Commissioning Agent's Guide for Inspecting & Testing Access Floor Air Plenums

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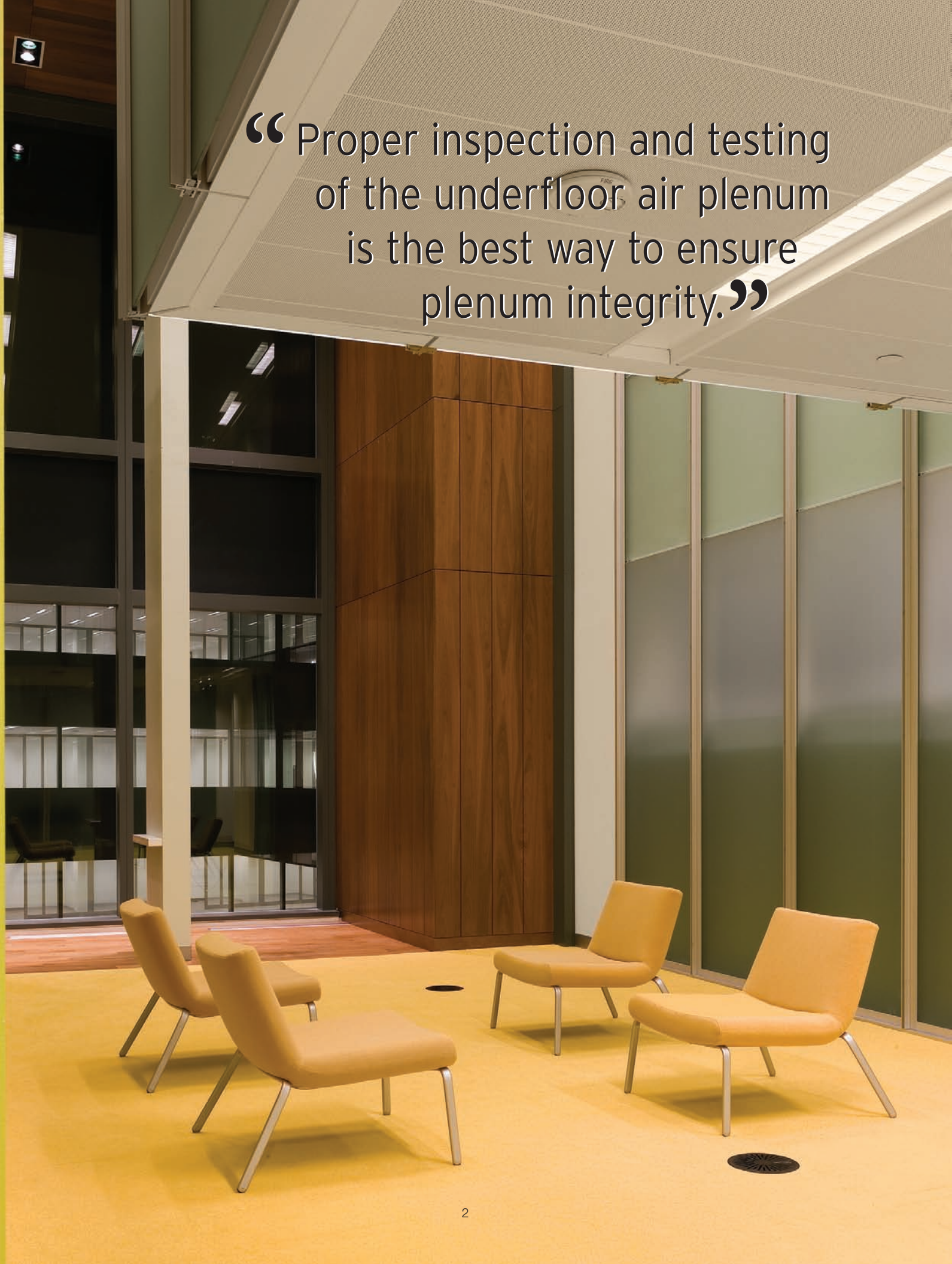
“Proper inspection and testing of the underfloor air plenum is the best way to ensure plenum integrity.”

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Plenum Integrity is one of the most important aspects of designing, constructing and maintaining an underfloor air delivery (UFAD) system. It is vital that the entire design and construction team does their part to ensure the underfloor plenum is sealed properly. As the commissioning agent, you have the responsibility to review, inspect, test, and report as outlined in the projects specifications any plenum integrity sealing deficiencies

To this end, Tate Access Floors is providing the following *Commissioning Agent's Guide for Inspecting & Testing Access Floor Air Plenums* for consideration. The recommendations contained within this guideline are based on lessons learned through working on a wide range of UFAD projects.

There are seven primary recommendations. An overview and explanation of each recommendation is provided below followed by detailed information on inspecting, reporting and testing.

Design:	Review the project specifications and construction details with the architect prior to issuance of the construction documents
Pre-Bid:	Participate in pre-bid meetings to assist with providing information and education to the subcontractors on the specific sealing requirements associated with access floor air plenums.
Pre-Construction:	Participate in pre-construction meeting to re-affirm plenum sealing requirements as outlined in the construction documents
Mock-up:	Prior to construction, perform inspection and air leakage testing of an access floor air plenum mock-up that represents typical building conditions encountered on the project as defined by the construction documents.
Quality Inspections:	Throughout construction, conduct frequent inspections to ensure work is completed as outlined in the construction documents.
Testing:	Conduct air leakage testing on the access floor air plenum to determine compliance with category 1 & 2 air leakage performance requirements.
Reporting:	Provide frequent and timely reports highlighting any plenum integrity sealing deficiencies as outlined in the construction documents.

This guide is provided to help facilitate the commissioning agent's tasks of inspecting and testing the access floor air plenums. Below you will find plenum inspection, reporting and testing procedures for the mock-up and building. This guide is intended to be used in conjunction with the *Architect's Guide for Detailing & Specifying Access Floor Air Plenums* and the *General Contractor's Guide for Constructing & Sealing Access Floor Air Plenums*.

Plenum Inspection & Reporting Form

The following checklist of structures, plenum seams, penetrations and openings should be inspected for plenum integrity. Some sealing requirements may not be applicable to all projects; ideally the architect will have omitted those that are unnecessary. Each checklist item bears the name of the architectural detail drawing that appears in the Architect's Guide. Also, if design changes occur, new specifications and details may need to be added (or created). All inspections should be coordinated with the general contractor.

Base Building Core and Shell

Inspect the construction, seams and penetrations of these building core and shell elements before any access floor components are installed. Conduct inspections as early as possible before the scheduled start of access floor installation so that corrective measures, if necessary, will not delay schedules.

Location of Seal	OK	Remediation Required
Perimeter seam along slab and exterior wall.	❑	
Enclosed column seam at slab line.	❑	
Drywall partition condition at slab line.	❑	
Base of stair landing.	❑	
Top of stair landing.	❑	
Elevator shaft below access floor line.	❑	
Expansion joint in concrete deck.	❑	

HVAC System

Inspect the sealed annular space around supply ducts in plenum walls and in the building slab before any access floor components are installed. Conduct inspections of plenum penetrations as early as possible before the scheduled start of access floor installation so that corrective measures, if necessary, will not interfere with floor installation.

Location of Seal	OK	Remediation Required
Opening in slab for vertical ducts.	❑	
Opening in plenum wall for ducts.	❑	

Plumbing System

Inspect the sealed annular space around pipes in plenum walls and in the building slab before any access floor components are installed. Conduct inspections of slab and plenum wall penetrations as early as possible before the scheduled start of access floor installation so that corrective measures, if necessary, will not interfere with floor installation.

Location of Seal	OK	Remediation Required
Pipe penetrations through concrete deck.	❑	
Pipe penetrations through plenum walls.	❑	

Electrical System

Inspect the sealed annular space around electrical conduit in plenum walls before any access floor components are installed. Conduct inspections of plenum wall penetrations as early as possible before the scheduled start of access floor installation so that corrective measures, if necessary, will not interfere with floor installation.

Electrical outlets and thermostats in fixed walls and columns: Any conduit used to run outlets and thermostats in fixed walls and columns must be properly sealed in the plenum space. This is critically important for stats as cold air leaking through conduit into the stat can cause false temperature readings.

Location of Seal	OK	Remediation Required
Conduit through plenum walls.	❑	
Open ends of conduits in the plenum space.	❑	

Voice/Data System (Communications)

Inspect the sealed annular space around cables in plenum walls before any access floor components are installed. Conduct inspections of plenum wall penetrations as early as possible before the scheduled start of access floor installation so that corrective measures, if necessary, will not interfere with floor installation.

Location of Seal	OK	Remediation Required
Cable penetrations through the plenum walls with cable sleeves.	❑	
Caps on empty conduits or cable sleeves.	❑	

Access Floor

The zone partitioning inspections should be held prior to completion of the floor panel installation for easy visual inspection. The abutment and access floor penetration inspections should be conducted throughout the entire access floor installation including the installation of carpeting or other finishes and all service distribution devices.

Location of Seal	OK	Remediation Required
ZONE PARTITIONING		
Plenum dividers.	❑	
Air highways.	❑	
Penetrations through plenum dividers.	❑	
ABUTMENTS		
Perimeter seam without wall base.	❑	
Through wall without wall base.	❑	
Perimeter seam with wall base.	❑	
Through wall with wall base.	❑	
Perimeter seam at non-smooth walls and columns.	❑	
Access floor seal at fascia/exposed edge	❑	
Perimeter seam at elevator shaft.	❑	
Perimeter seam at top of stair landing.	❑	
Perimeter seam at bae of stair landing	❑	
Perimeter seam at fire barrier below door threshold.	❑	
Perimeter seam at curb where floor covering is continuous.	❑	
Perimeter seam at curb where floor covering is not continuous.	❑	
PENETRATIONS		
Cable cutouts and grommets.	❑	
Power/voice/data distribution boxes in access floor panels.	❑	
Pipe penetrations through the access floor.	❑	
Inside walls through the access floor.	❑	

Air Leakage Test Procedures

Access Floor Air Plenum Leakage Categories

There are two basic categories of UFAD air leakage, Category 1 leakage occurs outside of the intended occupied zone, Category 2 leakage is plenum air that leaks into the occupied zone through spaces other than the designed air distribution devices such as diffusers. Category 2 leakage is unique to UFAD systems because all of this leakage goes into the occupied space whereas in a traditional ducted overhead system, all leakage and short-circuited air enters the return plenum and will not reached the intended zone.

Category 1 Leakage

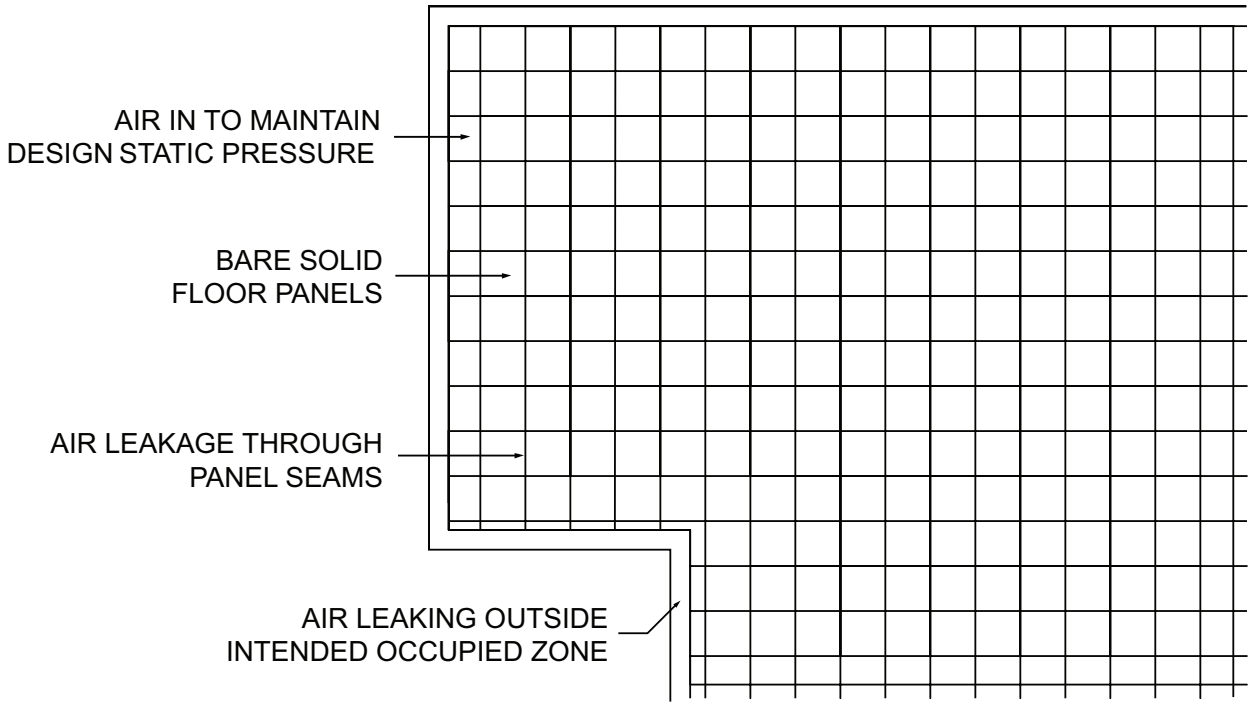
A good UFAD system will have a category 1* air leakage rate of no more than 10% of the total design airflow volume however the allowable limit will be based on the project specifications. If category 1 leakage is beyond the specified limit, the plenum should be repaired to yield leakage of no more than the specified limit.

The allowable Category 1 leakage number used to commission UFAD systems is higher than overhead distribution. This higher number is used because the entire HVAC system from supply point to diffuser is being tested in a UFAD system. By comparison overhead systems typically only test the trunk or high and medium pressure ducts. The test being performed on a UFAD system would be the equivalent to using the following equation on an overhead system: Leakage = supply duct + VAV box + low pressure duct + flex duct + diffuser & flex connection.

Category 1 Air leakage Test Procedures:

Tate recommends the following procedure for testing category 1 air leakage during the mock-up and final plenum commissioning stages: Construct the access floor air plenum and install the access floor system as outlined in the project specifications and construction details using only solid bare access floor panels with no cutouts, accessories or carpeting (see figure 1). Seal all unused duct risers and pressurize the plenum to the design static pressure, typically .05 -.10" w.g. max, and measure the CFM required to maintain pressure. This leakage represents both the category 1 leakage and the panel seam leakage. To determine Category 1 leakage only, subtract the manufacturer's panel seam leakage at the specified static pressure and compare against project specifications to determine compliance. The manufacturers panel seam leakage is determined by assessing the average panel seam gap in the test area using a feeler gage then refer to the chart on page11. (sample report on page 10)

Figure 1:



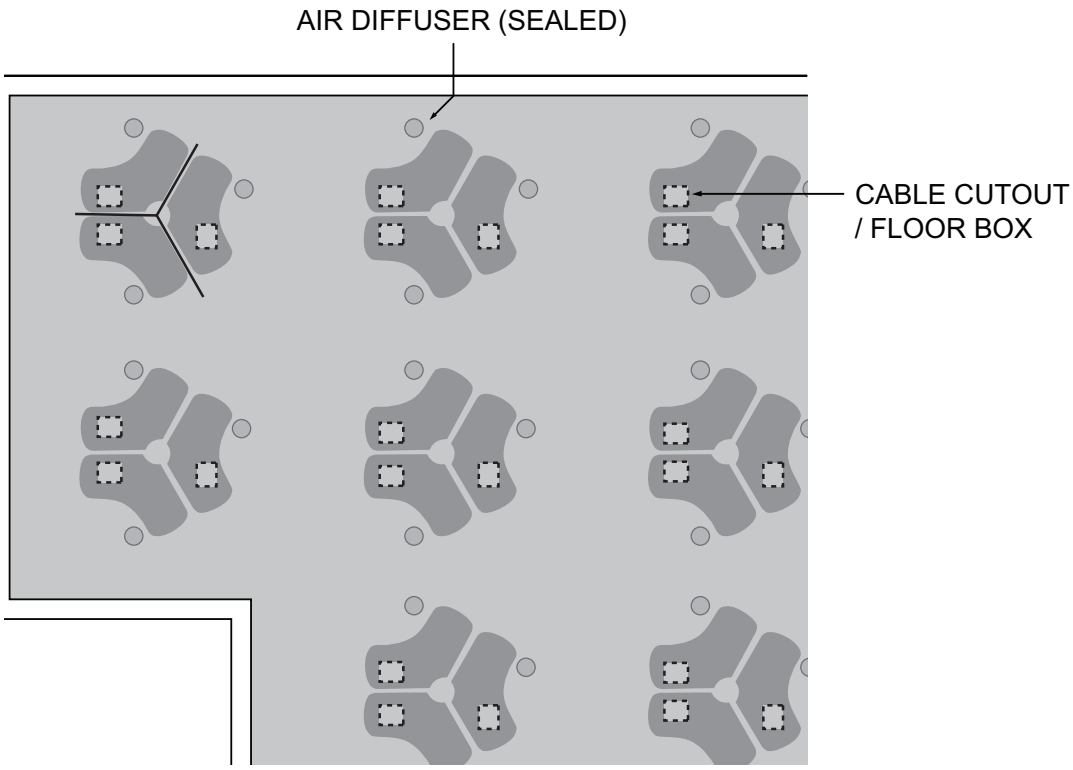
Category 2 Leakage:

Category 2 air leakage allowable limit will be based on the project specifications. If category 2 leakage is beyond the specified limit, the plenum should be repaired to yield leakage of no more than the specified limit.

Category 2 Air Leakage Test Procedures:

Tate recommends the following procedure for testing category 2 air leakage during the mock-up and final plenum commissioning stages: Category 2 testing shall use the access floor air plenum assembled as described in category 1 testing however all cutouts, accessories, and carpeting shall be installed as per the project specifications and construction details. All air delivery devices shall be closed and sealed tight to prevent passage of plenum air (see figure 2). Seal all unused duct risers and pressurize the plenum to the design static pressure, typically .05 - .10" w.g. max, and measure the CFM required to maintain pressure. This total leakage represents both category 1 and category 2 leakage. To determine category 2 leakage only, subtract the category 1 leakage determine in the first test from this total and compare against project specifications to determine compliance. (sample report on page 10)

Figure 2:



UFAD Air Leakage Testing Report

General Testing Information

Date of air leakage testing: 10/08/2007
Project Name: South Development Building 1
Project Number: 152G485
Location of test area: 3rd Floor Southeast Wing

Determine Maximum Allowable Category 1 Air Leakage (CFM)

1. Total square foot of test area..... ..... 5,000 ft^2
2. Total number of diffusers designed for test area 40
3. Design static pressure per project specifications . . . .05" H2O
4. Design airflow per diffuser (fully open) . . . . . .90 CFM
5. Total design airflow in test area (Line 2 x 4) . . . . . .3600 CFM
6. Max. Category 1 air leakage per specifications . . . . . 10% of design airflow
7. Max. allowable Category 1 air leakage (Line 5 x 6) . . . . . **360 CFM**

Category 1 Air Leakage Field Test Result

8. Total CFM required to maintain .05" static pressure . . . . . .2500 CFM
9. Assessed average panel gap . . . .013"
10. Manufacturer's panel seam leakage data @ .05" static pressure . . . .44 CFM/ft^2
11. Total panel seam leakage @ .05" static pressure (Line 10 x 1) . . . . . .2200 CFM
12. Total Category 1 air leakage result (Line 8 – 11) . . . . . .**300 CFM**

Compliance with Category 1 Project Specifications

Pass (Line 12 is less than line 7) ❑ Fail (Remediation Required)

Determine Maximum Allowable Category 2 Air Leakage (CFM)

1. Total square foot of test area 5,000 ft2
2. Total number of diffusers designed for test area 40
3. Design static pressure per project specifications . . . . . .05" H2O
4. Design airflow per diffuser (fully open) . . . . . 90 CFM
5. Total design airflow in test area (Line 2 x 4) . . . . . .3600 CFM
6. Max. Category 2 air leakage per specifications . . . . . 10% of design airflow
7. Max. Category 2 air leakage (Line 5 x 6) . . . . . **360 CFM**

Category 2 Air Leakage Field Test Result

8. Total CFM required to maintain .05" static pressure . . . . . .650 CFM
9. Total Category 1 air leakage result (from above) . . . . . .300 CFM
10. Total Category 2 air leakage result (Line 8 – 9) . . . . . .**350 CFM**

Compliance with Category 2 Project Specifications

Pass (Line 10 is less than line 7) ❑ Fail (Remediation Required)

Tate's Panel Seam Leakage Chart

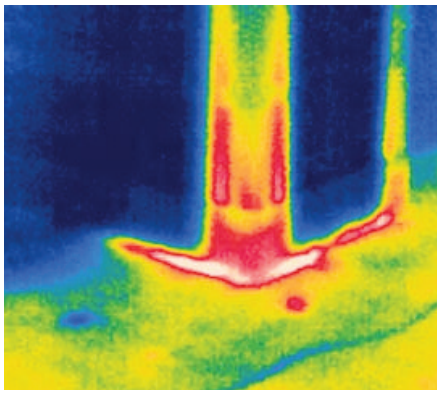
Average Panel Gap (inches)	@ 0.1" H_2O (CFM/SqFt)	@ 0.05" H_2O (CFM/SqFt)
.005	0.19	0.11
.006	0.24	0.14
.007	0.30	0.18
.008	0.35	0.21
.009	0.39	0.24
.010	0.49	0.30
.011	0.55	0.34
.012	0.62	0.39
.013	0.70	0.44
.014	0.77	0.49
.015	0.84	0.54
.016	0.92	0.59
.017	1.00	0.64

UFAD Air Leakage Remediation

In the event that excessive category 1 leakage is discovered during plenum testing there are several techniques that have been used to help identify the location of a leak. One common method is to conduct a smoke test. A smoke test is performed by blowing smoke into the floor plenum and then looking for places where the smoke is escaping. By removing panels in this location the point of leakage is easier to find.

Thermal Imaging

Another option is to conduct a thermal scan of the interior spaces. Thermal imaging can identify the location of leakage with better accuracy. The improved accuracy, elimination of smoke and the ability to conduct this scan without sealing the plenum are just some potential benefits.



Images provided by ISC Building Diagnostics, www.iscbuildingdiagnostics.com

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