

# *Spaul Environmental, Inc.*

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Environmental and Medical Monitoring  
EPA/OSHA Compliance  
Hazardous Waste Control  
Indoor Air Quality Evaluations

Safety Evaluations  
Training  
Expert Testimony  
Hazard Communication

31 August 1994

Ms. Judith Hunt, Director  
Risk Management and Safety Department  
School Board of Broward County  
1320 Southwest Fourth Street  
Ft. Lauderdale, FL 33312

RE: A Follow-up Indoor Air Quality (IAQ) Evaluation at Cooper City High

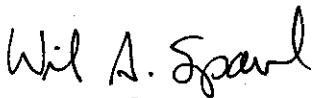
Dear Ms. Hunt:

First, thank you for allowing me to provide these services to your school district. The enclosed report follows a standard scientific report format plus a recommendation section. Should you desire additional information, want clarification on any item, or have any questions about this report, please do not hesitate to contact me.

This report is a follow-up inspection of my 30 March 1993 and 13 April 1993 evaluation reports for this school. Since my earlier reports, this school has reportedly been cleaned in accordance with my earlier recommendations.

I would like to express my appreciation to the Principal for providing free access at this school, and for assistance in identifying areas where concerns had been expressed.

Sincerely,



Wil A. Spaul, President  
PhD, MPH, MSCE  
Certified Industrial Hygienist

Adjunct Associate Professor of Indoor Air Quality  
College of Public Health  
University of South Florida - Tampa

# **A Follow-up Indoor Air Quality Evaluation At Cooper City High School**

## **ABSTRACT:**

On 25 and 29 August 1994, Dr. Wil A. Spaul (PhD, MPH, MSCE) conducted a follow-up indoor air quality (IAQ) evaluation at Cooper City High School in response to reported health concerns. The procedures that were used in the 1993 evaluation and report were also used in this evaluation. Dr. Spaul's evaluation consisted of teacher interviews, inspections of the inside of the air handler units, and carbon dioxide measurements.

The elevated carbon dioxide concentrations would support the hypothesis that "Tight Building Syndrome" complaints had been occurring and are still continuing. From the original employee interviews, there appeared to be a pattern of allergy and "Tight Building Syndrome" complaints. The initial detailed inspection inside a number of air handler units revealed sufficient mold growths that could result in some of the reported allergic responses in those people who are sensitive to those molds. These units have reportedly been cleaned. The enclosed report discusses the current findings and their significance, and provides a punch-list of recommendations to correct these problems.

## **INTRODUCTION:**

Dr. Wil A. Spaul (PhD, MPH, MSCE), a Certified Industrial Hygienist and an Adjunct Associate Professor of Indoor Air Quality (Department of Environmental and Occupational Health Sciences, College of Public Health, University of South Florida - Tampa), was requested by the Risk Management and Safety Department of the School Board of Broward County to conduct a preliminary screening indoor air quality evaluation at Cooper City High School in 1993. Since that earlier evaluation and report, the maintenance department has reported that they have completed the cleaning

recommendations. This report details a follow-up evaluation that was conducted on 25 and 29 August 1994.

## **METHODS AND MATERIALS:**

The procedures that were identified in the earlier report were followed in this evaluation.

The surrounding area was inspected to determine if likely outdoor sources could be identified that could contribute to any indoor air quality concerns. No possible contaminant sources that are extrinsic to the buildings were identified.

A number of air handlers were shut down, locked out and tagged, opened up, and inspected. The return air plenum (at the air handler), the filters, both sides of the coils, the condensation pans, the insulation inside the fan chambers, and the fan blades and housing were inspected. The supply air duct, where the air leaves the air handler, was inspected where inspection hatches or ports had been installed.

Carbon dioxide concentrations were again measured at several locations. The outdoor carbon dioxide concentration was also measured and recorded. All carbon dioxide measurements were performed with a direct reading carbon dioxide gas monitor (Gaztech International Corporation Telaire Model VEMS 1310) that was calibrated before and after sampling with two separate calibration gas mixtures.

## **RESULTS:**

This portion of the report is divided into four sections. These sections are: a) summary of interview patterns; b) air handler unit inspection results; c) carbon dioxide concentration results; and d) photographic documentation.

***a) Summary of Interview Patterns:***

The problem with the sewer odors that had been previously reported appears to have been resolved since the previous evaluation.

The "tight building" types of complaints can be expected to continue since the previously documented problems with inadequate outdoor air flow distribution have not been corrected.

Room 200 was extremely warm and reportedly was air conditioned by the same unit that handles some other non-classroom spaces. If this latter situation is true, then this room should be provided a thermostat to control the temperature and air flows to this classroom.

Room 227 had a major roof leak that had collapsed some ceiling tiles. This leak should be repaired and the ceiling tiles replaced.

Several rooms in the new wing (art and media) were very humid, and the media center had extensive mold growths.

***b) Air Handler Unit Inspection Results:***

***AHU-13:***

- Need to change from 1" filters to 2" filters;
- Need to remove low removal efficiency filter racks;
- Chilled water thermometers are split;
- Digital check of supply water temperature was 54°F; return temperature was 60°F; this supply temperature is too elevated to obtain proper dehumidification;
- Outside air intake dampers are not responding; not closing when unit is off.

***AHU-14D:***

- Chilled water supply temperature was 55°F;
- Outside air intake was discharging cold air, not drawing outside air into unit;

- Outside air intake dampers are not responding, nor closing when unit is off.

*Northwest Corner of Gym Unit:*

- Dirty condensation pan after coils and prior to re-heat elements;
- Access hatch is broken (top right corner) by fan;
- Outside air intake damper not working.

*AHU-14B:*

- Dirty in same area as in above unit;
- Return air fan blades on north side have not been cleaned; are dusty;
- Unit is clean otherwise;
- Blowing cool air out of air intake and exhaust damper;
- Outside air intake damper is not working.

*AHU-14E:*

- Outside air intake damper not working; exhaust damper not working;
- No set screw for latch on fan access panel;
- Back access panel is broken along bottom and had been painted closed; need to replace hatch;
- Metal cuttings also inside condensate pan; these should have been removed by the contractor after the access panels were cut;
- Access hatches were painted in place;
- Unit was flushed between heat elements and fan, but not between coils and heat elements.

*Carrier Unit Serial #2487 T 00806:*

- Very loose fan belts;
- Condensation pan not flushed ("inspected Moody 8/29/94");
- No number on unit.

*Mechanical Room 611:*

- Three air handler units: AHU-2, -3, and -4;
- Room is clean;

- Need to check outside air flow and test and balance report.

**AHU-2:**

- Inadequate air gap on condensate line;
- Unit is very clean throughout;
- School needs to order proper filter size for unit.

**AHU-3:**

- Clean medium removal efficiency filter, but wrong size; need to install correct size of filter;
- Metal cuttings on floor under where access hole was cut should be cleaned up; see also inside back lower panel in unit;
- Access hatches have been painted in place and should be made free by the Contractor.

**AHU-4:**

- Need correct filter size;
- Deteriorated fiberglass insulation is not sealed on return plenum in front of filters;
- Hatch is too small on back panel to be functional; there was room for a larger hatch;
- Very clean inside unit;
- Very good coating of Portersept.

***Carrier Heat Pump Serial #W295259 On Roof West Of Gym:***

- Single unit on this roof;
- Outside air intake blocked off;
- Very deteriorated coils;
- Clean low removal efficiency filters;
- Clean unit;
- Access panel screws on filter cover are plugged with Portersept and not able to tighten.

***AHU (# missing) - Carrier (AHU-R-2 temporary number):***

- Clean unit;
- Outside air is almost blocked off;
- Contractor has removed air handler unit number.

**NOTE:** Contractor has blocked off air handler numbers when he installed access panels to fan, and he failed to renumber the units. Units need to be renumbered by contractor.

*AHU Serial #2487T00808:*

- Contractor removed AHU number;
- Clean inside;
- Outside air almost blocked off.

*Room 227:*

- Major ongoing roof leak, possibly from air handler above the room;
- Ceiling tiles should be replaced as soon as this leak is corrected.

*AHU-10:*

- Return air plenum under return air fan is very dirty and should be cleaned; piles of dried mud at return plenum duct, just below fan;
- Rest of unit is very clean;
- Same problem as previously reported in with inadequate outside air;
- Lot of standing water in condensate pan; unit needs to be pitched to encourage drainage.

*Old Lennox Unit next to AHU-10:*

- Partially cleaned and treated;
- Very dirty and deteriorated insulation between fans and coils;
- Dirty coils;
- Old fiberglass insulation on fan blades - not removed;
- Fan belts are extremely loose and about to break - see photos;
- This unit needs to be reworked.

*AHU-6:*

- Clean unit, but excessive amount of water in unit;
- Area under fan is also flooded, which should normally be dry.

**AHU-5:**

- Return air fan was wrapped in plastic and the plastic was not removed by contractor; the district Maintenance Department representative at the school should have caught this problem;
- Very clean inside unit;
- Lot of standing water.

**NOTE:** Maintenance needs to come to this school and adjust the pitch on these roof top units to get the excess water out of the units. These areas will soon grow molds if not drained.

**AHU-3:**

- Very clean;
- Lot of standing water.

**AHU-1:**

- Same problem with air conditioned air coming out of outside air intake instead of air flowing in;
- Return air fan area appears to have been sprayed with Oxine, but was not wiped clean; contractor needs to return and wipe this area clean;
- Condensation pan and supply fan motors were not protected from Portersept;
- Lot of standing water in unit.

**NOTE:** A Maintenance Department representative should conduct a thorough inspection of each unit before informing Risk Management that the job has been completed by the contractor. It is apparent that some rather obvious items (plastic wrap around fan motor) were not checked by the School Board's HVAC supervisor on site prior to Dr. Spaul's inspection.

**AHU-7:**

- Same conditions as those observed in AHU-1.

**New Wing Chiller:**

- Supply water temperature = 45°F; set point = 45°F.



*New Wing: Mechanical Room 613: AHU #1:*

- Return water temperature = 61°F; no supply water test port;
- Condensate line hard plumbed to floor drain;
- Mixed return air temperature = 73°F; outside air temperature = 83°F; supply air temperature above coils = 64°F;
- Dirty return medium removal efficiency filters; cut and taped to fit; need proper size;
- Lot of condensate sweating on supply air duct above unit;
- Fan belt is so loose that it bangs against the guard;
- Unit needs to have port installed to check supply water temperature to coils;
- Contractor needs to return to remove metal cuttings for hatches and to remove Portersept from condensation pan, which is now starting to grow microbial slime; these items should have been caught by the School Board's HVAC project supervisor.

*Media Center:*

- Mold growths on surfaces are fairly extensive even though custodian has been cleaning these surfaces (see photographs);
- Inadequate dehumidification at these units;
- Supply air temperature at room diffusers is 64°F; air temperature is 71°F; relative humidity is 76%.

*Mechanical Room 618:*

- Four small units: AHU-5, -6, -7, and -8.

*AHU-6 and AHU-7:*

- Both units are in about the same condition;
- Need to get properly sized medium removal efficiency filters;
- Fan belts are very loose and about to break at any time;
- Lot of condensate sweating at unit where supply air duct leaves unit; this area needs to be re-insulated;
- Condensation pans were coated with Portersept, which has not set up and has started to grow microbial slime on the latex coating; these condensation pans need to be flushed clean;
- Insulation at the base of walls around condensation pan was inadequately coated with Portersept.

**NOTE:** Contractor is reattaching cover panels before Portersept has dried.

*AHU-5 and AHU-8:*

- Same conditions as those observed in above two units;
- AHU-5 does not have any filters;
- Also, back access panel to condensation pan area still has Portersept (not cured);
- Condensation pan should be flushed; Portersept not cured and is supporting microbial growths.

*Portable 362:*

- Two units;
- Front unit has no outside air;
- Front unit has dirty coils;
- Back unit had outside air intake closed, now open.

*Portable 54:*

- Two air handler units;
- Both are dirty;
- Both units have no outside air.

**NOTE:** Most of the access panels are not in compliance with the specified 24"x24" access panel, even where they could have been installed. Contractor installed a lot of small access panels. These small access panels should be either relocated or replaced to provide as many 24"x24" access panels as can be installed.

The originally reported concerns about sewer odors appear to have been resolved with the stack extensions at the roof.

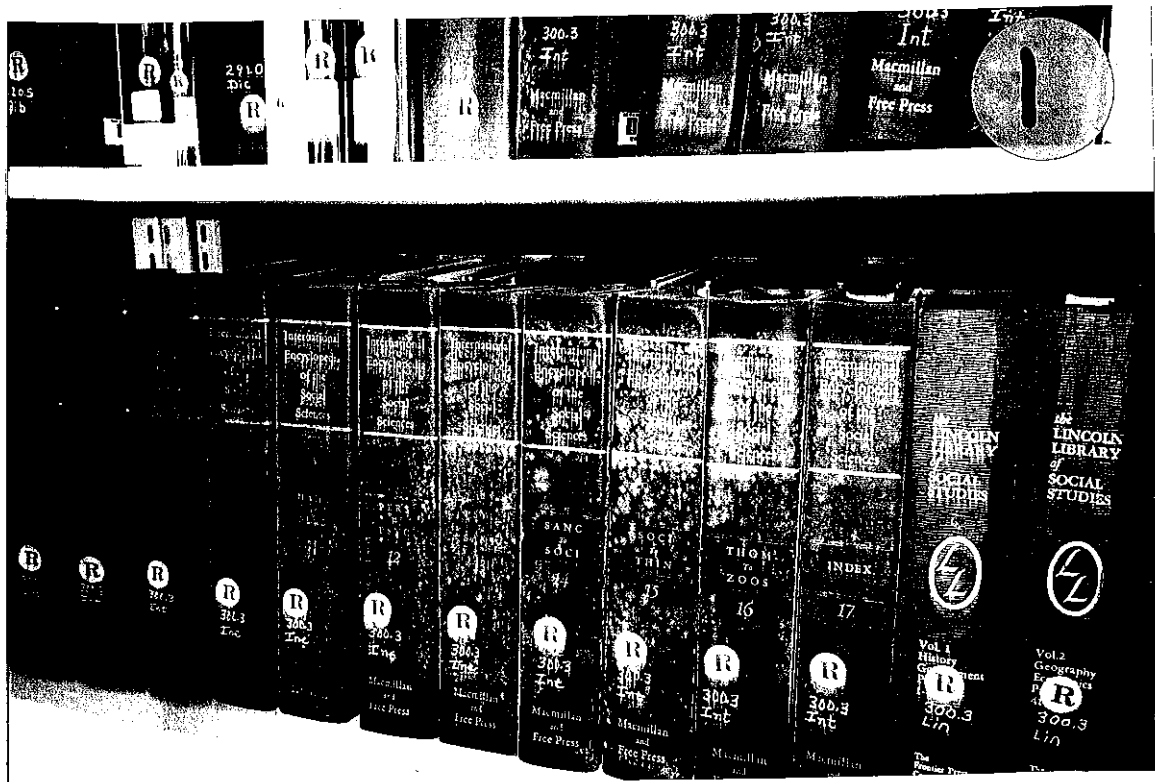
***c) Carbon Dioxide Concentration Results:***

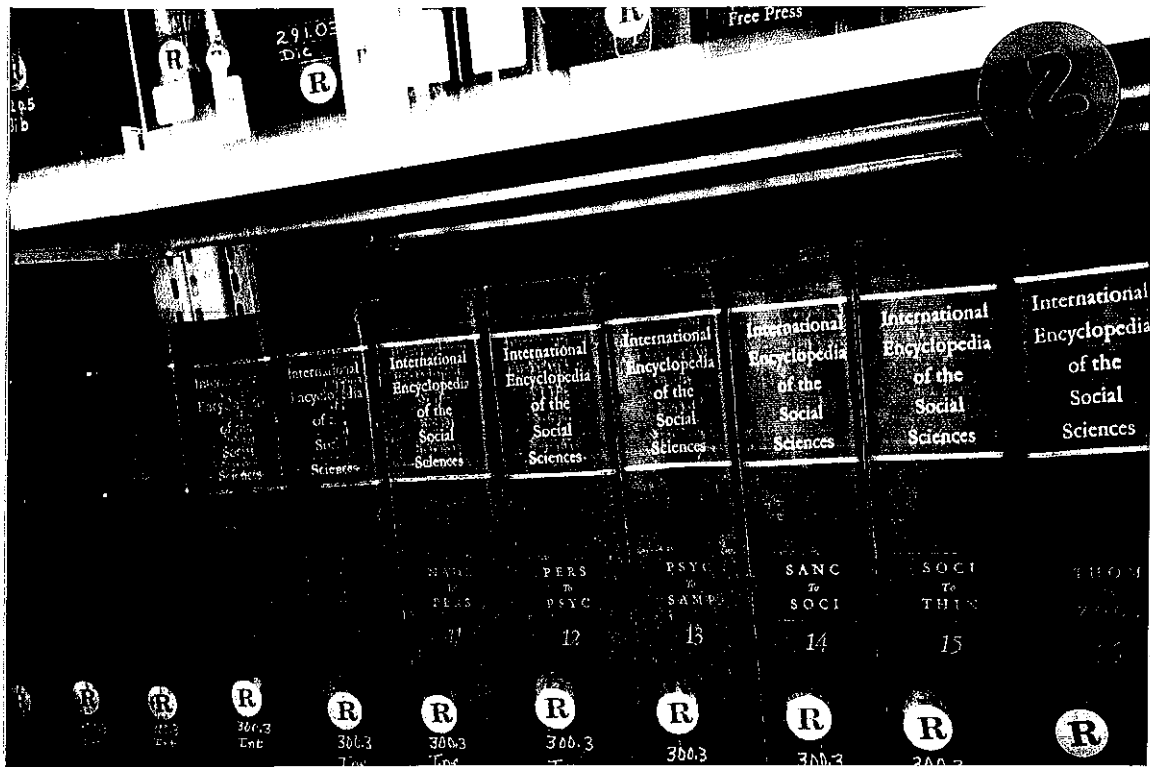
<u>Time</u>	<u>Room</u>	<u>CO<sub>2</sub> (ppm)</u>	<u>Temp</u>	<u>%R.H.</u>	<u>Notes</u>
1241	Outdoors	434	-	-	-
1252	619	>1100	75	60	30 students; start of class
1257	616	>1100	74	63	30 students; start of class

Time	Room	CO <sub>2</sub> (ppm)	Temp	%R.H.	Notes
1300	615	>1100	76.2	62	28 students; start of class
1303	101	>1500	78.6	69	33 students; start of class; minimal air flow detected; open door to hall
1306	151	>1500	77.3	63	34 students; start of class
1308	149	>1600	77.1	63	33 students; open to hall
1310	144	>2000	76.6	60	30 students; door closed to hall
1311	136	>2000	75.9	57	32 students; start of class
1313	176-C	>1600	76.4	68	29 students
1315	177	>1600	76.2	67	25 students
1316	176-A	>1560	75.6	67	30 students; wall damaged from moisture; water leaks under window
1317	174-A	1528	75.3	67	22 students; musty odor in room
1318	166	1215	74.7	67	27 students
1321	113	>1200	76	72	32 students
1323	115	>1200	76	73	29 students
1325	199	>2000	76	78	28 students; warm
1327	198	>2000	74	69	31 students; warm
1329	200	>2000	81	77	34 students; unit is reportedly frequently shut down; need to check VAV box setting - T & B
1400	Port. 362	>2000	-	-	32 students

**d) Photographic Documentation**

**Photographs 1-3: Moldy Books In Media Center Due To Inadequate Dehumidification**





**Photographs 4 & 5: Very Loose Fan Belts That Are About To Break. The School Board's HVAC On-site Project Supervisor For This Project Should Have Caught These Problems**



**Photograph 6: Fan Motor That Has Not Had The Plastic Removed After The Cleaning Process Inside The Air Handler. Both The Contractor And School Board's On-site Project Supervisor Should Have Caught This Problem During Their Final Inspection - If It Was Performed**



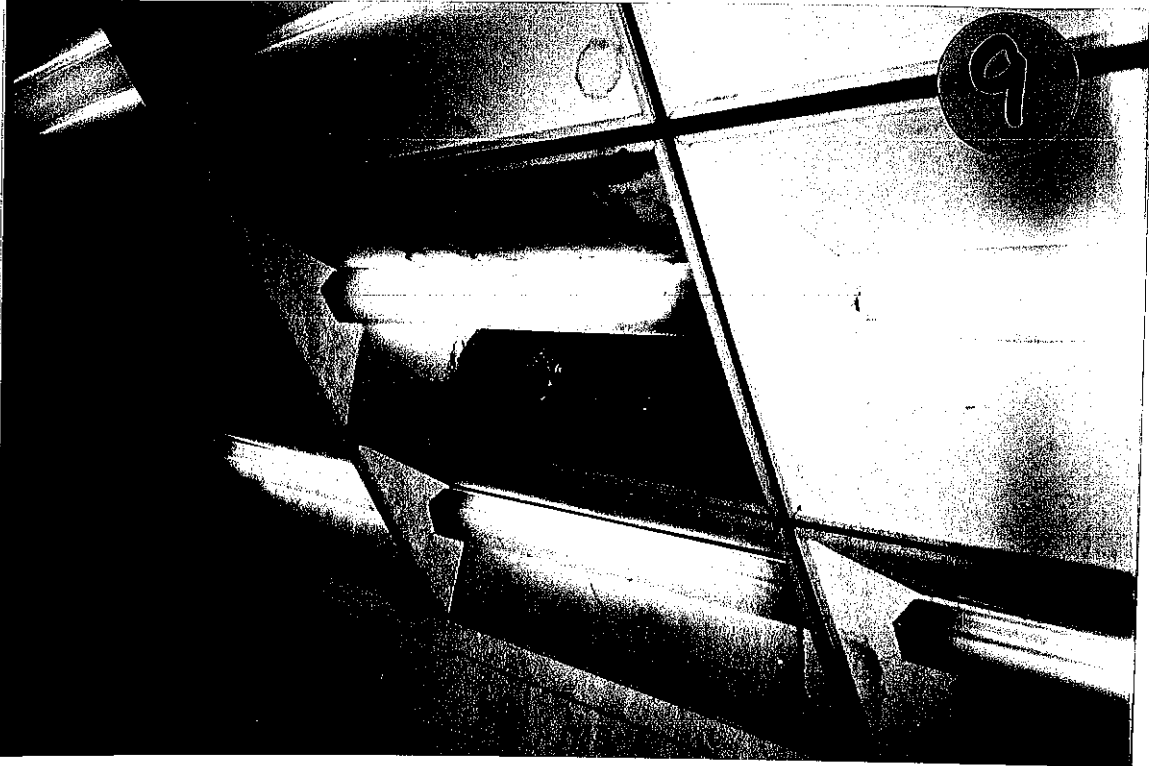
**Photograph 7: Access Panel That Was Not Properly Cleaned And Sealed Or Had The Deteriorated Fiberglass Insulation Replaced**



Photograph 8: Location Of Roof Leak In Room 227



**Photograph 9: Collapsed And Stained Ceiling Tiles In Room 227**



## **DISCUSSION:**

The purpose of the initial survey was to determine the causes of the reported health complaints by the staff, teachers and parents of children who attend this school. During the initial survey, two causes for the observed complaint patterns were found, which included an inadequate flow of outdoor air and excessive amounts of microbial growths in the air handler systems.

The air handler cleaning crews have been trained and have a very detailed set of procedures to follow when performing their assigned duties. Supposedly, there is also a supervisor's final inspection of the job by the maintenance supervisor prior to reporting back to Risk Management and Safety that the job is completed. After Risk Management and Safety receives a written response from Maintenance



that the air handler systems have been cleaned, Dr. Spaul is then contacted to perform a follow-up inspection.

From the inspection inside the air handler units, the source of the previously reported mold growths from inside the air handler units has been corrected.

The problems with the inadequate dehumidification and surface mold growths in the media center building have not been corrected.

Not all of the portables have had the window type air conditioners cleaned. This work should be completed since only a portion of the units have been cleaned.

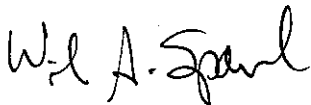
The problems with the outside air flows still have not been corrected. The "tight building" conditions, as have been previously reported, can be anticipated to continue until this problem is corrected.

The contractor should correct the deficiencies that were noted in the results section of this report.

In summary, although some of the work was performed very well, there are still areas that need to be cleaned and repaired.

It has been a pleasure to have been able to assist you with this project. Please do not hesitate to contact me if you have any questions about this report.

Sincerely,



Wil A. Spaul, President  
PhD, MPH, MSCE  
Certified Industrial Hygienist

Adjunct Associate Professor of Indoor Air Quality  
College of Public Health  
University of South Florida - Tampa