employees as a means of controlling exposure. Unprotected exposures above the PEL should not be permitted [Ex. 80–236].

Similarly, Richard A. Lemen, Director, Division of Standards Development and Technology Transfer for NIOSH, commented:

> Worker rotation as a compliance measure must be forbidden given the lack of a safe threshold for lung cancer and mesothelioma caused by asbestos [Tr. 6/21, p. 68].

The prohibition against worker rotation contained in the final standard for asbestos is, therefore, consistent with OSHA's view that this control strategy is not appropriate in occupational environments involving exposure to carcinogens.

7. *Paragraph (g). Respiratory Protection.*

The final standard requires that respirators be used to limit employee exposure to asbestos in the following circumstances:

(i) During the interval necessary to install or implement feasible engineering and work practice controls;

(ii) In work operations such as maintenance and repair activities or other activities for which the employer establishes that engineering and work practice controls are not feasible;

(iii) In work situations where feasible engineering and work practice controls are not yet sufficient to reduce exposure to or below the PEL; and

(iv) In emergencies.

These limitations on the required use of respirators are consistent with the requirements of the past asbestos standard, with 29 CFR 1910.1000 (e) and with good industrial hygiene practice. They reflect OSHA's determination, as detailed in the preceding section on methods of compliance, that respirators are inherently less reliable than engineering and work practice controls. OSHA believes, therefore, that relying on respirators to control exposures to the PEL must be confined to the designated situations.

The final standard requires the use of high efficiency filters when air purifying respirators are used. OSHA is particularly concerned about the penetrability of respirator filters (including single use respirators) other than the high efficiency type. At the new PEL of 0.2 f/cc, the NIOSH/MSHA certification criteria require the use of high efficiency filters [See 30 CFR 11.130 (a) and (c)]. NIOSH certification for other than high efficiency filters is not valid for toxic substances with PEL values less than 0.050 mg/M³ or 2 mppcf. Using the conversion factor provided by CHAP [Ex. 84–246, p. II–137], a PEL of 0.2 f/cc equates to 0.006 mg/M³, well below the cut-off for other than high efficiency filters.

Many commenters stated that non-powered air purifying respirators should be provided with high efficiency filters and that single-use and replaceable dust/mist respirators do not provide adequate protection against asbestos [Exs. 90–49, 90–234, 91–6, 91–40, 117E, 123A]. Other commenters were in favor of more stringent respiratory protection such as supplied air respirators or positive pressure respirators to assure the maximum protection possible (Exs. 223, 90–147].

In a letter to all respirator manufacturers published in the American Industrial Hygiene Association Journal, Dr. Jon R. May of NIOSH stated the following:

> On the issue of asbestos; the Institute wishes to state that although asbestos can produce fibrosis, this effect pales in significance in comparison to the known human and animal carcinogenicity of this fibrous material. It is not our position that single-use dust respirators will provide adequate protection against the cancer causing potential of asbestos [Ex. 91–6].

Furthermore, in regards to dust, fume, and mist respirators, either with replaceable or reusable filters, Dr. May expressed concern about the filters effectively removing asbestos during the entire period of recommended use. This is based on the fact that the air-purifying components of these devices are not tested against asbestos but rather against a fine silica dust aerosol.

Norton Company, a respirator manufacturer, stated:

> To obtain the greatest degree of protection available from non-powered air-purifying respirators, in asbestos environments where the TWA concentration is less than 20 fibers per cubic centimeter, Norton recommends the use of an elastomeric half-mask or full-facepiece respirator with high-efficiency filters [Ex. 117E].

OSHA acknowledges that respirator filter efficiency for asbestos has not been thoroughly tested (49 FR 14125). A recent study by the Los Alamos Scientific Laboratory (LASL), submitted to the OSHA docket [Ex. 93–5], has cast further doubt on the effectiveness of respirators when used specifically to protect against asbestos exposure. Five respirator filters, all of which are approved by the Mine Safety and Health Administration (MSHA) and NIOSH for the use with asbestos, where challenged with an aerosol of chrysotile asbestos under varying environmental conditions. Only one model (the high efficiency filter) functioned consistently well under all experimental conditions: (1) fresh from the package, (2) after exposure to an organic oil mist, and/or (3) after prolonged storage at high humidity. The other respirator filters yielded varying results. Thus, even under laboratory conditions, most approved respirator filters did not provide the consistent protection necessary to ensure worker health.

A number of commenters stated that air purifying non-high efficiency half mask negative pressure respirators should be permitted to be used as they reliably provide protection up to ten times the permissible exposure level [Exs. 328, 331, 339, 341]. E.I. DuPont DeNemours and Company submitted for the record [Ex. 339] a study it conducted on workplace protection factors for elastomeric half-mask and single use respirators. Results of their study showed that five of six respirators tested provided workplace protection factors of ten or greater and the remaining one provided a protection factor of five or greater. Unfortunately this study was not completed in time to present at the public hearing and could not be reviewed and commented upon by other interested parties. Also, DuPont did not submit data to indicate the magnitude of counting errors in their study.

OSHA does not believe that the DuPont data proves that negative pressure air purifying respirators provide adequate protection. The study was based on evaluating only a few manufacturers' respirators. In addition, workplace protection factors obtained appeared to be inconsistent with the types of respirators tested. For instance, the 3M–9910 disposable respirator tested yielded a protection factor almost equivalent to the Scott Air-Pak (SCBA) tested, and the 3M–9910 far exceeded the protection factor of an elastomeric/high efficiency filter.

The expected results would be that the supplied air respirator would have a higher protection factor than the negative pressure respirator. The superiority of supplied air respirators is recognized by all respiratory selection procedures in existence and conforms to OSHA respirator selection tables in all toxic substances to date, including the existing asbestos standard, and all NIOSH criteria documents. There is no explanation for the inconsistent findings in the DuPont studies.

Another factor that must be realized when interpreting the results of the DuPont study is that the protection factors reported by DuPont were based upon data gathered after the workers were fit tested. According to industrial hygiene practice, if the fit test procedures adequately work, then no workers should be expected to have