

# Experimental Determination of Correction Factors for Use with Capture Hoods

Application Note TI-128

Anecdotal evidence from test and balance professionals suggests that correction factors need to be applied to capture hood measurements to make the readings agree with those from other instrument types. Corrections as large as 50% of the reading have been suggested as realistic. Factors that possibly contribute to the need for correction factors include entrance conditions to the diffuser, obstructions in the outlet flow pattern (walls, etc.), diffuser type, or type of instrumentation used.

Testing was performed at TSI with a TSI ACCUBALANCE<sup>®</sup> Air Capture Hood; and another manufacturer's capture hood to determine the effect that diffuser type has on the capture hood reading. The main purpose of the testing was to determine the effect, if any, of each diffuser on capture hood flow measurement, and, if necessary, determine a correction factor for each diffuser and capture hood. The correction factors determined in this test are valid only for the capture hoods, diffusers, and test system used in this test. They should not be used as a general rule of thumb in the field.

## Definition of Correction Factor

The term correction factor is commonly used in test and balance applications, but it does not always mean the same thing. The term as it is used in this application is defined as:

$$\text{Correction Factor} = \text{True Flow} / \text{Hood Measurement}$$

where the true flow can be determined from a different measurement method, such as a duct traverse. In this test the true flow is the test system reading. Once a correction factor has been determined, it can then be used for subsequent measurements using the equation:

$$\text{True Flow} = (\text{Hood Measurement})(\text{Correction Factor})$$

## Test System

The test system that was used is pictured in Figure 1. It is a single-inlet, single-outlet system approximately 25 feet (7.6 m) long. There are more than six duct diameters between the nearest flow obstruction or bend and the diffusers. The primary measurement standard is two venturi flow nozzles, each connected to a differential pressure sensor, all with NIST-traceable calibrations. The small venturi

has a flow range of 25 to 225 CFM and the large venturi has a flow range of 200 to 2000 CFM. A pair of leak-proof dampers was used to select the venturi needed for each measurement.

The barometric pressure, ambient temperature, and differential pressure sensors were all connected to a digital multimeter which was connected to a computer. Data acquisition of all parameters except the other manufacturer's capture hood readings was performed automatically by the computer.

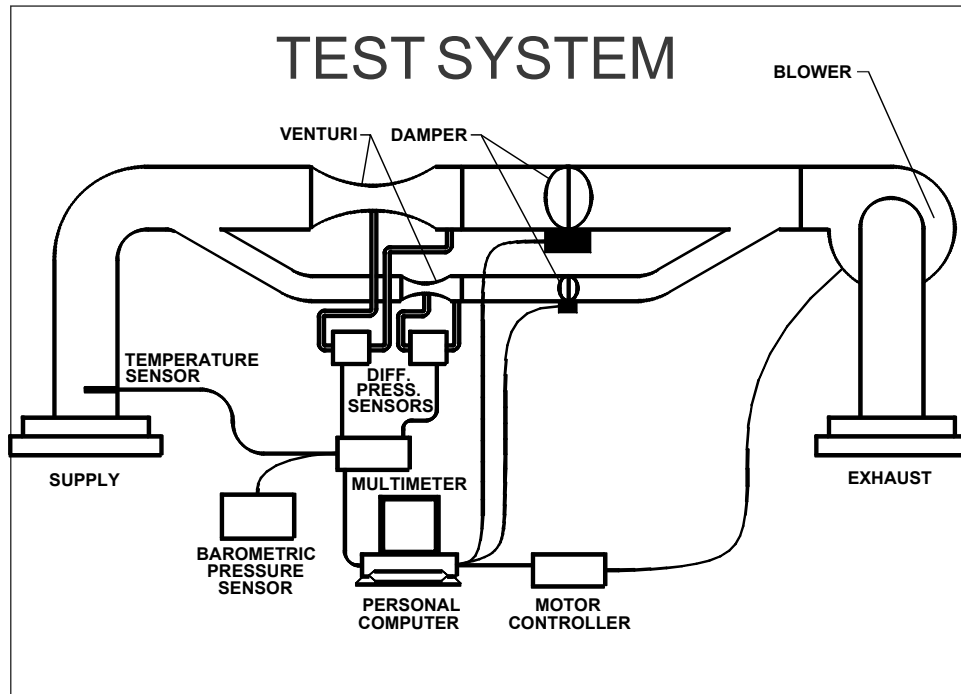


Figure 1: Capture Hood Test System

### Diffusers and Capture Hoods Used in Test

Eight diffusers from one manufacturer were used in this test. Table 1 describes the configuration of the diffusers. In addition, tests were performed with no diffusers attached to the system. Two capture hoods were used in this test. The TSI ACCUBALANCE<sup>®</sup> capture hood uses a hot film sensor to do flow measurement and has a digital display. The other manufacturer's capture hood uses a deflecting vane as the sensing element and has an analog display.

Number of Throw Directions	Number of Slots or Fins	Diffuser Size	Neck Size	Tested Flow Direction	
diffuser	4	8 each way	2' x 2'	10"	supply
diffuser	4	3 each way	2' x 2'	10"	supply
diffuser	2	7 each way	2' x 2'	10"	supply
diffuser	1	14	2' x 2'	10"	supply
diffuser	3	8 each way	2' x 2'	10"	supply
linear slot	1	4	8" x 4'	10"	supply
linear slot	2	2 each way	8" x 4'	10"	supply
perforated grille	--	--	2' x 2'	10"	supply
no diffuser	--	--	--	10"	supply,exhaust

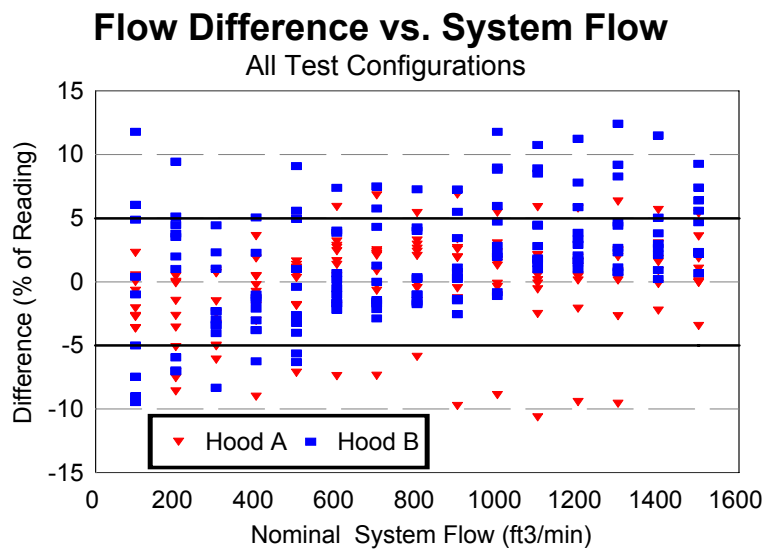
Table 1: Diffusers Used in Test

## Test Method

A diffuser and capture hood were mounted on the test system. For tests with no diffuser, only the capture hood was mounted on the system. The flow was varied randomly from 100 to 1500 CFM in 100 CFM increments. The system readings and capture hood readings were recorded at each flow. The test was repeated for the other capture hood and diffusers. Each diffuser/capture hood combination was tested twice; the stated results are the average of the two tests. Unless otherwise indicated, the tests were performed on the supply side of the system.

## Results

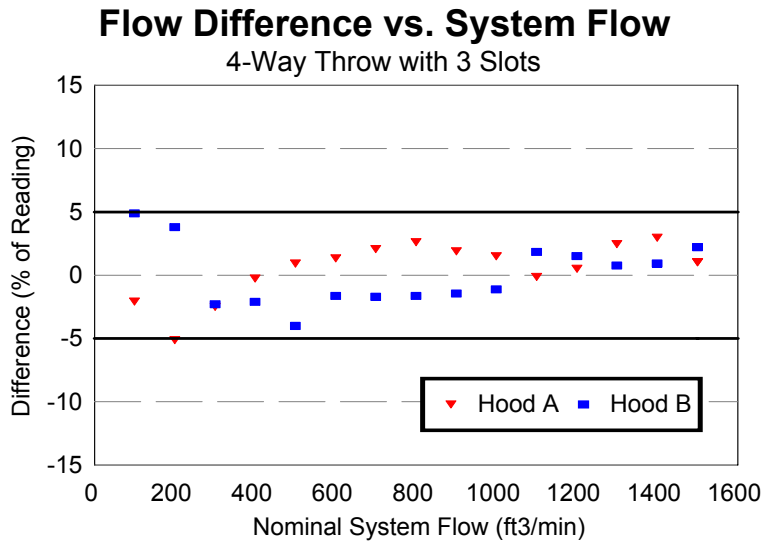
The difference between capture hood readings and system readings was less than  $\pm 15\%$  for all test configurations. The majority of the readings fell into a band between  $+5\%$  and  $-5\%$ . Figure 2 shows the results of all tests performed. Hood A is the ACCUBALANCE<sup>®</sup> hood B is the other manufacturer's capture hood. Readings that fall between the bold lines at  $+5\%$  and  $-5\%$  are considered to be accurate readings that do not need to be corrected. This acceptance range was determined based on the stated accuracy of the capture hoods used and the accuracy of the test system. The readings outside of that band should be corrected.



**Figure 2: Results of All Test Configurations**

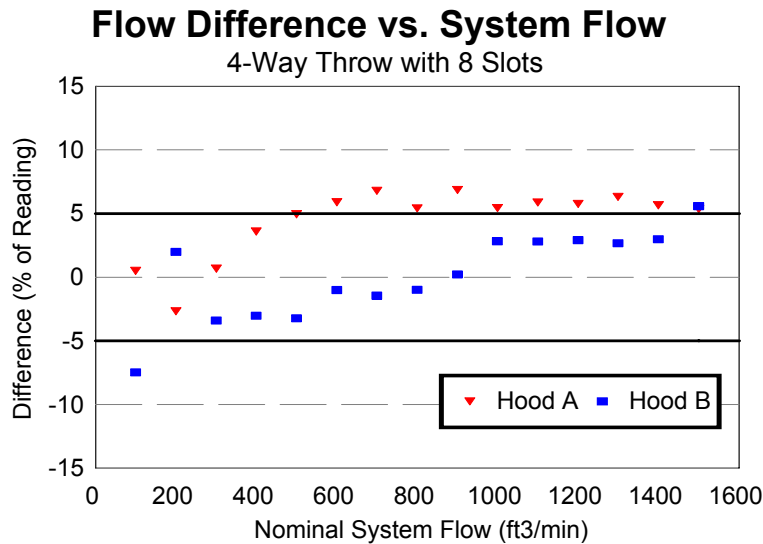
The tests with no diffuser were performed on both the supply and the exhaust side of the system. In both cases, both capture hoods agreed well with the system and with each other. The phrase "agreed well with the system and each other" means that all readings were within the  $+5\%$  to  $-5\%$  acceptance band and that both capture hoods read approximately the same throughout the flow range.

The test with the perforated grille was performed on the exhaust side of the system. Hood A agreed well with the test system. Hood B read 6% low below 500 CFM and agreed well with the system above 500 CFM.



**Figure 3: Results of Test With 4-Way Throw Diffuser With 3 Slots**

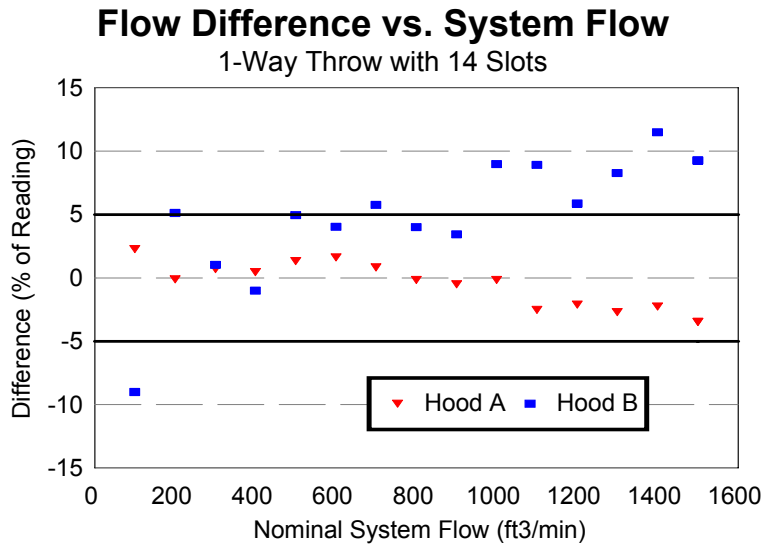
Figure 3 shows the results of the test with the 4-way throw diffuser with three slots. In this test, both capture hoods agreed well with each other and with the test system. Figure 4 shows the results of the test with the 4-way throw diffuser with eight slots, also performed on the supply side of the system. Although the diffuser has the same number of throws, the results are different. Hood A read about 6% high above 500 CFM, while the readings of Hood B were comparable to those in the previous test.



**Figure 4: Results of Test With 4-Way Throw Diffuser With 8 Slots**

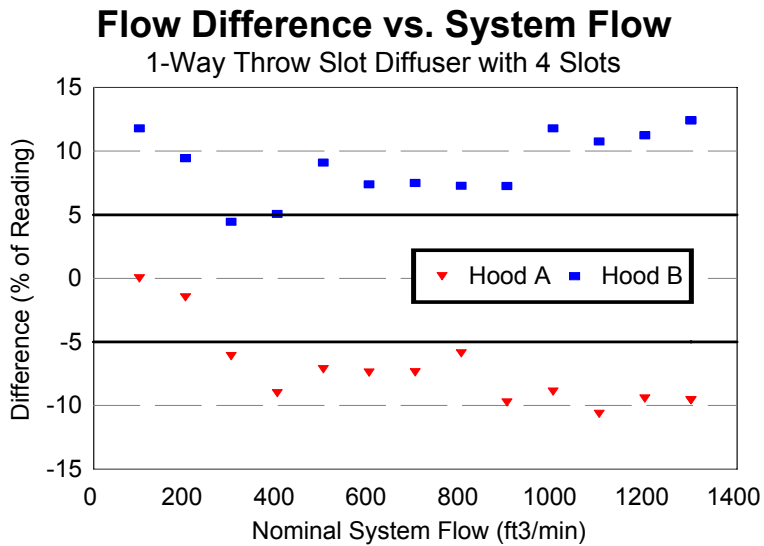
The test results with the 3-way throw diffuser and the 2-way throw diffuser with seven slots each way were similar to each other. In both cases, Hood A agreed well with the system, but Hood B read 5% high above 1000 CFM.

Figure 5 shows the results of the test with a 1-way throw diffuser with fourteen slots. Hood A agreed well with the system. Hood B read 5% high between 400 and 1000 CFM, and 8% high above 1000 CFM.



**Figure 5: Results of Test With 1-Way Throw Diffuser With 14 Slots**

Figure 6 indicates the results of the test with a linear slot diffuser set for 1-way throw. This diffuser caused the largest discrepancy in capture hood flow readings. Hood A read about 7% low between 300 and 800 CFM, and 10% low above 800 CFM. Hood B read 7% high below 1000 CFM and 11% high above 1000 CFM. When the same linear slot diffuser was set for a 2-way throw, the results were considerably different. Hood A agreed well with the system and Hood B read an average of 5% high over the entire flow range.



**Figure 6: Results of Test With 1-Way Throw Slot Diffuser With 4 Slots**

## Correction Factors

Table 2 contains the correction factors that were determined from these tests. The correction factors range from 0.90 to 1.11. The configurations that didn't require correction factors are indicated with a '--'. These correction factors are accurate only for this test system; results in the field could be different.

		Hood A		Hood B	
Diffuser Type	Direction	Correction Factor	Range (CFM)	Correction Factor	Range (CFM)
None	Supply	--	--	--	--
	Exhaust	--	--	--	--
Perforated Grille	Exhaust	--	--	1.06	<
4-way 3 slot	Supply	--	--	--	--
4-way 8 slot	Supply	0.94	>500	--	--
3-way 8 slot	Supply	--	--	0.95	>1000
2-way 7 slot	Supply	--	--	0.95	>1000
1-way 14 slot	Supply	--	--	0.95	400-1000
		--	--	0.95	>1000
1-way linear slot	Supply	1.08	300-800	0.93	<1000
		1.11	>800	0.90	>1000
2-way linear slot	Supply	--	--	0.95	100-1500

**Table 2: Correction Factors Determined From Tests**

## Conclusions

This test has shown that diffuser type does have an effect on capture hood readings. Linear slot diffusers had the largest effect on capture hood readings. In addition, this test has shown that correction factors may vary over the measurement range of a capture hood, and they may differ from one hood manufacturer to another.

## Recommendations

These test results support adherence to ASHRAE standard 111-1988, which states “For proportioning flows it is advisable to field calibrate the hood against a duct traverse for each typical situation.” Variables to consider when defining a typical situation include diffuser type, diffuser neck size, flow rate, entrance conditions to the diffuser, location of diffuser relative to walls, and how many diffusers are on the same system and their positions relative to each other.

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