Table 6 Duct Leakage Classification[a]

| Duct Type | Sealed[b,c] | | Unsealed[c] | |
	Predicted Leakage Class C_L	Leakage Rate, L/(s·m²) at 250 Pa	Predicted Leakage Class C_L	Leakage Rate, L/(s·m²) at 250 Pa
Metal (flexible excluded)				
Round and flat oval	4	0.14	42 (8 to 99)	1.5 (0.3 to 3.6)
Rectangular	17	0.62	68 (17 to 155)	2.5 (0.6 to 5.6)
Flexible				
Metal, aluminum	11	0.40	42 (17 to 78)	1.5 (0.6 to 2.8)
Nonmetal	17	0.62	30 (6 to 76)	1.5 (0.2 to 2.8)
Fibrous glass				
Round	4	0.14	NA	NA
Rectangular	8	0.29	NA	NA

[a]Leakage classes here are averages based on tests conducted by ASHRAE/SMACNA (1972), ASHRAE/SMACNA/TIMA (1985), and Swim and Griggs (1995).

[b]"Sealed" leakage classes assume that, for metal ducts, all transverse joints, seams, and openings in duct wall are sealed.

[c]Leakage classes anticipate about 0.82 joints per metre of duct. For systems with a high fitting-to-straight-duct ratio, greater leakage occurs in both sealed and unsealed conditions.

Table 7 Leakage as Percentage of Airflow[a,b]

| Leakage Class | System L/s per m² Duct Surface[c] | Static Pressure, Pa | | | | | |
		125	250	500	750	1000	1500
68	10	15	24	38	49	59	77
	12.7	12	19	30	39	47	62
	15	10	16	25	33	39	51
	20	7.7	12	19	25	30	38
	25	6.1	9.6	15	20	24	31
34	10	7.7	12	19	25	30	38
	12.7	6.1	9.6	15	20	24	31
	15	5.1	8.0	13	16	20	26
	20	3.8	6.0	9.4	12	15	19
	25	3.1	4.8	7.5	9.8	12	15
17	10	3.8	6	9.4	12	15	19
	12.7	3.1	4.8	7.5	9.8	12	15
	15	2.6	4.0	6.3	8.2	9.8	13
	20	1.9	3.0	4.7	6.1	7.4	9.6
	25	1.5	2.4	3.8	4.9	5.9	7.7
8	10	1.9	3	4.7	6.1	7.4	9.6
	12.7	1.5	2.4	3.8	4.9	5.9	7.7
	15	1.3	2.0	3.1	4.1	4.9	6.4
	20	1.0	1.5	2.4	3.1	3.7	4.8
	25	0.8	1.2	1.9	2.4	3.0	3.8
4	10	1.0	1.5	2.4	3.1	3.7	4.8
	12.7	0.8	1.2	1.9	2.4	3.0	3.8
	15	0.6	1.0	1.6	2.0	2.5	3.2
	20	0.5	0.8	1.3	1.6	2.0	2.6
	25	0.4	0.6	0.9	1.2	1.5	1.9

[a]Adapted with permission from HVAC Air Duct Leakage Test Manual (SMACNA 1985, Appendix A).

[b]Percentage applies to airflow entering a section of duct operating at an assumed pressure equal to average of upstream and downstream pressures.

[c]Ratios in this column are typical of flow (volumetric flow rate divided by total system surface. Portions of systems may vary from these averages.

HVAC Duct Construction Standards (2005). Fibrous glass ducts and their closure systems are covered by UL Standards 181 and 181A. For fibrous glass duct construction standards, consult NAIDA (2002) and SMACNA (2003). Flexible duct performance and installation

Table 8 Typical Design Velocities for HVAC Components

Duct Element	Face Velocity, m/s
Louvers[a]	
Intake	
3300 L/s and greater	2
Less than 3300 L/s	See Figure 14
Exhaust	
2400 L/s and greater	2.5
Less than 2400 L/s	See Figure 14
Filters[b]	
Panel filters	
Viscous impingement	1 to 4
Dry-type, extended-surface	
Flat (low efficiency)	Duct velocity
Pleated media (intermediate efficiency)	Up to 3.8
HEPA	1.3
Renewable media filters	
Moving-curtain viscous impingement	2.5
Moving-curtain dry media	1
Electronic air cleaners	
Ionizing type	0.8 to 1.8
Heating Coils[c]	
Steam and hot water	2.5 to 5
	1 min., 8 max.
Electric	
Open wire	Refer to mfg. data
Finned tubular	Refer to mfg. data
Dehumidifying Coils[d]	2 to 3
Air Washers[e]	
Spray type	Refer to mfg. data
Cell type	Refer to mfg. data
High-velocity spray type	6 to 9

[a]Based on assumptions presented in text.
[b]Abstracted from Ch. 28, 2008 ASHRAE Handbook—HVAC Systems and Equipment.
[c]Abstracted from Ch. 26, 2008 ASHRAE Handbook—HVAC Systems and Equipment.
[d]Abstracted from Ch. 22, 2008 ASHRAE Handbook—HVAC Systems and Equipment.
[e]Abstracted from Ch. 40, 2008 ASHRAE Handbook—HVAC Systems and Equipment.

standards are covered by UL Standards 181 and 181B and ADC (2003). Soldered or welded duct construction is necessary where sealants are not suitable. Sealants used on exterior ducts must be resistant to weather, temperature cycles, sunlight, and ozone.

Shaft and compartment pressure changes affect duct leakage and are important to health and safety in the design and operation of contaminant and smoke control systems. Shafts should not be used for supply, return, and/or exhaust air without accounting for their leakage rates. Airflow around buildings, building component leakage, and the distribution of inside and outside pressures over the height of a building, including shafts, are discussed in Chapters 16 and 24.

System Component Design Velocities

Table 8 summarizes face velocities for HVAC components in built-up systems. In most cases, the values are abstracted from pertinent chapters in the 2008 ASHRAE Handbook—HVAC Systems and Equipment; final selection of components should be based on data in these chapters or, preferably, from manufacturers.

Use Figure 14 for preliminary sizing of air intake and exhaust louvers. For air quantities greater than 3300 L/s per louver, the air intake gross louver openings are based on 2 m/s; for exhaust louvers, 2.5 m/s is used for air quantities of 2400 L/s per louver and greater. For smaller air quantities, refer to Figure 14. These criteria are presented on a per-louver basis (i.e., each louver in a bank of louvers) to include each louver frame. Representative production-run louvers were used in establishing Figure 14, and all data used were based on AMCA Standard 500-L tests. For louvers larger than

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