to 0.57 f/cc with a geometric mean value of 0.09 f/cc [Exhibit 84-474, Table 3.10]. OSHA assumes that smaller jobs would be associated with such lower TWAs (due to the shorter duration of exposure). In addition, "glove bags" are available for certain types of jobs. In 15 area samples collected during the removal of asbestos from steam pipes while using glove bags [Exhibit 84-474, Table A-2], TWA concentrations ranged from below detectable (less than 0.1 f/cc) to 0.02 f/cc. These data demonstrate that glove bags can reduce airborne fiber concentrations to below the 0.2 f/cc PEL.

Encapsulants are still being used in many asbestos abatement projects. Encapsulants are water-soluble latex products that are sprayed on to asbestos materials to bind and prevent the release of asbestos fibers. An encapsulant may either be a bridge, which forms a film over the surface of the insulation material, or a penetrant, which soaks at least partially through the fiber matrix. By its nature, encapsulation, when applied by an experienced professional, does not normally involve high fiber release. In personal samples collected by Clayton Environmental during the application of both bridging and penetrating encapsulants, TWA concentrations, however, ranged from 0.03 f/cc to 0.28 f/cc, with a geometric mean of 0.17 f/cc. Thus, with the majority of samples below 0.2 f/cc, OSHA believes that it is generally feasible for this sector to comply with the 0.2 f/cc PEL during encapsulation work, although respirators may be needed on some projects.

Renovation/Remodeling of Existing Structures. Asbestos has been used widely in construction until the mid-1970s when certain applications were curtailed by the Environmental Protection Agency (EPA). As a result, substantial amounts of asbestos materials are present in numerous buildings that were constructed in earlier years.

In addition to the uses in new construction described above, materials containing asbestos are used for pipe and boiler insulation, fireproofing, drywall tape and spackling, and acoustical plasters. Consequently, such materials are present in office buildings, schools, hospitals, residential buildings, industrial facilities, power plants, etc. that were built in earlier years.

In renovation projects, workers indirectly involved with asbestos products may be exposed inadvertently by disturbing these materials [Exhibit 207]. For example, in multistory buildings where beams and/or decking are covered with asbestos fireproofing, electricians, pipefitters, telephone installers, or workers who repair heating ventilation and air-conditioners may be exposed to appreciable concentrations of asbestos fibers when working above suspended ceilings. This exposure may result from direct contact with the fireproofing, or from the disturbance of settled fibers from various surfaces above the ceiling (i.e., existing pipe, ductwork, or drop ceiling tiles).

In personal samples collected in office buildings and schools, [Exhibit 84-474, p. 3.31] Clayton Environmental Consultants measured TWA exposures ranging from 0.02 f/cc to 1.4 f/cc, with a geometric mean of 0.14 f/cc, while workers were removing drop ceiling tiles from the ceiling tract. The results of the samples collected in the breathing zones of electricians, pipefitters, and heating, ventilation, and air-conditioning (HVAC) workers indicated geometric mean TWA concentrations of 0.11 f/cc, 0.12 f/cc, and 0.14 f/cc, respectively [Exhibit 84-474, Table A-12]. The highest value measured was 2.8 f/cc for an HVAC worker. In each case, wet methods were employed for any direct contact with asbestos material, and HEPA vacuums were used for clean-up. These values are consistent with OSHA inspection data [Exhibit 84-474, Table A-11].

A variety of other activities may also involve the disturbance of asbestos materials and the subsequent exposure of renovation workers. For example, carpenters and drywallers may install new walls which, if attached to beams covered with fireproofing, may result in exposure. The results of samples collected by Clayton Environmental Consultants, Inc., indicate geometric mean TWA concentrations of 0.16 f/cc for carpenters and 0.41 f/cc for drywallers. Personal samples taken by the Argonne National Laboratory during similar activities showed TWA concentrations ranging from 0.35 f/cc to 0.87 f/cc using wet methods and HEPA vacuums [Exhibit 84-474].

OSHA has determined that engineering controls (such as negative-pressure enclosures and vacuums) are generally effective in limiting exposures after asbestos containing materials have been disturbed, but that workers who actively disturb these materials will probably require respiratory protection to comply with the 0.2 f/cc PEL.

Routine Facility Maintenance. Routine maintenance and repair activities may also involve the disturbance of asbestos materials and products, as described in the industry profile. Such activities include the repair of leaking steam pipes in buildings and the adjustment of HVAC equipment above suspended ceilings.

TWA exposures ranging from 0.02 f/cc to 1.4 f/cc have been measured in personal samples collected during the removal of drop ceiling tiles. In data reported by Paik and coworkers [Exhibit 207], the average concentrations during routine maintenance activities ranged from 0.9 f/cc to 1.4 f/cc.

In samples collected by Clayton Environmental during the inspection and repair of HVAC equipment near asbestos insulation materials, TWA concentrations ranged from 0.04 f/cc to 0.9 f/cc, with a geometric mean of 0.21 f/cc [Exhibit 308, Table A-14]. Results consistent with these findings were also reported by Argonne National Laboratory during maintenance activities where wet handling was used, when possible, and where HEPA vacuums were used [Exhibit 298].

These data demonstrate a potential for exposure of maintenance personnel to concentrations exceeding 0.5 f/cc. With the exception of wet handling, which is feasible in only very limited situations due to problems such as electrical wiring, and the use of HEPA vacuums for the clean-up of any debris generated during maintenance activities, OSHA believes that there does not appear to be any feasible engineering controls or work practices available to reduce these potential exposures to levels below the 0.2 f/cc PEL and that respirators will be required to comply with the 0.2 f/cc PEL.

Demolition. Demolition of all or part of a building or industrial facility that contains asbestos would also be likely to cause a disturbance of asbestos materials.

Under current EPA regulations (40 CFR Part 61, Subpart M, National Emission Standard for Asbestos), demolition is defined as the "wrecking to taking out [SIC] of any load-supporting structural member of a facility together with any related handling operations." EPA requires that friable asbestos materials be removed from buildings or industrial facilities prior to wrecking or dismantling the structures. Presuming compliance with the EPA regulation, the only potential for exposure would be during the removal of such materials before demolition. The feasibility of compliance with the 0.2 f/cc PEL for asbestos removal was discussed previously. The demolition project at the National Press Building in Washington, D.C., further illustrates this feasibility. During this project, work practices were so effective in limiting exposure levels that asbestos levels were higher outside