CARNES®
Tech Talk

AWARE
a● ware'
Adj.
apprised;
informed;
cognizant;
conscious

THIS ISSUE: **Diffuser Suitability for VAV Systems**
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May 1998
Volume 2

Overview:

An interesting design problem that we are sometimes asked to address is diffuser suitability for VAV applications. The typical concern is to specify a diffuser model and size that addresses noise and throw concerns in the full open damper position and resists dumping to a vertical air pattern under low flow conditions. Selecting the proper model and size can be a difficult balancing act. A larger size can reduce the cost and reduce noise (by requiring fewer for the same CFM), but a smaller size will maintain a good discharge even at the low flows that VAV systems can require when partially throttled down.

Carnes has tested various diffusers to determine suitability for low CFM applications. Listed on page 2 are the results, sorted by decreasing ability to maintain horizontal discharge at low flows. Your local mechanical consultants may find this information useful with respect to VAV building designs.

Background:

The minimum flow at which a VAV system will control the air flow is approximately 75 CFM, although the threshold is higher in larger sizes (See Carnes Catalog AV-01 for VAV performance data). It is important in designing an air distribution system that the diffuser be capable of meeting two criteria.

First, it must maintain a horizontal discharge down to the minimum flow that the VAV system can operate at as it throttles down the flow. Second, it must jump to a horizontal flow quickly as the flow increases from zero or minimum CFM.

Carnes test procedures were designed to duplicate VAV system operating conditions. The procedure is as follows:

- Base conditions: Each diffuser is set for horizontal air flow (where applicable), supply air is isothermal (same temperature as room air), and the ceiling height is at the same level of the diffuser at 10 feet.
- The flow is gradually increased from 0 CFM until the air pattern becomes horizontal at ceiling level. This CFM is recorded in *Column 3.*
- This flow is given as a percentage of Nominal CFM *in Column 4.*
- The flow rate is then doubled and then gradually decreased until the air flow becomes vertical, or "dumps." This CFM is recorded in *Column 5.*
- This flow is given as a percentage of Nominal CFM *in Column 6.*
- Nominal CFM is shown in *Column 1.*

Column # - - - >			1	2	3	4	5	6
Diffuser Description	Neck Size or Length	Panel Size	Nominal CFM	NC at Nominal CFM	CFM at which air goes to Horiz.	% of Nominal CFM	CFM at which air Drops to Vert.	% of Nominal CFM
Channelaire, set to 1-Way blow (CHBB 2-Slot)	48" Long	- - -	320	36	0	0%	0	0%
Channelaire, set to 1-Way blow (CHBB 1-Slot)	48" Long	- - -	160	32	0	0%	0	0%
Channelaire, set to 2-Way blow (CHBB 2-Slot)	48" Long	- - -	320	36	14	4%	8	2%
Adj. Plenum Slot, 2-Slot, 2-Way (DFSA)	48" Long	- - -	400	37	38	10%	0	0%
Louvered Face Steel, 4-Way (SKTA-40)	12"x12"	2'x2'	700	33	55	8%	38	5%
Stamped Louvered Steel, 4-Way (SFTB 24)	8" Rnd	2'x2'	420	35	55	13%	38	9%
Perf. Face, Off-The Face Adj. Disch. (SPGC 1-Way)	8"x8"	2'x2'	265	34	75	28%	62	23%
Stamped Louvered Steel, 4-Way (SFTA 24)	14" Rnd	2'x2'	962	34	80	8%	80	8%
Perf. Face, Off-The Face Adj. Disch. (SPGC 2-Way)	8"x8"	2'x2'	265	33	100	38%	90	34%
Perf. Face, Off-The Face Adj. Disch. (SPGC 4-Way)	8"x8"	2'x2'	356	36	150	42%	120	34%
Perf. Face, On-The Face Adj. Blow (SPAB 4-Way)	16" Rnd	2'x2'	977	36	370	38%	260	27%

(The columns showing the % of CFM at which the diffuser dumps or returns to a horizontal discharge can be applied to other sizes of that model as long as they have the same blow pattern and neck shape.)

Example:

The designer is using a Carnes Single Duct VAV (Model AVCC) in the 8" size, which calls for an operating range of 185-1000 CFM. By attaching a Multi-Discharge Adapter (Model AXM) for 3 outlets, this allows the use of three 8" round neck Stamped Louvered diffusers (Model SFTB24). The operating range per diffuser would be 61.7 - 333.3 CFM.

We see from the chart above that each diffuser resists dumping down to 38 CFM, well below the operating range of the VAV, and each returns to horizontal at 55 CFM, still below the operating range.

Air distribution goals are achieved and NC/RC levels remain at reasonable levels (around 30). This illustrates a good match of VAV and diffuser.

As a contrasting example, if the designer uses three 8" x 8" square neck Perforated Face On-The-Face-Louvers Diffusers (SPGC 4-way), the performance deteriorates. The same CFM is delivered, but each diffuser will dump at 120 CFM as the system throttles back, and will not return to horizontal until the flow reaches 150 CFM. This illustrates a poor match of VAV and diffuser.

Conclusion:

When designing a system involving the use of VAV boxes, it is wise to know the operating range of the system and select and size the diffusers accordingly. In the effort to manage overall environmental quality (thermal comfort, acoustics, IAQ, air distribution), VAV-Diffuser compatibility can be a distinct issue.