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# Damper Leakage Rates –

## More Important Than Ever

By John Knapp

### **GUIDELINES FOR SPECIFYING DAMPER PERFORMANCE.**

All HVAC dampers, i.e., control, backdraft, fire, smoke, and combination fire/smoke, contribute to the overall efficiency of the air system. With the emphasis on “green,” sustainable buildings, IAQ, and energy savings, damper leakage rates are more important than ever. Every CFM counts!

The International Energy Conservation Code (IECC) and ASHRAE Standard 90.1 *Energy Standard for Buildings Except Low-Rise Residential Buildings* state that dampers integral to the building envelope should have “a maximum leakage rate of 4 cfm per square foot (21 L/s per square meter) at 1.0-in. w.g. (0.25kPa) when tested in accordance with AMCA 500D.” But what do these requirements really mean?

Dampers generally leak in two main places: between the blade ends and the frame, an area typically known as the “jamb,” and between the blade edges. Therefore, low-leakage dampers are normally supplied with blade and jamb seals. However, the type of seal supplied can mean significant differences in leakage rates. There can be a 10-to-1 difference in a damper supplied with mechanically locked seals and flexible metal jamb seals versus a damper supplied with no seals at all.

AMCA Publication 502, *Damper Application Manual for Heating, Ventilating and Air Conditioning*, defines the “sealing performance” of a closed damper as “described by the airflow leakage rate through the damper for a given pressure differential across the damper.” So leakage is a function of pressure, not airflow. This sealing performance is usually expressed (or plotted) as cfm/sq.ft. ( $m^3/s$  per  $m^2$ ) through the face area of a damper versus measured pressure differential across the damper and includes a statement of the specified seating torque. For example, a 24x24-in. opposed blade damper may have its sealing performance described as 32 cfm/sq.ft. @ 4-in. w.g. pressure with 5 inch-pounds/sq.ft. torque applied holding damper closed. This is a lot of information, but all necessary when a specifier or end-user is comparing information from one manufacturer to another.

Published leakage data of dampers are usually expressed as cfm/sq.ft. of damper at 1.0-in. w.g. static pressure. Once you know how much a damper will leak at 1 inch, it is easy to estimate the leakage at other pressures using the basic fan laws.



To find the leakage at other pressures, simply multiply the leakage at 1 inch times the square root of your actual pressure.

For example, if a damper leaks 10 cfm/sq.ft. at 1.0-in. w.g. pressure, to find the leakage at 4.0-in. w.g. pressure, simply multiply 10 times the square root of four (two) and you can estimate that the damper will leak approximately 20 cfm/sq.ft. at 4.0-in. w.g. pressure. However, you must be careful when using this technique. Be sure the damper is designed to withstand the actual pressure. It will do no good to approximate the leakage of a damper at 9.0-in. w.g. of pressure if the damper is designed to withstand only 3.0-in. w.g. – you will see considerably more leakage as the damper blades deflect or bend due to the higher pressure.

### **Leakage is a Function of Pressure**

Leakage performance should not be specified or described as a percentage of flow. Percentage of flow leakage criteria is not useful in most cases. As stated before, leakage is a function of pressure, and not airflow. If you have a system that operates at 2,000 ft./min. and another that operates at 500 ft./min., a 1% of flow leakage specification would allow four times as much leakage through the same size damper. For example, a 12x12-in. damper would be allowed 20 cfm leakage in the larger system. The same damper under the same stipulation would be allowed 5 cfm in the smaller system.

## DAMPERS

### *Damper Leakage Rates, continued*

Damper manufacturers test their products to AMCA Standard 500-D, *Laboratory Methods of Testing Dampers for Rating*. This standard includes recognized and accepted standard test procedures for performance testing, including sealing performance. There are many test centers that can test dampers to the procedures in AMCA Standard 500; many manufacturers have the ability to test their own products. Should a specifier or owner want impartial data that a damper will perform, they should specify that the damper comply with AMCA Standard 511, *Certified Ratings Program – Product Rating Manual for Air Control Devices*.

AMCA 511 details procedures for participation in the AMCA Certified Ratings Program (CRP). Manufacturers having their products tested in an AMCA-accredited laboratory, with the test results verified by the AMCA staff and then obtaining the proper license from AMCA, can offer products bearing AMCA's

Certified Ratings Seal for Air Leakage. The purpose of the seal is to offer assurance that a damper will perform in accordance with the manufacturer's published data. Therefore, if a particular damper's ratings comply with the performance criteria specified, it should produce an acceptable application, provided all other requirements are satisfied.

Bearing the seal doesn't stop with the first round of testing. All of the manufacturer's literature must be verified for accuracy before publication. The ratings are subject to review at all times by AMCA and the products are "check-tested" on a minimum three-year basis to make sure that the products perform as required. And all licensed products are open to challenge testing by competitors or any third party.

AMCA 511 also introduces us to damper "Leakage Classes." **Chart 1** illustrates each damper classification.

**Chart 1: Leakage Classifications per AMCA Standard 511**

Pressure/ Class	Leakage, cfm/ft <sup>2</sup> (L/S/m <sup>2</sup> )			
	Required Rating		Extended Ranges (Optional)	
	1" w.g. (0.25kPA)	4" w.g. (1.0kPA)	8" w.g. (2.0kPA)	12" w.g. (3.0kPA)
1A	3 (15.2)	8 (40.6)	11 (55.9)	14 (71.1)
1	4 (20.3)	8 (40.6)	11 (55.9)	14 (71.1)
2	10 (50.8)	20 (102)	28 (142)	35 (178)
3	40 (203)	80 (406)	112 (569)	140 (711)

**Chart 2: UL555S Classified Leakage Ratings**

Leakage Class	Leakage, cfm/ft <sup>2</sup> (L/S/m <sup>2</sup> )		
	4" w.g. (1.0kPA)	8" w.g. (2.0kPA)	12" w.g. (3.0kPA)
I	8 (40.6)	11 (55.9)	14 (71.1)
II	20 (102)	28 (142)	35 (178)
III	80 (406)	112 (569)	140 (711)

Earlier we covered the requirements of the IECC and ASHRAE Standard 90.1. Using the AMCA 511 table, we now see that both the IECC and ASHRAE require Class 1 dampers.

**UL Classified Leakage Ratings**


UL Standard 555S, Smoke Dampers, is the test standard to qualify dampers for use in smoke-control systems. UL 555S identifies leakage classes for both smoke and combination fire/smoke dampers (combination fire/smoke dampers must meet the requirements of both UL 555, *Fire Dampers*, and UL 555S). **Chart 2** identifies the different leakage classes under UL 555S.

Note the similarities between the leakage classes in both AMCA 511 and UL 555S. They are the same except that UL 555S does not have a Leakage Class 1A nor does it allow leakage ratings at 1-in. w.g. (0.25kPA). Anyone specifying a leakage class can feel comfortable knowing that the class is essentially the same for all damper types and styles.

Moreover, AMCA 511 also includes procedures to qualify smoke and fire/smoke dampers to bear AMCA's Certified Ratings Seal for Air Leakage.

Understanding damper leakage rates and leakage classes enables specifiers, contractors, and building owners to identify the correct damper products. Specifying and installing low-leakage dampers (Class 1 preferred, Class 2 at a minimum by code) helps ensure that the building HVAC system is operating at its most energy-efficient level. Specifying and installing dampers licensed to bear the AMCA Seal for Damper Leakage is a sensible way to provide specifiers, contractors, and owners peace-of-mind that the dampers in their systems will perform as intended and help take their buildings to the "green," sustainable level.

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To learn more about Ruskin's energy-saving solutions, or to locate a representative nearest you, visit our website at [www.ruskin.com](http://www.ruskin.com) or call us at **(816) 761-7476**.

1 Based on Class 1A leakage rate of 3 CFM/sq. ft. versus a standard leakage of 40 CFM/sq. ft. and energy rate of \$0.10/KWH.



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