft. flooring span
	Jets mounted to spray upward, allowing water droplets to better mix and disperse
	4 ft. elevation above flooring
Drying:	Studebaker Air Path used as control air mover, run 4 times to determine if drying was consistent.
Results:	Misting pattern more consistent. Ran subsequent tests with multiple air flow technologies, and preliminary results were recorded. A repeatable pattern was realized, however misting was determined to be imperfect, and decision was made to make additional improvements.

Round 3

Surface:	12x12 ft. 30 oz nylon cut pile carpet, over vinyl sheet goods
Wetting:	2 misting systems (Blastmaster fogging systems, 18 oz per minute ea., 20 micron droplet size)
	30 second travel on motorized gantry across 12' flooring span
	Application rate set to 2 full turns of rate controller on each system
	3.5 ft. elevation above flooring
	Each nozzle aimed precisely at opposite edge of flooring
Drying:	Sahara Pro X3 used as control to ensure consistency, run twice. Multiple systems run 4 times each to determine overall consistency.
Results:	Misting system generated a far superior consistency across wet surface. Each air moving technology produced the same patterns generated in round 2, with greatly improved imaging quality. However, the 12 ft. span of flooring was too short to fully evaluate the effectiveness of the air movers, especially the Sahara Pro X3. It was determined that a longer carpet sample was needed.

Round 4, Final Setup

Surface:	12x24 ft. 23 oz nylon cut pile carpet, over concrete slab
Wetting:	2 misting systems (Blastmaster fogging systems, same as Round 3)
	60 second travel on motorized gantry across 24 ft. flooring span
	Application rate set to full open on rate controller of each system
	4.5 ft. elevation above flooring
	Each nozzle aimed precisely at opposite edge of flooring
Drying:	Sahara Pro X3 used as control to ensure consistency, as performed in Round 3. Process yielded same level of consistency. Each technology was run 3 times to validate that results could be duplicated.
Results:	Round 4 validated results found in Round 3, however the increase in the surface area yielded significantly more meaningful imaging.

For more information, go to www.restorationsciencesacademy.com.

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