analysis. Thus, only 30 percent of the samples collected were analyzed by one other analyst. In contrast, each of the Johns-Mansville samples relied upon by Busch et al. (Ex. 84–62, Appendix C) were analyzed by 2 to 5 technicians, and each of the samples used by Ogden (Ex. 84–447) were analyzed by 7 to 8 technicans. Because of the larger number of sample recounts conducted to obtain the results reported in the Busch et al. and Ogden studies, and because of the more rigorous quality assurance procedures used by the laboratories whose results were reported in these studies, OSHA believes that the intralaboratory CV estimates reported by Busch et al. and by Ogden better reflect the inherent intralaboratory variability associated with the phase contrast method than the CV reported in the Chase and Rhodes study.

Interlaboratory Variability

Another significant source of sample variability addressed by the AIA was that of interlaboratory variability, defined as differences in results for a single sample analyzed by different laboratories. The AIA stated that analysis of samples by different laboratories "... produces a broader spread of results than would repetitive analysis by a single laboratory [i.e., intralaboratory variability]" Ex. 328, p. A–15). AIA estimated that the combined intra- and interlaboratory CV for the P&CAM 239 method was between 0.3 and 0.4. The AIA relies most heavily on the Chase and Rhodes study (Ex. 002) and information obtained from NIOSH's PAT program to estimate the interlaboratory CV (Exs. 118–A to 118–D). These reports estimated average interlaboratory values of 0.24 and 0.35, respectively.

As discussed earlier in this section, laboratories may achieve very different results from monitoring the same workplace if they use different sampling and analytical methods. In describing the NIOSH PAT program, Dr. Taylor pointed out that the program does not require participants to use the P&CAM 239 method:

> [The NIOSH PAT program] ... is not an evaluation of 239, or any other particular procedure. It's an average of whatever procedures that the laboratories are using. (Tr. 6/21, p. 180)

Dr. Busch also explained that the large variability in results for PAT samples analyzed by different laboratories is due to the small sample size, which results in statistical imprecision in the CV calculated for each PAT sample (Tr. 6/21, p. 176).

Furthermore, differences in training and quality assurance procedures instituted by different laboratories can lead to large discrepancies in the analytical results obtained by those laboratories. When asked by Scott Schneider of the BCTD if quality assurance procedures can reduce interlaboratory variability, Dr. Taylor responded:

> I think quality improvements and quality control within laboratories, and participation in round robin testing between laboratories and participation in a proficiency testing program tends to decrease the variability of the laboratories. And NIOSH has presented a paper at [The American Industrial Hygiene Association Conference] ... a year ago and is ready to publish results of analysis of the last 10 years of PAT data. And, in that, we show a decreasing variability with the laboratories with the number of years that [they have] ... been in it (Tr. 6/20, p. 182).

Dr. Ogden also testified as to the importane of quality assurance programs in reducing interlaboratory variability:

> Standardization of the membrane filter method does not on its own harmonize results. ... There is no doubt that participation in interlaboratory quality control schemes improves comparability of results, and it is reasonable to suppose that participation and improvement of standards will be encouraged by an OSHA requirement to achieve passing grades, as suggested in the proposed rule. (Tr. 6/20, p. 17)

It is clear from this testimony, as well as the evidence presented earlier in this section, that standardization of the monitoring method as well as laboratory quality control programs are important for minimizing interlaboratory error. OSHA does not believe that the Chase and Rhodes study (Ex. 86–002) nor the NIOSH PAT data (Exs. 118–A to 118–D) are reliable measures of the intrinsic interlaboratory variability of asbestos measurement because quality assurance procedures vary widely among the laboratories participating in these studies.

In his study of HSE laboratories in Great Britain, Dr. Ogden found that, among laboratories with comparable quality control procedures, interlaboratory and intralaboratory variability are analogous in that both are dependent on the number of fibers counted (Exs. 84–446, 84–447, 93–3). It is not surprising that, as laboratories become more similar in their analytical, training, and quality control procedures, the problem of *inter*laboratory variability becomes more a problem of *intra*laboratory variability. This is also reflected in NIOSH's statistical analysis of the Johns-Manville asbestos data (Ex. 84–62, p. 6), in which interlaboratory variability was treated as a non-random (systematic) rather than random source of sampling and analytical error; that is, a source of error that is capable of being controlled.

Since the NIOSH estimate of the CV for the P&CAM 239 and NIOSH 7400 methods included only sources of random variability, other sources of controllable error, such as interlaboratory or systematic intralaboratory variability, may decrease the precision of the method used beyond that estimated by NIOSH. In order to minimize both nonrandom intra- and interlaboratory variations for asbestos monitoring, OSHA has included quality control requirements in Appendix A of the revised asbestos standards for general industry and construction.

Specifically, OSHA requires in Appendix A of the revised rule for general industry that employers rely only on laboratories that have instituted intralaboratory and interlaboratory comparisons and requirements for the training of microscopists. The laboratory relied upon by the employer must conduct an intralaboratory quality assurance program involving blind recounts for statistical monitoring of the variability of counting by each microscopist and among microscopists in the laboratory. For companies with more than one laboratory location, intracompany evaluations of variability must also be conducted.

The laboratory that an employer relies on to analyze air samples for asbestos must also participate in round robin testing with at least 2 other laboratories. Each laboratory is required to participate in round robin testing at least once every six months; conduct a statistical analysis of the results, and post results in each laboratory. Appendix A of the revised rule for general industry also requires that all microscopists who analyze air samples for asbestos take the NIOSH course for sampling and evaluating airborne asbestos dust, or an equivalent course.

Some commenters requested that OSHA consider requiring laboratories that analyze personal air sample to be proficient participants in the NIOSH PAT Program (Exs. 92–8, 277, 328, 330, Tr. 6/26, p. 73). For example, the Building and Construction Trades Department, AFL–CIO, recommended that OSHA require that

> ... samples be sent for analysis at the end of each shift and [be] analyzed by certified laboratories. To be certified, a laboratory must meet OSHA and/or NIOSH quality control requirements for certified laboratories and participate in and pass NIOSH review in