estimates of airborne asbestos concentrations than the use of other counting rules because fibers that appear to be attached to non-fibrous particles are not counted in the AIA method (Tr. 6/20, p. 13). OSHA believes that much of the testimony and evidence describing interlaboratory error (that is, differences in analytical results obtained by different laboratories analyzing the same sample) reflects the use of different analytical procedures by these laboratories. OSHA also believes that mandating a specific monitoring procedure will ensure a greater degree of consistency in monitoring results among different employers who use different laboratories. Furthermore, by using the same sampling and analytical procedure as that adopted by OSHA's Salt Lake City laboratory, employers will have greater confidence that their monitoring results will parallel those that would be obtained from OSHA's compliance monitoring.

Selection of a Standardized Monitoring Method

OSHA reviewed a number of asbestos sampling and analytical methods described during these rulemaking proceedings (Exs. 84-62, 84-230, 84-238, 84-444, 84-446, 86-002). As noted by OSHA in the April proposal, phase contrast microscopy has been widely adopted and used internationally as an accepted and reliable indicator of asbestos concentrations. The major disadvantage of this method is its inability to distinguish among different types of asbestos and among asbestiform fibers and other types of fibrous particles. Although electron microscopic analysis of asbestos samples can distinguish among different fiber types, OSHA noted in the proposal that, because of the costs involved and the length of time required for analysis, ". . . it is not practical or necessary to . . . require electron microscopic analysis instead of phase contrast light microscopy" (49 FR 14126). In addition, OSHA noted that standard counting methods for the electron microscope have only recently been developed and one in need of improvement, while those for phase microscopy are widely known and used.

Rulemaking participants were in agreement that OSHA should rely for routine monitoring of asbestos on a sampling and analytical method that utilizes phase contrast microscopy (Exs. 123A, 253, 328, 330; Tr. 7/5, p. 121). For example, the AIA stated:

> The record does not demonstrate any significant advantages in terms of reproducibility of results or lowered practical limits of reliable detection to justify the large increase in analytical expenses that would result if an electron microscopy method were adopted. The primary advantages of electron microscopy methods are better visualization of very thin asbestos fibers and more precise fiber identification capabilities. Neither of these advantages are necessary for routine workplace analysis. Moreover, at the present time, standard electron microscopy analytical methods have not been sufficiently tested under workplace conditions for either precision or comparability to historical PCM measurements. (Ex. 328)

Similarly, the Building and Construction Trades Department (BCTD) of the AFL-CIO stated:

> Electron microscopy has the advantage of counting all the fibers present, including the thin ones that cannot be seen under current optical microscopy. However, due to the additional cost and time in preparation, the BCTD is recommending it only as the method to be used in categorizing products or processes and for clearance samples to declassify regulated areas when greater accuracy is needed. (Ex. 330)

Dr. Eric Chatfield of the Department of Applied Physics, Ontario Research Foundation, stated that "in view of the number and frequency of measurements required [in the field] there is currently no fully developed alternative [to phase contrast microscopy] which could be immediately implemented" (Ex. 84-319). These similar comments reaffirm OSHA's view, as expressed in the April proposal, that requirements in the revised standard for asbestos sampling and analysis must be based on the use of phase contrast microscopy, which has proven to be adequate for most situations in the past.

The sampling and analytical method used by most laboratories in the United States has been the NIOSH P&CAM 239. This method requires the use of a 37-mm diameter filter, phthalate-oxalate clearing solution, Porton graticule, and the set "A" counting rules.

In February 1984, NIOSH issued a revision of the P&CAM 239 method (Ex. 84-444), incorporating a number of analytical changes that were being used for other methods worldwide. NIOSH (Ex. 117D) presented a concise comparison of the new method, called the NIOSH 7400 method, with other sampling and analytical methods, including the AIA-recommended method, Chatfield's method, and the method recommended by the International Standards Organization (ISO). Their findings were as follows:

- The NIOSH 7400, AIA, ISO, and Chatfield methods require the use of a 25 mm-diameter filter.
- The NIOSH 7400, AIA, and ISO methods require the use of a 3-piece filter cassette and a 50-mm-long cowl extension. The Chatfield method does not require the use of a cowl.
- The NIOSH 7400 method requires that the flow rate be greater than 0.5 liters per minute (lpm). The AIA, Chatfield, and ISO methods require a 1 lpm flow rate.
- The NIOSH 7400 method requires a minimum filter loading of 100 fibers/mm^2. The AIA, ISO, and Chatfield methods require a minimum filter loading of 50 fibers/mm^2.
- The NIOSH 7400, AIA, ISO and Chatfield methods all require the use of acetone-triacetin clearing solution for the preparation of samples for analysis, and a Walton-Beckett graticule to provide the counting area on the microscope.
- The NIOSH 7400, AIA, ISO, and Chatfield methods all require the use of a phase shift test slide to calibrate the microscope.
- The NIOSH 7400 method permits the use of the same counting rules (designated as the "A" rules) as the NIOSH P&CAM 239. The AIA, ISO, and Chatfied methods permit the use of the "A" rules except that fibers with a diameter of greater than 3 microns or fibers that appear to be attached to particles with a diameter of greater than 3 microns are not counted. The NIOSH 7400, AIA, ISO, and Chatfield methods all permit the use of the "B" counting rules as an alternative.

Several commenters agreed that the NIOSH 7400 and similar methods represent vast improvements over the currently used NIOSH P&CAM 239 (Exs. 117-A, 123-A, 328, 330; Tr. 6/20, p. 10; Tr. 6/21, p. 186; Tr. 7/8, p. 69). For example, the AIA stated that it has

> . . . looked favorably in the past on a number of modifications to the existing NIOSH analytical method, P and CAM 239, that will increase standardization and quality control . . . These improvements include the specification of a standardized graticule, a reduction in the sample filter size, the required use of a test slide to maintain appropriate resolution and a change to the acetone-triacetin slide mounting method (Ex. 328).

Dr. Chatfield testified at the hearing that the NIOSH Method 7400 is an improvement over the existing NIOSH method in its provisions for standardization of counts between counters and laboratories. Its adoption of the acetone-triacetin fixing technique follows the international trend in that direction (Tr. 7/8, p. 69).

As part of the submittal from Organization Resources Counselors, Inc., Graham W. Gibbs, Ph.D., also agreed that the modification of P&CAM 239 is appropriate:

> The reduction in the filter [size] to 25 mm [diameter] to improve the uniformity of the dust deposit is probably a sound move. . . . The use of acetone to collapse the filter results in a much [more thinly] mounted sample than with previous methods, which in turn helps to reduce the error if the observer fails to focus properly through the sample. . . .