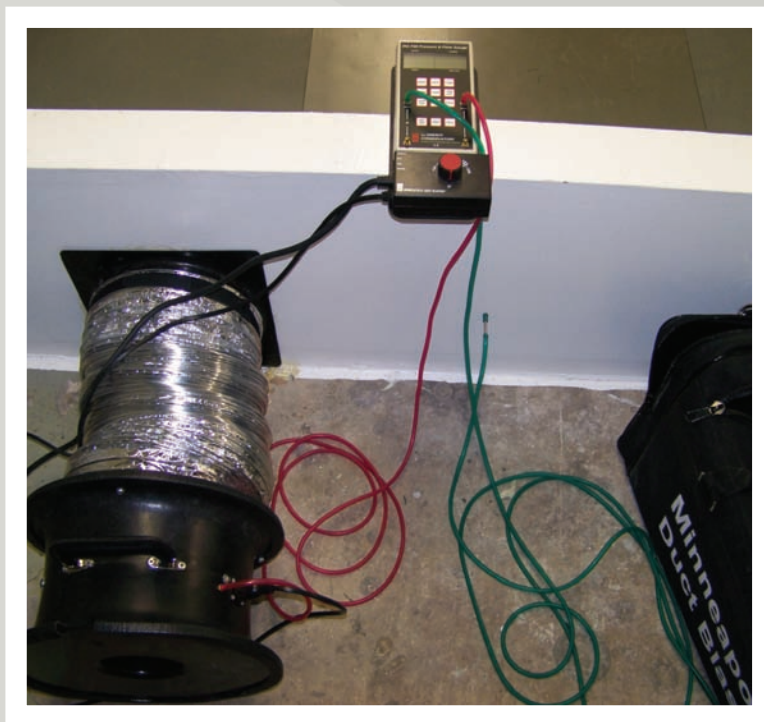
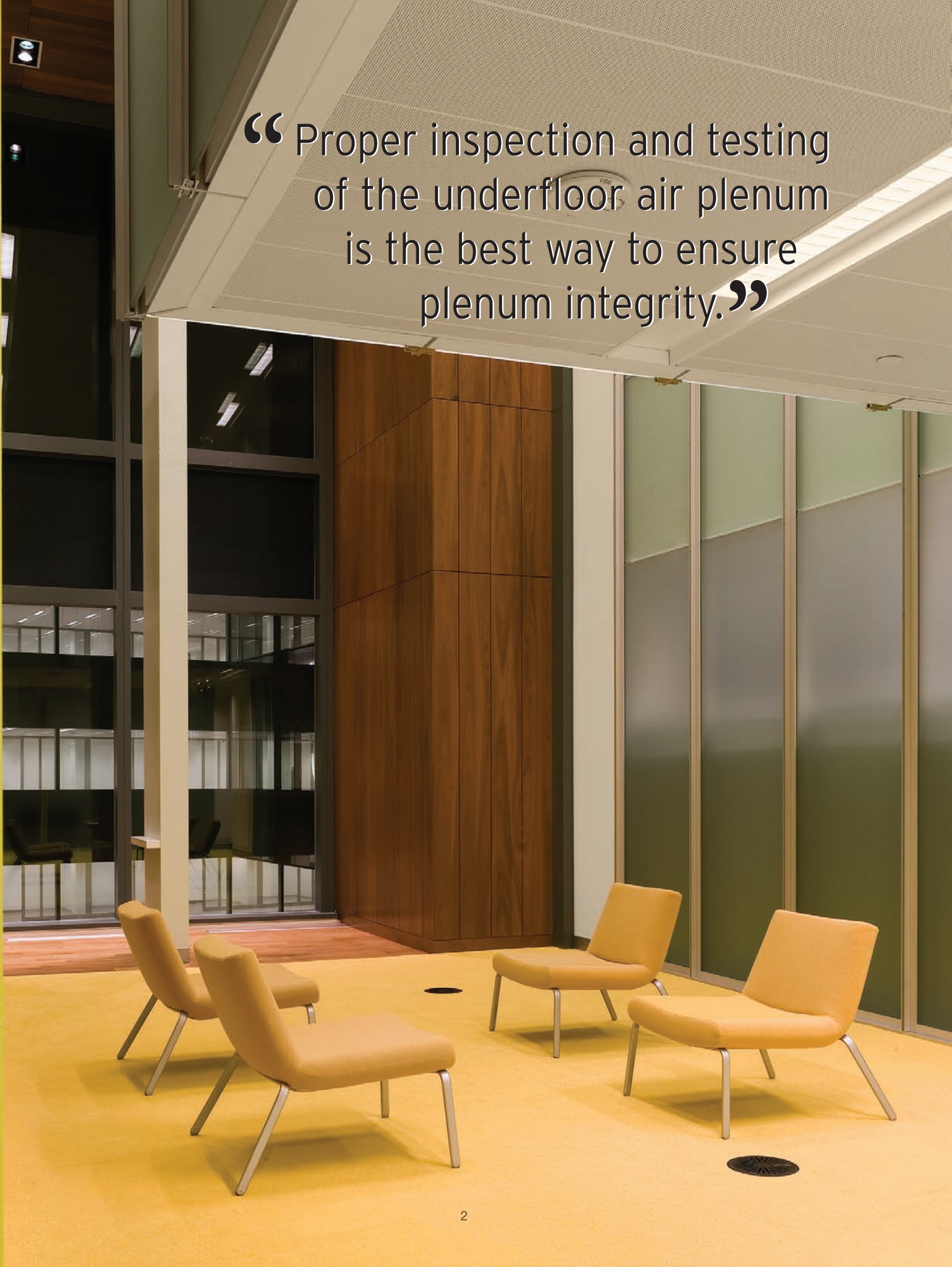


Commissioning Agent's Guide for Inspecting & Testing Access Floor Air Plenums



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



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

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.	<input type="checkbox"/>	
Enclosed column seam at slab line.	<input type="checkbox"/>	
Drywall partition condition at slab line.	<input type="checkbox"/>	
Base of stair landing.	<input type="checkbox"/>	
Top of stair landing.	<input type="checkbox"/>	
Elevator shaft below access floor line.	<input type="checkbox"/>	
Expansion joint in concrete deck.	<input type="checkbox"/>	

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.	<input type="checkbox"/>	
Opening in plenum wall for ducts.	<input type="checkbox"/>	

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.	<input type="checkbox"/>	
Pipe penetrations through plenum walls.	<input type="checkbox"/>	

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.	<input type="checkbox"/>	
Open ends of conduits in the plenum space.	<input type="checkbox"/>	

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.	<input type="checkbox"/>	
Caps on empty conduits or cable sleeves.	<input type="checkbox"/>	

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.	<input type="checkbox"/>	
Air highways.	<input type="checkbox"/>	
Penetrations through plenum dividers.	<input type="checkbox"/>	
ABUTMENTS		
Perimeter seam without wall base.	<input type="checkbox"/>	
Through wall without wall base.	<input type="checkbox"/>	
Perimeter seam with wall base.	<input type="checkbox"/>	
Through wall with wall base.	<input type="checkbox"/>	
Perimeter seam at non-smooth walls and columns.	<input type="checkbox"/>	
Access floor seal at fascia/exposed edge	<input type="checkbox"/>	
Perimeter seam at elevator shaft.	<input type="checkbox"/>	
Perimeter seam at top of stair landing.	<input type="checkbox"/>	
Perimeter seam at base of stair landing	<input type="checkbox"/>	
Perimeter seam at fire barrier below door threshold.	<input type="checkbox"/>	
Perimeter seam at curb where floor covering is continuous.	<input type="checkbox"/>	
Perimeter seam at curb where floor covering is not continuous.	<input type="checkbox"/>	
PENETRATIONS		
Cable cutouts and grommets.	<input type="checkbox"/>	
Power/voice/data distribution boxes in access floor panels.	<input type="checkbox"/>	
Pipe penetrations through the access floor.	<input type="checkbox"/>	
Inside walls through the access floor.	<input type="checkbox"/>	



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 reach the intended zone.

Category 1 Leakage

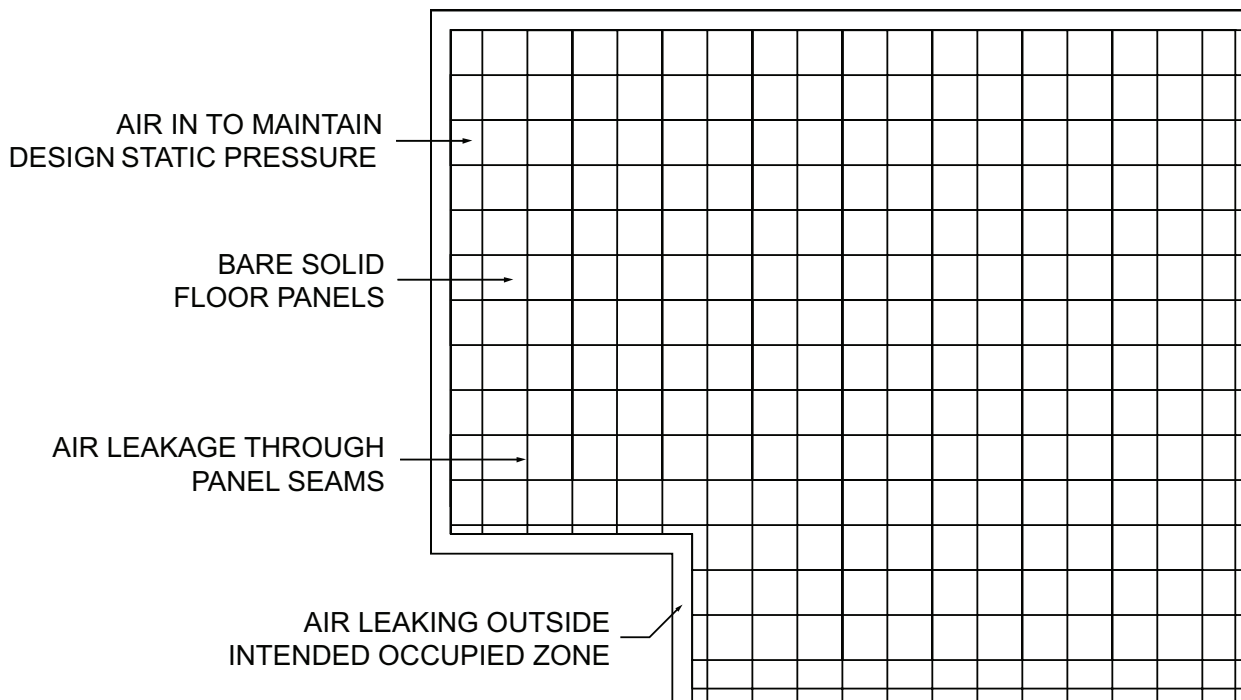
A good UFAD system will have a category 1* air leakage rate of no more than 10% of the total design airflow volume however the allowable limit will be based on the project specifications. If category 1 leakage is beyond the specified limit, the plenum should be repaired to yield leakage of no more than 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 manufacturer's 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 page 11. (sample report on page 10)

Figure 1:



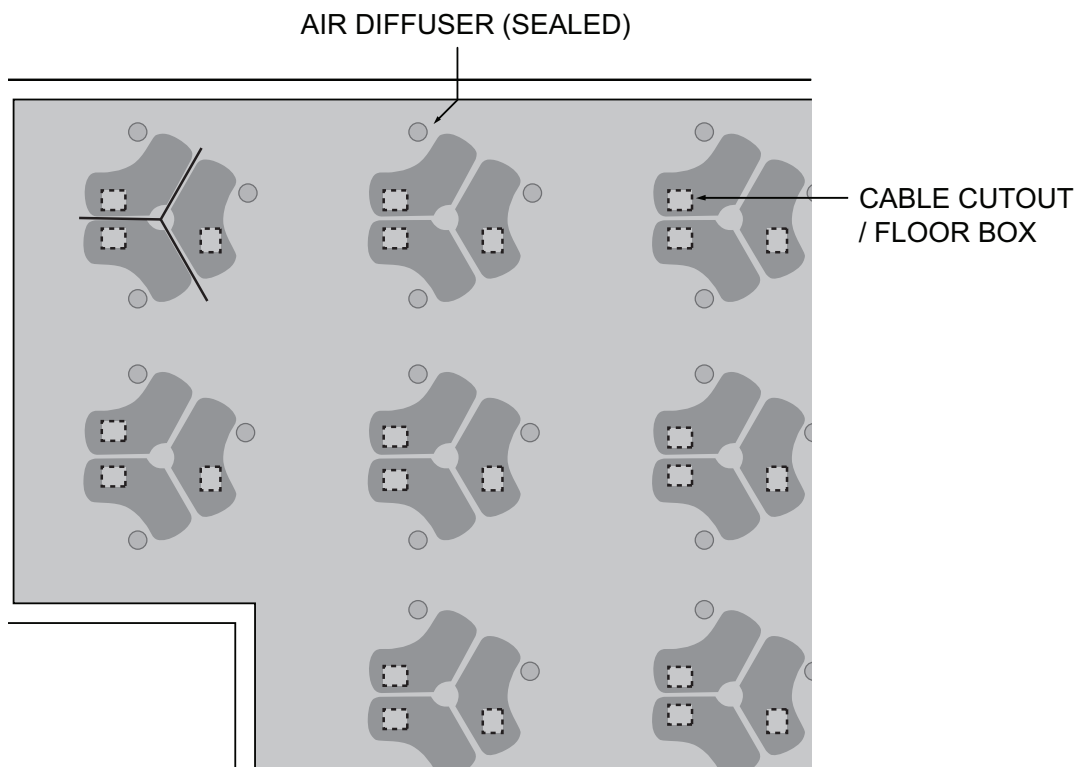
Category 2 Leakage:

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 ft²
2. Total number of diffusers designed for test area40
3. Design static pressure per project specifications0.05" 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 pressure2500 CFM
9. Assessed average panel gap0.013"
10. Manufacturer's panel seam leakage data @ .05" static pressure44 CFM/ft²
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 area5,000 ft²
2. Total number of diffusers designed for test area40
3. Design static pressure per project specifications0.05" 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 pressure650 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

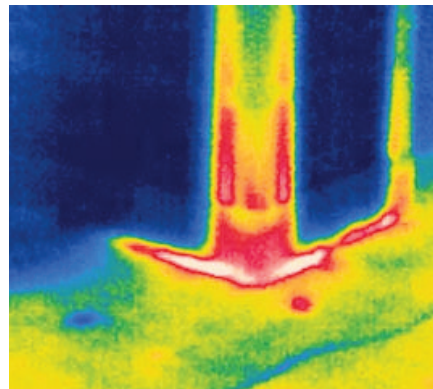
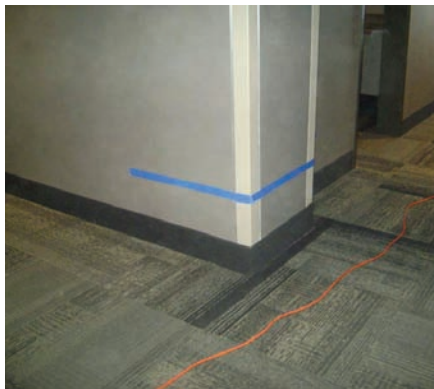
Average Panel Gap (inches)	@ 0.1" H ₂ O (CFM/SqFt)	@ 0.05" H ₂ O (CFM/SqFt)
.005	0.19	0.11
.006	0.24	0.14
.007	0.30	0.18
.008	0.35	0.21
.009	0.39	0.24
.010	0.49	0.30
.011	0.55	0.34
.012	0.62	0.39
.013	0.70	0.44
.014	0.77	0.49
.015	0.84	0.54
.016	0.92	0.59
.017	1.00	0.64

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

Tate®



Tate Access Floors, Inc.

Corporate Headquarters:

7510 Montevideo Road, Jessup, MD 20794
Tate Hotline: 1-800-231-7788
Tel: 410-799-4200 Fax: 410-799-4207

Production Facilities:

7510 Montevideo Road, Jessup, MD 20794
52 Springvale Road, Red Lion, PA 17356

International Sales & Support Office:

169 Jalan Jurong Kechil
#7-011, Sherwood
Singapore 598669
Tel: 65-6468-1332 Fax: 65-6468-6681

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kingspan.com

tateaccessfloors.com
kingspan.com



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made in the U.S.A.



Tate ASP Access Floors, Inc.

Canadian Office & Production Facilities:

880 Equestrian Court, Oakville, ON L6L 6L7 Canada
Tate Hotline: 1-800-231-7788
Tel: 905+847-0138 Fax: 905+847-0141

tateasp.com
kingspan.com

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