

## **Summary of Cleaning of Stuyvesant High School**

This summary was prepared based on the review of documents and information provided by the New York City Department of Education (DOE) [formerly Board of Education] and the School Construction Authority (SCA), review of laboratory data reports prepared by ATC Associates and EMSL Analytical, and observations made and information obtained during inspections of the school by representatives of ENVIRON Corporation and H. A. Bader and Associates, as consultants to the Stuyvesant High School Parents' Association (PA).

### **1. Unit Ventilators**

There are a total of approximately 305 unit ventilators at Stuyvesant High School, including 264 that are floor-mounted window units and 41 that are ceiling-mounted units. In April 2002, ten dust wipe samples were collected by ATC Associates from inside selected unit ventilators for analysis of lead, and ten bulk dust samples were collected from inside the unit ventilators for analysis of asbestos and dioxins and dibenzofurans. The results showed that no asbestos was detected in any of the ten bulk dust samples, and the samples were found to contain trace levels of dioxin at concentrations between 0.000037 to 0.0031 parts per billion (ppb), well below the NYSDEC guideline of 0.6 ppb for dioxins in soil. Lead concentrations in the dust wipe samples were found to be between 500.6 and 1902.7 micrograms per square foot ( $\text{ug}/\text{ft}^2$ ). Although there are not specific standards for lead that apply to the interiors of unit ventilators, the measured lead concentrations were above the residential indoor standards for floors ( $40 \text{ ug}/\text{ft}^2$ ), windowsills ( $250 \text{ ug}/\text{ft}^2$ ), and window wells ( $400 \text{ ug}/\text{ft}^2$ ). [The U.S Environmental Protection Agency has recently proposed a guidance level of  $25 \text{ ug}/\text{ft}^2$  for lead on floors as part of its lower Manhattan apartment cleaning program.] The DOE decided to undertake a cleaning program in which the unit ventilators at Stuyvesant High School were disassembled, cleaned and tested, as described below. The SCA, which managed the cleaning operation, used  $20 \text{ ug}/\text{ft}^2$  as the clearance level for lead on surfaces in the unit ventilators.

#### **Floor-Mounted Unit Ventilators**

Floor-mounted unit ventilators were removed from the wall and sealed inside a plastic enclosure, which was kept at negative pressure during cleaning of the unit in order to contain the dust from the unit. The unit ventilator panels were removed to allow access to the unit. The existing filter was removed from each unit and the insulation inside the front and rear panels was removed as was insulation inside the air handling portion of the unit. The heating/cooling coil and

supply fan blades were cleaned using a low volume water cleaning system. The interior of each unit ventilator was HEPA vacuumed, and wiped clean and dry. All areas made accessible by the removal of the unit were also cleaned, including the exterior louvers and the area beneath the unit. Insulation inside the electrical compartment of the unit was HEPA vacuumed and coated with an encapsulating paint. After cleaning, the unit was inspected for residual dust. If the unit was judged clean based on inspection, one wipe sample for analysis of lead was collected from the inside of the unit. If the wipe sample passed (that is, it contained less than 20 ug/ft<sup>2</sup>), the unit had new insulation and filter installed, was reassembled and wrapped in plastic. If the wipe sample failed (that is, contained lead at a concentration above 20 ug/ft<sup>2</sup>), the unit was re-cleaned and retested until it passed both a visual inspection and wipe testing. The unit ventilators were reconnected and reinstalled and covered with plastic sheeting.

In addition to inspections being made by the School Construction Authority and its contractors, the cleaning of the unit ventilators was also observed by consultants to the Stuyvesant High School Parents' Association approximately two to three times per week. Some of those inspections resulted in recommendations to enhance the completeness of the cleaning of the unit ventilators, which were adopted by SCA and its contractors. A total of approximately 286 wipe samples were collected from the floor-mounted unit ventilators, of which 21 samples were found to have lead concentrations above the screening level of 20 micrograms per square foot. For those samples, the unit ventilators were re-cleaned and re-tested and all were found to have lead levels below the screening levels upon re-testing.

In addition to the inspection of the unit ventilators during the cleaning operation, random unit ventilators were opened and inspected by consultants to the PA after the units had been reinstalled. Those inspections found the unit ventilators to be clean, with new insulation and new filters installed. Based on the results of physical inspections of the unit ventilators and the results of the post-cleaning wipe sampling, no major issues were identified with regard to the cleaning of the floor-mounted unit ventilators.

### **Ceiling-Mounted Unit Ventilators**

Due to the difficulty in removing these units, the ceiling-mounted unit ventilators were cleaned in place. Access panels were cut into the ductwork on either side of these units and an access hole was drilled into the fan housing. The unit ventilator was isolated from the ductwork with polyethylene isolation barriers. An enclosure was constructed around the unit, which was kept under negative pressure during cleaning. Fiberglass insulation was removed from inside the unit. The unit ventilator was cleaned using HEPA vacuuming, wet and dry wiping, and low volume water cleaning. Following cleaning, the units were visually inspected and wipe sampled in the same manner as the floor-mounted units. After the

ceiling-mounted units passed both the visual inspection and wipe testing, new insulation and filter were installed in the units and the units were reassembled. The unit ventilators were kept isolated from the ductwork until the ducts and exterior louvers had been cleaned by HEPA vacuuming and wiping.

In addition to inspections being made by the School Construction Authority and its contractors, the cleaning of the unit ventilators was also inspected by consultants to the Stuyvesant High School Parents' Association. Those inspections resulted in requests to the SCA to replace the insulation from inside the supply air plenum and to collect wipe samples from inside the supply air plenum after cleaning. The SCA agreed to replace the insulation as requested, and also collected wipe samples from the supply air plenums of some of the ceiling-mounted units. A total of 54 wipe samples were collected from ceiling-mounted unit ventilators, of which 3 had lead concentrations above 20 micrograms per square foot. Those unit ventilators were re-cleaned and re-tested and were found to have lead levels below the screening level after re-cleaning. Based on the physical inspections of the cleaning of the ceiling-mounted unit ventilators as well as the results of post-cleaning wipe testing, no major issues were identified with regard to the cleaning of the ceiling-mounted unit ventilators.

## **2. Central HVAC Systems**

In addition to the unit ventilators, there are a total of 15 central heating, ventilation and air conditioning (HVAC) systems in Stuyvesant High School. In April 2002, 14 dust wipe samples were collected by ATC Associates from inside air handling units and ductwork associated with selected HVAC systems at Stuyvesant High School for analysis of lead, and 14 bulk dust samples were collected for analysis of asbestos and dioxins and dibenzofurans. The results showed that no asbestos was detected in any of the 14 bulk dust samples and the dioxin samples were found to contain trace levels of dioxin at concentrations between 0.0000046 to 0.00016 parts per billion (ppb), well below the NYSDEC guideline of 0.6 ppb for dioxins in soil. Lead concentrations in the dust wipe samples were found to be from less than the detection limit of 9.0 ug/ft<sup>2</sup> to 253.0 ug/ft<sup>2</sup>. Although there are not specific standards for lead that apply to the interiors of air handling units and HVAC system ductwork, these lead concentrations were above the residential indoor standards for floors and windowsills, as previously discussed. The DOE decided to undertake a cleaning program in which the air handling units and associated ductwork at Stuyvesant High School were cleaned and tested, as described below. The SCA used 20 ug/ft<sup>2</sup> as the clearance level for lead on surfaces in the air handling units and 40 ug/ft<sup>2</sup> as the clearance level for lead in the HVAC system ductwork.

Cleaning of the central HVAC systems included cleaning of all air conditioning/heating and ventilation air handlers; connecting supply, corridor return and exhaust ductwork; and supply diffusers, grills, dampers and turning valves. The cleaning proceeded floor by floor, starting on the tenth floor. All supply outlets and return grills were removed and

cleaned using HEPA vacuuming and wiping. Access doors were installed, if necessary, so that each there was no more than 100 feet between access points in each duct. The ducts were cleaned in sections, with each section of ductwork sealed or blocked to minimize the spread of contaminants during cleaning. The ducts were cleaned using compressed air sweep tools, rotating brushes, and/or manual brushing systems. A HEPA vacuum was used at the downstream end of each duct segment to collect all dust and residue. Larger ducts were entered by cleaning workers and manually scraped and cleaned with compressed air. Ceiling tiles in the vicinity of supply diffusers and return grills were HEPA vacuumed and wiped. Corridor ceiling return plenums and associated ceiling tiles were HEPA vacuumed. Air handling units were vacuumed using a HEPA filtered dry vacuum unit. Air filters were removed and replaced with new filters after cleaning was complete. Coils and fans were HEPA vacuumed followed by pressure washing, using isolation barriers as required. Any insulation that was not being removed from the HVAC system was coated with encapsulating paint. In addition to inspections being made by the School Construction Authority and its contractors, the cleaning of the central HVAC system units and ducts was also inspected by a consultant to the PA approximately two to three times per week. Those inspections generally found the ducts to be acceptably clean. During some inspections, areas that warranted additional cleaning were identified to the SCA. In those cases, the SCA and its contractors re-cleaned duct interiors and related equipment. On other occasions, the SCA and its contractors performed re-cleaning of certain ducts and related equipment based on their own inspections.

Once the visual inspections indicated that the systems appear satisfactorily clean, surface wipe samples were collected from air handling units and ductwork. This sampling was not part of the original scope of work proposed by the DOE and SCA. The sampling was added at the request of the PA and the UFT. A minimum of six wipe samples were to be collected from the duct system on each floor, three from supply ducts and three from return ducts. In addition, wipe samples were collected from supply and return dampers in each air handling unit. The samples in the air handlers were to be collected at similar locations to the samples previously collected by ATC Associates before cleaning, where possible, but all air handling units were sampled, even if they were not previously sampled by ATC. Inspections of the sampling locations by consultants to the PA found that all sampling locations appeared appropriate, with the exception of the samples collected from the supply air duct system. The samples from the supply air duct system were observed to have been collected from vertical collars immediately adjacent to the supply diffusers. An alternative sampling location was proposed to the SCA: collecting the samples from horizontal surfaces within the supply ducts, which would be more representative than sampling from vertical surfaces. This recommendation was not accepted by SCA and the supply duct samples were all collected from vertical collars.

Once all HVAC system components in each of the major zones were cleaned, inspected and tested, a final inspection was done of all HVAC components for that zone. These final inspections included random inspections of ducts by the consultants to the PA. These final inspections generally found the duct interiors to be clean, with no evidence of significant dust. The difference in the appearance of the interior duct surfaces before and

after cleaning was dramatic. For example, prior to cleaning, the supply ducts were typically lined with a very noticeable layer of dark gray to black dust. After cleaning, this dust layer was observed to no longer be present in the supply ducts.

During one inspection by a consultant to the PA, it was noted that certain areas of the corridor return system plenum did not appear to be adequately cleaned. In response to this finding, the SCA assigned cleaning crews to re-clean the corridor plenums on all floors.

A total of 32 wipe samples for lead were collected from the air handling units after cleaning; all 32 samples were found to contain less than 20 ug/ft<sup>2</sup> of lead. A total of approximately 81 wipe samples for lead were collected from the duct systems; 5 of those samples were found to contain lead at a concentration above 40 ug/ft<sup>2</sup>. Upon re-cleaning and re-testing, samples from those five areas were found to contain lead below 40 ug/ft<sup>2</sup>.

After completion of the final inspections, the HVAC zone was turned on and operated with filters covering all diffusers and vents for a period of 24 hours. The filters were then removed and aggressive air monitoring was conducted with the HVAC system fully operating. A second set of aggressive air samples were collected from the corridors following re-cleaning of the corridor ceiling plenums.

### **3. General Cleaning of School**

After all of the unit ventilators and the central HVAC system ductwork on a floor were cleaned and tested, a general cleaning was performed in each room on the floor and two wipe samples for analysis of lead were collected from horizontal surfaces in the room (typically one sample from the floor and one sample from a counter or desk). If the room surface samples passed (lead concentrations less than 20 ug/ft<sup>2</sup>), then the plastic was removed from the unit ventilators and the room was deemed completed. If room surface samples failed, then the room was re-cleaned and re-tested until satisfactory test results were obtained. A total of approximately 939 post-cleaning wipe samples were collected from room surfaces, such as floors, desks, and shelves, of which 19 were found to contain lead at above the screening level of 20 ug/ft<sup>2</sup>. Re-cleaning and re-testing of those rooms found lead levels to be below 20 ug/ft<sup>2</sup>, with one exception for a room in the basement. In one room in the basement, a gas meter room, wipe samples from a painted floor and a gas pipe were found have lead concentrations above 20 ug/ft<sup>2</sup>, even after repeated cleaning. A sample of the floor paint was tested and found to contain 18 percent lead, which classifies the paint as lead-based paint. Although the paint in that room appeared to be different than the paint on the other painted surfaces in the basement, a basement-wide paint sampling was conducted, at the request of the PA and the UFT, to further evaluate this finding. All other paint samples were found to contain less than 0.5 percent lead, and are, therefore, not lead-based paint.

#### **4. Post-Cleaning Air Testing**

After all cleaning of unit ventilators, central HVAC systems and ductwork, and interior surfaces was completed, aggressive air monitoring was conducted by turning on all the ventilation systems and using leaf blowers to stir up dust. At the same time, air sampling was conducted for asbestos and lead, with 10 air samples on each floor collected for asbestos analysis and 5 samples on each floor collected for lead analysis. In the basement, 5 samples were collected for asbestos and 3 samples for lead, due to the much smaller size of the basement. The DOE and SCA compared the results to the AHERA clearance level of 70 structures/mm<sup>2</sup> for asbestos and the USEPA screening level of 1.5 ug/m<sup>3</sup> for lead. All of the air samples were analyzed for asbestos by transmission electron microscopy (TEM), and asbestos structures were not detected in any of the samples. Lead was not detected above the screening level in any of the air samples.

A second set of aggressive air samples (total of 35 samples) for asbestos and lead were collected from the corridors after re-cleaning of the corridor ceiling plenums. All of the asbestos and lead concentrations were below the screening levels; lead was not detected in any of the samples and asbestos was only detected in one of the 35 samples, at 16 structures/mm<sup>2</sup>, below the AHERA clearance level of 70 structures/mm<sup>2</sup>.

#### **5. Carpeting and Upholstery**

Two carpet samples from the auditorium were submitted for ultrasonication analysis for asbestos at EMSL Analytical. Results indicated 60,000 and 2.4 million asbestos structures/cm<sup>2</sup> in the two samples. There are no standards for such analyses, although one guideline suggests that levels above 10,000 structures/cm<sup>2</sup> are above background levels. Based on these sampling results, a written request for replacement or testing of upholstered seats in the auditorium and upholstery elsewhere in the school was made to the Department of Education by the PA.

##### **Testing of Carpeting and Upholstery**

In an attempt to evaluate the potential for asbestos to be released from carpeting and the upholstered seats in the auditorium and in other carpeted areas, the DOE and SCA performed a modified aggressive air sampling for asbestos in the auditorium, library and two carpeted offices. This testing was conducted prior to any additional cleaning of these materials and prior to replacement of any carpeting. In the tests, plastic enclosures were set up on carpeted areas in the auditorium and library, and around some upholstered seats in the auditorium. For the carpeted areas in each enclosure, five air samplers were set up in each enclosure to collect samples for analysis of asbestos. While the air samples were being collected, the carpeting was vacuumed using a new vacuum with standard filtration in order to try to mobilize asbestos fibers into the air within the enclosure, if asbestos fibers were present. For the samples collected in the auditorium, asbestos was detected in two of the five air samples collected inside

the enclosure. In one sample, asbestos was detected at 96 structures/mm<sup>2</sup> and 48 structures/mm<sup>2</sup> in two analyses of the same sample. The higher level is above the AHERA clearance level of 70 structures/mm<sup>2</sup> clearance level. A second sample in the auditorium enclosure was found to contain 40 structures/mm<sup>2</sup>, while the remaining three samples from the auditorium enclosure did not contain detectable asbestos. For the auditorium seats, a similar enclosure was constructed with five air samplers set up inside. During the air sampling within this enclosure, however, the seats were struck with a blunt object in an attempt to release fibers. None of the five air samples collected inside the seat enclosure were found to contain any asbestos fibers.

A similar enclosure was set up on the carpeting in the library. In rooms 105 and room 107, carpeted offices, the rooms themselves were enclosed and air samples for asbestos were collected while the carpeting was being vacuumed. No asbestos structures were detected in the samples collected from within the enclosure in the library or from room 107. One air sample from room 105 was found to contain asbestos at 32 structures/mm<sup>2</sup>, below the clearance level of 70 structures/mm<sup>2</sup>.

### **Removal/Replacement and Cleaning of Carpeting**

The auditorium carpeting was removed inside a full containment enclosure with negative air pressure during the removal. The auditorium seats were pre-cleaned using HEPA-filtered vacuums and covered with two layers of plastic after cleaning. The carpet was saturated with an encapsulant, covered with three layers of plastic prior to removal, and misted with water during the removal. The carpet was cut into sections and sealed with three layers of plastic prior to transporting it. After the carpet was removed, the enclosure was removed and all the floor surfaces were wet wiped and HEPA vacuuming, and the seat upholstery and curtains were HEPA vacuumed.

Air monitoring for asbestos was conducted during the removal of the carpeting from the auditorium. Of approximately 74 air samples collected during the removal of the carpeting, asbestos was not detected in 71 of the samples. One air sample collected from the auditorium stage during the preparation for the removal of the carpet was found to contain asbestos at 140 structures/mm<sup>2</sup>, above the clearance level. One air sample collected from the first floor corridor at the same time was found to have asbestos at 20 structures/mm<sup>2</sup>, and one air sample collected from the rear of the auditorium during the carpet removal had asbestos measured at 16 structures; both of those measurements were below the clearance level. All other samples collected during the carpet removal did not have any asbestos structures detected.

In addition to the air monitoring conducted during the removal of the carpeting from the auditorium, aggressive air monitoring was conducted after the completion of the carpet removal and the cleanup of the surfaces in the auditorium following the carpet removal. Five aggressive air samples were

collected from the auditorium for asbestos and lead. Asbestos and lead were not detected in any of the air samples.

The carpeting in the Administrative Office was also removed and replaced. Carpeting in the library, room 105 and room 107 was cleaned rather than replaced. Those carpets were cleaned using a hot water extraction cleaner, the method identified as the most effective by the USEPA. However, the USEPA also notes that such cleaning methods generally removed only 60 to 70 percent of the asbestos in two studies. For its residential cleaning program, the USEPA recommends that residents consider replacing some or all carpets, upholstered furniture or draperies in homes that were impacted by WTC-related dust and debris. Given this USEPA recommendation for residences, it is appropriate that further consideration be given to replacement of or further testing of carpets, upholstery, and draperies. It should be noted, however, that aggressive air sampling after the removal of the auditorium carpeting and the after the cleaning of the carpets in the library, room 105 and room 107, did not detect asbestos in any sample.

It is important to note that during the period October 19, 2001 through June 26, 2002, air sampling for asbestos was conducted on a daily basis throughout the inside of the school, with 13 samples collected daily at 10 indoor locations (a total of more than 3,200 individual samples). The indoor sample locations included the auditorium, cafeteria, first and second floor lobbies, hallways, pool, gymnasium, and classrooms. Of those 3,200+ air samples for asbestos analysis collected inside the school, none was found to have asbestos at a level above the AHERA clearance level of 70 structures/mm<sup>2</sup>, and almost all samples had no asbestos structures detected. This included all of the daily air samples collected in the auditorium during that period, in which no asbestos structures were detected in any of the samples.