PLAINTIFF'S EXHIBIT G-303

Minutes
General Meeting
Asbestos Textile Institute
October 8, 1965
The INN, Buck Hill Falls, Pa.

In Attendance:

AMERICAN ASBESTOS TEXTILE CORP.
J.L. Rainey
J.W. Christenbury
D.F. Quealy
Wm. Maaskant
H.H. Walter

ASBESTOS CORPORATION LTD.
G.F.A. Brink
E.L. Alexander (A.C.S. LTD.)

BELL ASBESTOS MINES LTD.
G.W. Smith
F.P. Smith
Wm.J.W. Smith
R. Dodds-Hebron

JOHNS-MANVILLE CORPORATION
W.S. Hough
E.A. Schuman
W.C. Atkinson
I. Barnett
C.L. Sheckler

CADWALADER, WICKERSHAM & TAFT
P.Jay Flocken (Legal Counsel)

H.K. PORTER COMPANY, INC.
J.T. Griffis
J.D. McCluer
D.E. Childers

RAYBESTOS-MANHATTAN INC.
J.A. Brown, Jr.
J.A. Bettes, Jr.
L.C. Williams
J.P. Wronski
J.W. Hawkins
R.B. Smith

TURNER & NEWALL LTD.
Bernard Lincoln

TURNER BROS.ASBESTOS CO. LTD.
W.M. Deckman

BRITISH BELTING & ASBESTOS LTD.
J.L. Mitchell

UNITED STATES RUBBER COMPANY
S.J. Peele, Jr.
A.C. Link
D.T. Austin, Jr.

ASBESTOS TEXTILE INSTITUTE - H.E. Sunbury (Exec. Secretary)

** GUESTS **

S.R. Zimmerman,Jr.,Exec.Vice President, Raybestos-Manhattan Inc.
M.Q. Scowcroft, District Sales Mgr., Raybestos-Manhattan Inc.
C.W. Briggs, Control Mgr., Raybestos-Manhattan, Inc.
E.H. Wells, Vice Pres. & Genl. Mgr., Packing & Friction Matls. Div.
Johns-Manville Corp.
Dr. J.W. Axelson, Research Chief, Asbestos Fiber Applications
Johns-Manville Corp.
P.O. Nicodemus, Chairman, ASTM Sc A-4 of D-13
J.L. Tucker, Technical Consultant to A.T.I.
N.L.A. Martucci, Products Manager, Garlock Inc.
C.H. Sigler, Director of Marketing, Tex.Div., United States Rubber Co
S.N. Smith, Marketing Mgr.,General Textiles, United States Rubber Co

In addition to the above guests we were privileged to have twenty-fo ladies accompany their husbands to our luncheon on Friday, Oct. 8th.

PLAINTIFF'S EXHIBIT GAR-29
PENGAD-Bayonne, N. J.

------ Minutes of the Meeting ------

1. President Brown called the meeting to order at 9:30 A.M., and introduced the guests as listed above.

2. The minutes of the last meeting were presented for reading. On motion by J.A. Bettes, Jr., seconded by I. Barnett it was voted to omit the reading of same.

3. The Financial Report was presented by E.A. Schuman, Treasurer. Mr. Schuman stated that the Institute's books for the year ending September 9th, 1965, had been examined by Mr. W.E. Eddy, General Auditor of the Johns-Manville Corporation, and found to be in order. On motion by S.J. Peele, Jr., seconded by W.S. Hough, it was voted to accept the financial report, and it is made a part of these minutes.

4. President Brown introduced Dr. J.W. Axelson, Research Chief - Asbestos Fiber Applications, Johns-Manville Research Center, Manville N.J., Dr. Axelson presented a most excellent technical paper entitled "Testing of Asbestos Fibers - Discrete and Bulk Properties". By courtesy of Dr. Axelson and his company the full text of this paper is included with these minutes. Any correspondence concerning same should be addressed to Dr. Axelson at the Johns-Manville Research Center, Manville, N.J. 08835. President Brown expressed our sincere appreciation to Dr. Axelson for his fine paper.

5. The Fibre Producers Report was given by F. Parker Smith of the Bell Asbestos Mines Limited. Mr. Smith, as usual, had some most interesting remarks about the current situation in respect to the production and sales of asbestos fiber of all grades. He mentioned that, judging from sales to August 31st, the total year now looks as if it might be about 5% below the year 1964, however, last year was a record year. Textile fibers, to August 31st, were down more than 5%. The world market is fairly good at present, except for India and Japan.

6. The Legal Report usually presented at this time by Mr. P.Jay Flocken, our Legal Counsel, had to be omitted as the meeting was running late due to the length of the technical paper by Dr. Axelson. A summary of the Counsel Report is attached to these minutes, by courtesy of Mr. Flocken.

7. President Brown stated that the Board of Governors at their meeting last June had voted to award a Certificate of Appreciation to Mr. George F. Jenkins, who retired as Senior Vice President of Asbestos Corporation Limited, Thetford Mines, Quebec, on May 31st, 1965, to express our appreciation of his staunch support of the Institute over a period of many years, and his service as a member of our Fiber Testing Committee. As Mr. Jenkins was on a trip and could not attend this meeting, the plaque was entrusted to the care of Mr. G.F.A. Brink, for delivery to Mr. Jenkins.

8. The Chairmen of our several working committees reviewed the work of their committees for the past year, and their reports are attached

to these minutes. All of these Chairmen are completing their terms, after serving two or more years, namely:

L.C. Williams - Chairman: Air Hygiene & Mfg. Committee
J.W. Christenbury - Chairman: Sales Promotion Committee
Wm. Maaskant - Chairman: Technical Committee
I. Barnett - Chairman: Fiber Testing Committee

President Brown expressed to them the sincere appreciation of the Board of Governors for their highly valued contribution to the advancement of the Institute during their term of office.

The new committee chairmen, who normally serve for a period of two years, are:

Air Hygiene & Mfg. - W.C. Atkinson
Technical - J.D. McCluer
Sales Promotion - W.S. Hough
Fiber Testing - J.F. Wronski

9. Mr. I. Barnett reported on the progress of the 2nd Edition of the "Manual of Testing Procedures for Chrysotile Asbestos Fibre". He explained that the copy had been practically ready for the printer but that some additional tests are now to be included, and some re-typing is necessary to take care of last minute changes. Further, that the original cost estimate was too low in view of the inclusion of additional tests, and expenses of preparing the copy for the printer. He stated that the 2nd Edition, soon to be printed, would probably not be revised for at least five years, and asked that this be taken into consideration when final orders are placed with the Secretary of A.T.I. Those who have already placed orders on the basis of the original cost estimate, will be contacted by the Secretary and given the opportunity to revise their order in view of the 5 year period between editions, and the higher cost.

10. Mr. S.J. Peele, Jr., Chairman of the Nominating Committee, which consisted of Messers W.S. Hough, L.C. Williams and himself, reported he had submitted a slate of officers to the Board of Governors at their meeting on October 7th, 1965, to serve the Institute for the coming year, and that the following had been duly elected:

President - J.A. Brown, Jr. - Raybestos-Manhattan, Inc.
Vice President - J.L. Rainey - American Asbestos Textile Corp.
Treasurer - E.A. Schuman - Johns-Manville Corporation
Exec. Secretary - H.E. Sunbury

11. President Brown announced that the next meeting would be held on February 10th and 11th, 1966, at the Barbizon-Plaza Hotel in New York City.

12. The meeting then adjourned for luncheon, to which the wives had been invited, and it proved to be a most enjoyable affair.

Respectfully submitted,

H.E. Sunbury

H.E. Sunbury
Exec. Secretary

MYRIL CLEMENT SHAW

With extreme sadness we report the sudden and unexpected death of Dr. Myril C. Shaw, on the evening of November 12th, at his home 563 Gates Street, Philadelphia 28, Pa. He had recently observed his 56th birthday. While the cause of death was a heart attack, he had never had any previous heart ailment.

Dr. Shaw served the Asbestos Textile Institute well and faithfully for a period of seventeen years, rendering to it an invaluable service.

When the Asbestos Textile Institute Fellowship was established at Rutgers University in 1946, Dr. Shaw was employed as a "Research Specialist" to work on projects of interest to our members. In 1948 he was given, in addition to his work as Research Fellow, the responsibilities of Executive Secretary and Assistant Treasurer. In 1961 he was appointed Executive Director. During his long association with the Institute he became widely known throughout the asbestos industry, both in this country and abroad, for his many technological contributions.

Dr. Shaw resigned from the Asbestos Textile Institute in August of 1963 to accept the position of asbestos fiber specialist with the Certain-teed Corporation. At the time of his death he was Director of Research and Development for the American Asbestos Textile Corporation, Norristown, Pa.

A native of Columbus, Ohio, Dr. Shaw received his bachelor's and master's degrees from Pennsylvania State University, and his Ph.D in elevated temperature chemistry from Ohio State University.

He was a member and Fellow of the American Ceramic Society, a registered Professional Ceramic Engineer in the State of Ohio, a member of the American Society for Testing & Materials; American Trade Association; American Ordnance Association; and the American Standards Association. He was a member of the Roxborough Baptist Church, and of the Masonic Order.

Survivors include his wife, Mrs. Garnet Shaw; a daughter, Marilyn, who is a sophomore student at Marietta College; a son, Myril C.Jr. who is a fifth grade student at Penn Charter School; his mother, Mrs. Marian Shaw; and a brother and three sisters.

The funeral service was held on Tuesday, November 16th, at the J. Burton Corson Funeral Home in Philadelphia. The Asbestos Textile Institute was well represented at the service, and had the opportunity to extend to Mrs. Shaw and the children our deepest sympathy on behalf of all our members.

Interment was in West Laurel Hill Cemetery, Philadelphia, Pa.

November 20, 1965

H.E. Sunbury
Exec. Secretary

ASBESTOS TEXTILE INSTITUTE

Report of Funds   September 9, 1965

Balance on Hand at Last Report, May 10, 1965

General Fund	$ 2630.11	
Savings Fund	23114.01	
Petty Cash Fund	96.54	
		$25840.66
Receipts		
To Savings Fund (Interest)	209.13	
To General Fund (1965 dues)	500.00	
To General Fund (Book Sales)	56.26	
		765.39
Total on hand and received		26606.05
Disbursements		
Legal Retainer (Six months ending 8/31)	1000.00	
Legal travel	127.69	
Telephone (4 months)	145.70	
Meeting Expense (June)	534.43	
ASTM membership dues	35.00	
F.I.C.A. Tax	22.88	
Secretary's Salary (4 months)	363.75	
Secretary's travel	159.96	
Office rent (4 months)	166.64	
Technical Consultant (Test Manual)	225.26	
Accountant (Caruso-year ending 8/31	300.00	
Printing & Office supplies	56.01	
Petty Cash vouchers #177-197 inclusive	86.10	
Total Disbursements		3223.42
Balance on Hand as of Sept.9, 1965		23382.63
Funds		
General Fund (Bank Statement of 9/9/65)	2049.05	
Savings Fund (Three Accounts)	21323.14	
Petty Cash Fund	10.44	
Total Funds		23382.63
Assets as of Sept.9, 1965		
Cash in Bank (General Fund)	2049.05 *	
Cash in Bank (Savings Fund)	21323.14	
Petty Cash on Hand	10.44	
Accts Receivable (Book sales)	6.34	
Postage on hand	1.88	
Furniture & Equipment (Nominal Value)	1.00	
Total Assets		23391.85

Liabilities (None)

Net Worth $23391.85

* $2000.00 transferred from Savings Fund to General Fund on 9/2/65

Respectfully submitted,

H. E. Sunbury

H.E. Sunbury

Asst. Treasurer

SUMMARY OF COUNSEL REPORT

Asbestos Textile Institute's counsel, P. Jay Flocken, reports that the United States Supreme Court's decision in the United Mine Workers of America v. Pennington Case seems to have taken labor unions out from under the protective blanket thrown over them by Federal legislation in the labor management relations field in the 1930's. Counsel reviewed the background of this case and the Supreme Court's decision June 7, 1965, and stated that the essence of the decision is that:

> " . . . a union forfeits its exemption from the antitrust laws when it is clearly shown that it has agreed with one set of employers to impose a certain wage scale on other bargaining units."

Although unions seeking to negotiate uniform wages or working conditions throughout an entire industry face new problems under the antitrust laws, the decision may also seriously affect bargaining tactics of employers. For whenever an antitrust case could be made out against a union under the Supreme Court's rule against an employer-union conspiracy to restrain trade, a similar case could be made out against the participating employer.

It now seems clear that a commitment by a union not to grant more favorable conditions or terms to any competing employer - a common form of collective bargaining agreement -- is illegal on its face. Unions can be expected to avoid any agreements with any employers as to what kind of agreements the union will negotiate with other employers. The greatest hazard for unions who seek uniform labor standards -- and for the employers that deal with them -- lies in the threat of treble damage suits by disgruntled or marginal producers or by recalcitrant members of an employer association.

There has been little indication since the Supreme Court's decision last June that a new unsettled period of industrial labor relations is about to begin. But while the unions, particularly the United Mine Workers, appear to have been the principal losers in the Supreme Court, the increase in litigation involving unions and antitrust charges which seems likely to result from the Court's decision may show that workable collective bargaining has been the real loser.

Minutes: Air Hygiene and Manufacturing Committee
October 7, 1965
The Inn
Buck Hill Falls, Pa.
9:30 A.M. to 12 Noon
9:00 P.M. to 11:00 P.M.

Attending:
Members:

L. C. Williams, Chairman	Raybestos-Manhattan, Inc.
W. C. Atkinson	Johnsville-Manville Corp.
D. T. Austin, Jr.	United States Rubber
C. L. Sheckler	Johns-Manville Corp.
A. B. Smith	Raybestos-Manhattan, Inc.
H. Walter	American Asbestos Textile
A. C. Link	United States Rubber

Absent:

A. P. Gouvcis	H.K. Porter, Inc.
T. C. McCluskey, Jr.	Tallman-McCluskey Fabrics
R. W. Nelson	American Smelting & Refining

Demonstration - Bausch & Lomb, Rochester, N.Y. 14602
40-1 Dust Counter

All members attending.
Bausch and Lomb Representatives - Mr. R. A. Schmer
Product Administrator
Industrial Products Dept.

Mr. Charles Tepe
Technical Engr.

The industry is always interested in new types of Automatic Dust Counters as they come on the market. It is desirable to have a counter that could monitor conditions over a longer period of time than our standard dust counting procedure, and also to eliminate the possibility of human error.

The 40-1 dust counter demonstrated by Bausch and Lomb representatives operates on an optical system. There are input optics - photomultiplier and lamp, and output optics - collector mirror and focus lens. There are two streams of air supplied to the unit, 1) a sample stream and 2) a filtered air sheath. This gives accuracy to the unit. Slides were used to give details on exactly how the unit is built and operated. The unit contains a pump and by-pass, 2 mufflers, input photometer, 2 particle filters and exhaust. There are accessories available such as counter, alarm and strip chart recorder. The particular counter demonstrated would only be able to count particles up to one million per cubic foot. This would not be a satisfactory unit for our industry.

Thus, Bausch and Lomb has developed a new Proto-type 40-2 battery operated unit that will count particles from 1/2 to 15 microns in size and up to 100 million particles per cubic foot. This unit will be on test in the very near future. Mr. K. W. Nelson is to receive one of the prototype units and will be reporting to our committee the results of the trials using this unit.

For reference purposes the price of the 40-1 unit is $2965 and the new 40-2 unit is $3300. The unit can be set to count any given particle size. If you wish to pick out certain particle sizes and count them, the particle size indicator can be set, say for 2 micron setting, then a 4 micron setting and subtract. The demonstration was very well accepted by all members and I am sure the followup interest on this unit will be very active in the future ATI meetings.

Hearing Tests and Their Values

Recently word was received that presently and in the future, loss of hearing will be compensable. The committee therefore reviewed the Maico Audiogram Test Charts taken on new employees and mill employees. In all instances, except a few where persons knew they had loss of hearing, the critical speech area was not affected at all or just slightly affected. Since records were not taken prior to this date, it cannot be stated as to whether or not this loss of hearing was caused by job or by natural loss of hearing or some other outside effect. It is a known fact that between the ages of 40 and 60 years there is a 15 decibel loss of hearing and this happens to most everyone. It is, therefore, very importa nt that industry take tests on people as they are hired. These tests should be done by a Doctor or a Registered Nurse so we know that competently trained and experienced persons are doing the tests. One of the members supplied a paper on "East Range Symposium #3 Audiometry in Industry". This paper will be reviewed by members of the committee and discussed at the next meeting. Further, another member stated he will supply their Industrial records on this particular subject at the next meeting.

International Congress on ASBESTOSIS

A brief review was made of this International Congress report. Since portions of this are in French, we have delayed any comments on its contents until interpretation is received. This may take quite a long time to accomplish. Therefore, we will bring it up at each meeting in the hopes that someone will have some comments on its contents.

Consultant - Industrial Hygiene Program

Committee has given careful consideration to the suggestion that the ATI retain a consultant for the Industrial Hygiene Program. After discussion, it was decided that with the available personnel that we have within the industry and the help of Dr. Lewis Cralley of the U. S. Public Health Service, it is not necessary at this time to have a consultant. Therefore, the committee considers this investigation complete.

Method for Determining Dust Concentration

It had been recommended by the Committee that this method be placed in the new edition of the handbook. Committee will still recommend to the Sales Promotion that information on this handbook be made available to the consumer, either by including the entire method or stating that the "Method of Determining Dust Concentration" is available from the ATI upon request. The committee wants to restate that this is entirely up to the Sales Promotion committee, as to whether or not the handbook will contain reference to this method. With these minutes this item is considered complete.

American Textile Machinery Exhibition - International-1965

The committee discussed equipment that was displayed at this exhibition which would be of interest to the Asbestos Textile Industry. In particular, we reviewed the Parks-Cramer frame and loom cleaning equipment which is a continuous cleaning unit. A Saco-Lowell chute feed to cards and a Whitin cotton plucker. Also, there was a Saco-Lowell Rovamatic unit that operates very quietly in comparison to standard roving frames. This was of interest as we are active on the noise abatement program.

General Discussion

The committee discussed safety programs, the practicality of reworking fly waste, the effects of employee attitude on mill operation.

Review of Committee Activities for Past Year
Meeting - October 8, 1964

1. Public Health Service Survey - Dr. Lewis J. Cralley

Dr. Cralley gave us a status report on the inplant environmental studies. At this time six (6) were completed and the next study was to be made at Raybestos-Manhattan, Inc., Manheim, Pa. The studies have gone well as reported by Dr. Cralley and participating companies.

2. Biological Effects of Asbestos - Oct. 19,20,21,1964 - N.Y.C.

The committee suggested the Board of Directors of ATI send a Public Relations man to this conference since Dr. Selikoff is using the news media for publications.

3. Quality Control Systems under MIL-Q-9858 A.

The committee reviewed this specification and agreed it is well to be covered by this spec if you are doing Government work. A report from member companies indicates that all are co_vered by this spec.

Meeting - February 11, 1965

1. Public Health Survey - Dr. Lewis J. Cralley

Dr. Cralley reported on status of the studies and told us they will take approximately 25 years to acquire meaningful data. Some plants have records for the past 15 years. In the future, there will be need for medical studies. More information will be available on this later.

2. Review Current Publicity on The Effect of Asbestos on Public Health

The following articles were reviewed and discussed:

1) - "Dangerous Dust" - Scientific American, December, 1964 - Volume 211.

2) - "Cancer Experts Eye Asbestos in Alarm/Cancer Experts Eye Asbestos Perils", by Josephine Robertson. The Plain Dealer, January 12, 1965, Cleveland, Ohio.

Review and discussion of these articles keeps members of the committee up to date on the publicity Asbestos is receiving relative to Public Health.

3. Suggestion Systems

Following are general procedures used by member companies.
1) - Hourly employees participate.
2) - Separate participation for salaried employees.
3) - Management committee or Management and Employee Committee, accept or reject suggestion.
4) - The values is accessed through complete investigation of the suggestion.
5) - The reward is either a fixed amount or a percent of the first year's savings.

4. Variances - Production Control

Variances in production control systems immediately point out the reduced or increased manufacturing costs to the management. When a change from standard is noted it is investigated and the cause checked. By this method a more accurate control can be placed on costs or corrections made when necessary and the reason noted.

5. Portable Vacuum Cleaner

Discussed several units currently available. Several member companies are expecting to evaluate these units.

6. Noise Abatement

Reviewed the possibility of compensation cases coming up for loss of hearing. This program will be kept active in the future as several meembers feel that in the future loss of hearing will be compensable.

Meeting - June 3, 1965

1. Public Health Service Survey - Dr. Lewis Cralley

Dr. Cralley presented a paper prepared by Jeremiah B. Lynch on "Asbestos Study - Procedures and Findings". This information was made available to all member companies for their review. He also reported that all indications point to good dust control in Textile plants. He then distributed another paper entitled "Relationship of Impinger Counts to Fibre Concentration by Membrane Filters in Asbestos Textile Plants". Both of these papers are drafts and when they are finalized they will be published.

2. Portable Vacuum Cleaners

1. Two units - 1) Suction Apparatus and 2) Compressed Air Unit were tried. Both units do a satisfactory cleaning of easy to reach areas but in equipment and close areas they are not adequate. The committee has agreed to continue investigating vacuum cleaning equip ment as it comes on the market. We will report their findings at time of test.

3. Direct Dust Counter

Information has been received that Bausch and Lomb are developing a new dust counter light and photo electric cell to count all dust particles in the air. Three main factors make a unit such as this desirable:

1) - Eliminate the human factor in counting.
2) - Take more readings in a shorter period of time.
3) - Cost of unit estimated at $3300.

4. Consultant Industrial Hygiene Program

A suggestion has been received to discuss and investigate the possibility of Asbestos Textile Manufacturers retaining a consultant to supervise a uniform Industrial Hygiene Program and to conduct periodic surveys of plants. This suggestion has been taken under advisement and will be discussed in subsequent meetings.

5. Automatic Loom Cleaning

Parks-Cramer have developed a new unit called Weave Cleaner-Travel Vac which has much higher velocity air - cooperating vacuum. All members have received information on this unit and can follow up if they are interested in purchasing same.

- - - -

As outgoing Chairman of the Air Hygiene Committee, I wish to express my thanks and appreciation to the committee and members of other committees who have attended several of our meetings for being so cooperative in keeping the program active and making each meeting a worthwhile and interesting session.

I also want to express t he committee's welcome and congratulations to Mr. Walter Atkinson, who will be our new Chairman for next year.

Respectfully submitted,

L. C. Williams, Chairman
Air Hygiene & Mfg. Comm.

MINUTES: Asbestos Textile Institute
Sales Promotion Committee
The Inn, Buck Hill Falls, Pennsylvania
October 7, 1965

ATTENDING:

J.A. Brown	Raybestos-Manhattan, Inc.
J.A. Bettes, Jr.	Raybestos-Manhattan, Inc.
S.J. Peele, Jr.	United States Rubber Co.
W.S. Hough	Johns-Manville Corp.
E.A. Shuman	Johns-Manville Corp.
J.T. Griffis	H.K. Porter Co.
J.L. Rainey	American Asbestos Textile Corp.
J.W. Christenbury	American Asbestos Textile Corp.
P.J. Flocken	Cadwalader, Wickersham & Taft
N.L.A. Martucci, Guest,	Garlock, Inc.

1. The Sales Promotion Committee attended a demonstration of Bausc & Lomb Dust Counting Equipment with the Air Hygiene and Manufacturing Committee.

2. Our large display is now located at Renssilaer Polytechnic Institute at Troy, New York. Earlier this year, it was viewed at the Royal Ontario Museum in Toronto, Canada.

3. Continued work on revising the A.T.I. Handbook was discussed. Additional assignments were made by Mr. E.A. Shuman, head of our sub-committee.

4. We were brought up to date on the present status of Coast Guard requirements where fibreglas cloth is replacing asbestos to some extent.

5. The continuing pressure of Japanese imports of asbestos cloth was discussed.

6. Mr. S.J. Peele agreed to continue to write his market report on asbestos textiles for the ASBESTOS magazine.

Respectfully submitted,

J. W. Christenbury, Chairman
Sales Promotion Committee

MINUTES: Asbestos Textile Institute
Technical Committee Report
Buck Hill Falls, Pennsylvania
October 7, 1965

ATTENDING:		
	J.D. McCluer	H.K. Porter Co.
	W.M. Deckman	Turner Bros. Asbestos Co. Ltd.
	J.W. Hawkins	Raybestos-Manhattan, Inc.
	D.F. Quealy	American Asbestos Textile Corp.
	Wm. Maaskant	American Asbestos Textile Corp.

SUBJECTS DISCUSSED:

1. Specification SS-C-466e:

The Official Interim Amendment-1 to Specification SS-C-466e was distributed. Specification SS-C-466e is being revamped at the Bureau of Ships to include the various other asbestos textile specifications. Scheduled finished date - June 1966.

2. MIL-C-10316B:

This specification will also be part of the new SS-C-466e issue. In the meantime, attempts are being made to have this specification amended for change in thickness.

Note: Several requests were made by the writer to get an Interim Amendment for the thickness only. We were informed by Mr. Abel, of Bureau of Ships, on 10-26-1965, that he had reached an agreement with the Army to issue an Interim Amendment. As soon as this amendment is available, the writer will forward same to each Technical Committee Member.

3. A.T.I. HANDBOOK:

The section under Asbestos Textile Products (pages 29 thru 32) was reviewed. The following recommendations for change were forwarded to Mr. J.W. Christenbury on October 19, 1965:

1. Page 30 - Grades - Footnote 1 - As referred to under this paragraph, pages 64 to 68 might be different in the new issue.

2. Elevated Temperature Serviceability - Page 30 - First sentence to be changed after 1500° F), "but also, in more recent applications, where temperatures in excess of 5000° F may be encountered", change into "also, in applications where temperatures in excess of 5000° F are encountered".

3. Page 31 - First line "400° to 800° change into "400° F to 800° F".

3. A.T.I. HANDBOOK: (CONTINUED)

4. A. Chart A - Identify this chart just above the top line, in center.

   B. Include Grade AAAA - Strength retention 100% at 600° F and 800° F.

5. Page 32 - Third sentence "as an example recent studies show an erosion rate" change into "as an example, studies indicate an erosion rate, etc."

4. Chemical and Corrosion Tests:

Above tests for asbestos lagging cloth were discussed. According to the KNOLL Atomic Laboratories in Schenectady, New York, the Lehigh Laboratories at Wilmington, Delaware is authorized to perform the tests required.

May I thank all the Technical Committee Members for their support during my term as Chairman of the Technical Committee.

Respectfully submitted,

W. Maaskant

W. Maaskant, Chairman
Technical Committee

MINUTES: ASBESTOS TEXTILE INSTITUTE
FIBER TESTING COMMITTEE
OCTOBER 7, 1965

The meeting was held at the Inn, Buck Hill Falls, Pennsylvania.

In attendance:

G. F. A. Brink	Asbestos Corporation Ltd.
J. W. Axelson	Johns-Manville Corporation
B. Lincoln	Turner and Newall, Ltd.
D. E. Childers	H. K. Porter Company, Inc.
R. Dodds-Hebron	Bell Asbestos Mines Ltd.
J. Wronski	Raybestos-Manhattan, Inc.
I. Barnett	Johns-Manville Corporation
J. L. Tucker	Technical Consultant, A. T. I.

Subjects Discussed

The first part of the meeting was held jointly with the Air Hygiene and Manufacturing Committee for a demonstration and discussion of the Bausch and Lomb electronic dust counter. At the conclusion of the discussion the members of the Fiber Testing Committee adjourned and regrouped for a discussion of the forthcoming "Manual of Testing Procedures."

1. Mr. Tucker reported on the printing cost quotation from two printers on the manual that will contain about one-third more pages than the first edition. Individual test procedures were also quoted upon.

   On the basis of a manual bound similar to the first edition the lowest quotation for 2500 copies was $3200 and for 3000 copies $3450. For printing about 35,000 extra pages of the procedures to be used for the requirements of individual tests the quotation was $375. These costs do not include packaging and shipping. The final cost per copy will also include the recovery of expenses for our Technical Consultant and typing of the proof copies.

   After the inclusion of one additional procedure submitted by QAMA and one revision, the low bidder will again be contacted for a revised quotation. When this new cost is known Mr. Sunbury will request each member and affiliate to review original requirements on the basis that the next revision may not occur for about four to five years and also the reduced cost per copy when the total order is increased from 2500 to 3000 copies.

2. Bauer-McNett Wet Classification procedure previously approved by QAMA was officially approved for ATI. The revision allows the use of the new Model 203-C Bauer-McNett Classifier. This will be included in the new manual.

3. A new test for rapidly determining the apparent surface area of fiber was developed by Turner and Newall and adopted by QAMA on September 14, 1965. This will be included in the manual as an additional procedure to the Dyckerhoff method. ATI and MFPB will vote as soon as members have had an opportunity to study the procedure which has been circulated.

4. Magnetic Rating procedure will be published in the manual as currently revised, but the concensus is that more study is required to develop the desired improvements for future revision.

5. Some of the members convened at a special meeting later in the day with Mr. P. O. Nicodemus, Chairman of Sub-committee A-4 of Committee D-13, ASTM to discuss tests required for the revised ASTM publication.

Respectfully submitted,

Irvin Barnett, Chairman
ATI Fiber Testing Committee

TESTING OF ASBESTOS FIBERS

DISCRETE AND BULK PROPERTIES

JOHN W. AXELSON
JOHNS-MANVILLE RESEARCH AND ENGINEERING CENTER
MANVILLE, NEW JERSEY

Introduction

Before beginning a discussion of the testing methods and equipment used for asbestos, I want to briefly review a few things about asbestos. Since chrysotile is by far the most common commercial type of asbestos, all of my remarks will refer specifically to it although most will also apply to the other types.

Chrysotile is a fibrous hydrated magnesium silicate which occurs in nature. Geologically, it was formed under hydrothermal conditions and occurs throughout the world including at least 49 if not 50 of the states. It most commonly occurs in veins of various thicknesses in the serpentine host rock and is usually of the cross-vein type with the fibers perpendicular to the rock faces. The extraction of the fiber consists of mining the ore, crushing it, and removing and classifying the fiber. Since the thickness of the veins or the nominal fiber length will generally vary from about one inch down to submicroscopic sizes within a single piece of ore, it is very difficult to separate the product into any discrete sizes. Consequently, all milled fiber consists of fibers over a wide length spectrum and also includes some rock or granular substance. But that is not all. The fibers are also present in the milled product in clusters or bundles varying in size from the single fiber with a diameter of about 160 to 200 Angstroms to a bundle one quarter inch in cross-section containing millions of individual fibers. How are these tested?

I must admit that some of the methods are crude, some have been developed to help predict the use of the fiber in specific products, and some are very difficult. However, we do find these tests useful and we are always looking for new and improved tests which will characterize asbestos more specifically. First, I will review the more common tests that have been made to determine specific physical properties of asbestos.

Measurement of Discrete Properties

Tensile Strength

Tensile tests are made by the classical method of fastening a specimen between two jaws, one movable, and applying a tensile stress to the specimen until it fractures. The difficult part is to obtain the specimen and to mount it properly. The common technique is to have someone with good eyesight extract a bundle of fiber which is just visible, or in other words, is less than the diameter of a hair. Since the bundle is about 0.001 inches in diameter, it contains up to about a million fibers. Hopefully, these are all continuous fibers and the strength of the bundle represents the strength of the individual fibers. The length of the fiber specimen will depend on the sample but should be in the range of 1/2 to 1 inch.

Next, the cross-section has to be measured. This is done microscopically and assumes that the bundle is of circular cross-section and a solid mass of asbestos. There are several different methods for mounting the specimen. Our technique consists of first coating the top support wire of the tensile testing unit, Figure 1, with sealing wax and touching the fiber specimen against this while the wax is still soft. After cooling, the top support wire with attached sample is suspended from the top arm and the height of the bottom support wire is adjusted to the length of the specimen which is then attached to the bottom wire with a gob of molten wax. The testing machine is started to provide a tensile pull on the specimen until fracture occurs. At this time, the maximum load at break is recorded and the tensile strength is calculated from this load and the measured cross-section. Because of the heterogeneous nature of the fiber, it is very difficult to obtain good results. Values believed to be closer to the true tensile strength of asbestos are obtained when a sharp break is observed, as contrasted to a ragged break where sections are breaking or being pulled apart. Fibers tested are in the range of 25 microns or 0.001 inches and show breaking loads in the range of 100 grams.

The measurement of elongation during the application of a tensile load to a fiber will allow the elastic modulus to be calculated. However, this elongation or strain is very small and therefore very difficult to measure on these small fibers. One method is to use a cathetometer or measuring microscope which will measure the change in fiber length with load. In another method we used a laboratory balance with the load applied by releasing water in a container on one arm of the balance through a calibrated orifice so a counterweight on the other pan will apply a load to the fiber which is fastened between the first balance arm and the base of the balance. By extending the swing indicator on the balance, it was possible to obtain a 7:1 advantage and measure the strain by observing the movement of the swing arm. Total strains up to about 2% were measured for chrysotile asbestos as compared to 1% or less for the more brittle amosite and crocidolite fibers.

Typical values for tensile strength and modulus of a number of types of asbestos are shown in Table 1.

TABLE I.

PHYSICAL PROPERTIES OF ASBESTOS

Fiber	Average Tensile Strength, psi	Modulus of Elasticity, psi
Chrysotile	281,000 to 436,000	23.2×10^6
Crocidolite	469,000 to 605,000	27.1×10^6
Amosite	148,000 to 203,000	23.6×10^6

From "Asbestos Reinforced Plastic Pipe", R. E. Cryor, Chemical Engineering, pp 134, August 2, 1965

Density(1)

Since asbestos is a fibrous material with the fibrils associated in groups or bundles, special precautions must be used for determining the density. Basically, this consists of evaluation of the sample in a pycnometer. After complete degassing, a standard pycnometer density is determined from the known values for the weight of the asbestos, the weight of the asbestos plus the fluid in the pycnometer, the volume of the pycnometer and the density of the fluid. A number of determinations for Canadian chrysotile gave values ranging from 2.53 to 2.58 gms/cc with an average value of 2.56 gms/cc.

Coefficient of Thermal Expansion

This is a very difficult measurement with asbestos since a sample conducive to linear measurements is almost impossible to obtain. The technique used has been one in which the difference in density with temperature has been measured for a sample of asbestos and the coefficient of cubical expansion calculated from it.

Both the pycnometer and volumenometer were investigated but the pycnometer gave very erratic results that were believed to be caused by the loss of some of the fine asbestos with the fluid which is lost on expansion. By careful drying of the asbestos and degassing after immersion in the fluid, reasonable results were obtained with the volumenometer which uses the Archimedes principle that the decrease in weight of a sample immersed in a fluid is equal to the weight of the displaced fluid and the volume of this fluid is equal to the volume of the solid.

Tests were run using an asbestos float sample with weighings at 0.7°C and 99.2°C. Measured densities were 2.629 and 2.605 gms/ml. It can readily be shown that the coefficient of cubical expansion is related to density by the following equation:

$$B = \frac{d_o - d_t}{d_t \Delta t} = \frac{2.629-2.605}{(2.605)(98.5)} = 0.00008\ in^3/in^3/^oC \quad or$$

$$B = \frac{8x10^{-5}}{1.8} = 5x10^{-5}\ in^3/in^3/^oF.$$

These values coincide with those for an aluminum alloy. With anisotropic materials the linear coefficient of expansion is approximately 1/3 of the cubical coefficient but this probably does not hold for a fibrous material like asbestos. Although measurements of this type are made on a bulk sample, the technique at least theoretically gives a value which is discrete for an asbestos fiber.

Specific Heat

I will not dwell on this subject, but only state that the specific heat for chrysotile asbestos has been measured by standard calorimetric techniques and a value of 0.25 Btu/lb/^{o}F has been determined. There may be small differences for different grades of asbestos from different deposits but they are probably not significant.

Refractive Index

Refractive index is defined as the ratio of the velocity of light in a medium compared to its velocity in air. One of the easier ways to measure this property is to use liquids of known refractive indices. A small sample of asbestos is dispersed in liquids of varying indices on a glass slide. These are observed under a microscope. The refractive index of the chrysotile is taken as that of the liquid in which the fiber is least discernible. For chrysotile the refractive index is in the range of 1.50 to 1.55 depending primarily on the source of the fiber. This compares to a refractive index of about 2.5 for titania, 2.0 for zinc oxide, and 1.33 for water.

Measurement of Bulk Properties

A number of tests have been devised to measure the bulk properties of asbestos. A group of these have been standardized and the test methods published by the combined efforts of the Quebec Asbestos Mining Association, the Asbestos Textile Institute, and the Mineral Fiber Products Bureau (formerly the Asbestos-Cement Products Association). The publication is entitled "Manual of Testing Procedures for Chrysotile Asbestos Fibre" and copies can be obtained from the Q.A.M.A. Testing Laboratory, Sherbrooke University, Sherbrooke, Quebec, Canada. It is hoped that the tests in this manual will serve as the basis for test procedures for asbestos that will be promulgated by ASTM.

One of the most difficult parts in the testing of asbestos is to obtain a representative sample. Specific instructions are given in this manual for proper sampling of a shipment of asbestos in order to obtain a representative sample. Even if these are followed explicitly, there are difficulties, and variations within a lot are not detected. All I wish to state here is that the sample used for testing should be the best sample obtainable for the purpose and that special care should be taken to eliminate loss from any fraction of the sample. The test results should be reviewed in the light of the sample used and extrapolated conclusions should not be made.

Dry Screening

The Quebec Standard Asbestos Test

This is a test used to classify asbestos fiber into the commercial grades that have been established by the QAMA. It is a dry screen test which serves the stated purpose but leaves much to be desired in classifying the utility of a fiber for specific uses.

The test utilizes a series of nested box screens, Figure 2, constructed of cast aluminum and measuring 14-3/4" x 24½" x 3½" (approx.). Specific openings and wire dimensions are given for each screen to provide nominal ½", 4 mesh, and 10 mesh screens. A pan and cover complete the screen assembly with the ½-in. screen directly under the cover and the 10 mesh screen above the pan. The screen assembly is fastened to a gyratory mechanism that rotates at 327 rpm.

A one-pound sample of asbestos is used in this test. All clots and lumps should be broken up and the moisture content should be less than 3%. (Canadian chrysotile under atmospheric conditions will contain 1.5 to 2% absorbed water).

The fiber is allowed to fall loosely onto the top ½-in. screen and the cover is closed without compressing the fiber. The machine is started and runs for 600 revolutions when it automatically stops. The fiber remaining on each screen is removed, weighed and recorded in tenths of an ounce. The amount on the top screen determines the grade of the fiber.

Standards for a few grades of fiber are given in Table 2.

TABLE 2

LENGTH CLASSIFICATION OF ASBESTOS

Grade	Length or Distribution by Screen Size
No. 1 Crude	Basically crude 3/4" and longer
No. 2 Crude	Basically crude 3/8" to 3/4"

	Quebec Screen Analysis, oz.			
	1/2"	4 Mesh	10 Mesh	Pan
3K	7.0	7.0	1.5	0.5
3T	2.0	8.0	4.0	2.0
4D	0.0	7.0	6.0	3.0
4T	0.0	2.0	10.0	4.0
5D	0.0	0.5	10.5	5.0
5R	0.0	0.0	10.0	6.0
6D	-0.0	0.0	7.0	9.0
7D	0.0	0.0	5.0	11.0
7R	0.0	0.0	0.0	16.0

It should be pointed out that the classification in Table 2 applies only to asbestos out of Quebec. Other areas of the world, including other provinces of Canada, use different designations and equivalency of grades has to be determined.

In addition to the number-letter designation, most Quebec producers use a third number identification which tells how that particular grade was produced. It denotes what part of the mill the fiber came from and what processing it has undergone. For Johns-Manville asbestos, this third number roughly signifies the degree of openness of a fiber.

Ro-Tap Test

This is the standard test used by all industries dealing with particulate material. The testing unit is the W. S. Tyler Ro-Tap Testing Sieve Shaker, Figure 3, and consists of a series of 8-in. diameter screens which are nested together and shaken at a rate of 285 rpm while simultaneously having a tapper strike the set 154 times per minute. In operation, the screens are nested with a pan on the bottom and successive screens with larger openings stacked above this, and finally a cover on the top screen which has the largest opening. The mesh sizes of the screens will vary with the grade of fiber being tested but will range between a 3 mesh and a 65 mesh. The sample size is 50 grams for grades 4 and 5 and 100 grams for grades 6 and below. The time also varies from 10 minutes for all grades 7D and above to 30 minutes for those below 7D.

In some cases the procedure is varied by using a different-sized sample or changing the time or screen sizes; another innovation is to separate the fiber and granular portion on each screen by shaking to stratify each portion and then carefully aspirating the fiber off and weighing the remaining granular material.

The utility of this test to characterize a fiber for its usefulness is questionable but it can be effectively used as a control test to ensure that a specific grade of fiber maintains certain size characteristics. It is particularly useful with the shorter grades.

Wet Screening Tests

Bauer-McNett

The Bauer-McNett Wet Classification Test is the most common wet screening test and wet screening is the most effective, practical method known, to obtain a length distribution measurement of fibrous materials of heterogeneous length. The wet technique tends to separate the particles so each one is classified by itself rather than as a component of one or more other particles which are agglomerated together.

The Bauer-McNett unit, Figure 4, consists of a number of elliptical tanks with a removable screen on one side. The tanks are mounted in a cascade so the overflow of one will flow into the next. Each tank also contains a baffle plate parallel to the screen and about three quarters of an inch away and a bladed cylindrical rotor at one end which runs at 540 rpm. The purpose of these two modifications is to orient the fibers parallel to the screen surface and to minimize endwise flow of fiber through the screens. There is an outlet on the bottom of each tank which is closed with a plug, but which is also connected to a vacuum system through a special cup. This cup has a screen which supports a filter paper and acts to collect the material from each tank at the conclusion of the test.

In operation, all of the tanks are filled with water and a standard flow of water through the tanks is established at 3 gpm. The rotors are started and the sample is placed in the uppermost tank. During the running of the test, it is necessary to periodically brush off the material from the screens so blocking does not occur. After running for the prescribed time, the water flow and rotors are stopped and the plugs at the bottom of the tank are removed. The water drains out of each tank through the filter paper which collects all of the fiber remaining in that tank. The interior of the tank is thoroughly washed to remove all fiber and transfer it to the filter paper. The papers with their fiber are dried and weighed and the percentage of fiber from each tank is calculated.

Most Bauer-McNett systems consist of four tanks and therefore four screens, but five size fractions are obtained since the material going through the last screen to the drain is measured as the difference between the weight of the original sample and the sum of the weights from the four tanks. As with dry screening, the screen sizes, sample size and time of test vary with the grade. The screen sizes used are generally 4, 14, 35, and 200 mesh, but a 100 mesh is sometimes added with the 4 mesh removed and a 325 mesh may used as the last screen. Sample sizes are 10 grams through grade 7D and 20 grams for shorter grades, and the time of test is 20 minutes except for the float grades which use 30 minutes.

Clark Classifier

This test also consists of flowing water through a series of screens such as in the Bauer-McNett test. The unit, as shown in Figure 5, consists of a semi-cylindrical tank with four rotating, circular, perforated discs or screens dividing the tank into four compartments. A 5-gram sample of fiber is placed in the first compartment with the discs rotating at 48 rpm and the water flow set at 12.5 liters per minute. After 6½ or 20 minutes depending on the grade of fiber, the water flow is stopped and the water from each compartment is drained through a filter paper in a drain cup as with the Bauer-McNett. For fiber grades above 4A, the disc openings are 1/2, 1/4, and 1/8 inch and 30 mesh. A 100 mesh screen is used with the 1/2 inch opening disc removed for shorter grades. In some cases the fiber length for each fraction is not designated by the screen or plate opening, but rather the average length of each fraction is calculated from a microscopic measurement of 50 representative fibers. These average lengths and weights of.

each fraction are then used to calculate an average length of fiber for the sample on a dust-free (minus 100 mesh) basis.

Surface Area

Air Permeability

The determination of surface area by air permeability is based on the flow of fluids through porous beds. The rate of flow or the pressure drop across the bed is related to the size and length of the flow channels. These in turn are related to the size of the particles in the bed and this particle size determines the surface area. It should be noted that the area measured is only the external area exposed to the flow and does not include areas that are dead air spaces. In order for these relationships to hold, it is imperative that the porosity of the bed be essentially constant. With granular materials, this can be done only by screening into fractions and testing each one, but with compressible materials like asbestos fibers it only requires that a standard weight be compressed to a fixed volume.

All air permeability methods use the technique of flowing air through the porous bed. However, some types measure the pressure drop at a constant flow rate; others measure the volume of flow at a constant pressure; and others measure the time for a known volume of flow. The Dyckerhoff unit, shown in Figure 6, is the most widely used in the asbestos industry and is based on this last principle.

A 50-gram sample is placed in a cylindrical container with a perforated plate on the bottom and access to the atmosphere at the top. These are shown in Figure 7. The sample is compressed until the cap can be twisted into place to give a plug of asbestos of a standard height. The cylinder containing the sample is then twisted onto the unit so that it is connected to a vacuum chamber. The machine is completely automatic in its operation from this point on. A handwheel is turned to apply a suction which creates a vacuum chamber and displaces fluid in a U-tube. The handwheel is then turned to the measuring position which opens up the vacuum chamber to the cylinder containing asbestos, and air flows from the atmosphere through the plug of asbestos and into the vacuum chamber. This causes the fluid in the U-tube to return towards its original position. In so doing, it contacts an electric probe which starts a clock and subsequently contacts another probe which stops the clock. The U-tube and probes are shown in Figure 8. The time on the clock is a measure of the time required to fill the vacuum chamber at atmospheric pressure and has been correlated to the surface area of the fiber. This is a straight line relationship, and the surface area can be read off of a chart showing surface area vs time.

The unit is calibrated by using capillary tubes standardized for the time required to fill the vacuum chamber with the tube substituted for the fiber. Calibration can also be accomplished by using a standard sample of known surface area.

This unit is fast, gives reproducible results, and has little dependence on operator variability.

<u>Gas Adsorption</u>

The principle of this technique is the adsorption of a gas onto the surface of the material being studied. If this adsorption is in a monomolecular layer and the amount of gas adsorbed is known, the total area can be calculated by knowing the area covered by one molecule of the gas.

In practice the sample is placed in a high vacuum system and all adsorbed molecules are removed from the surface by the high vacuum. Heat is often applied to the sample to aid this desorption. A known volume of gas is then admitted to the system and is caused to adsorb on the sample by lowering the sample temperature. The amount adsorbed is determined by measuring the loss in pressure in the system, and the surface area can then be calculated.

Unlike air permeability, which measures only the area comprising the flow channels, gas adsorption measures all of the area in which the gas comes in contact. This will include internal pores unless they are blocked or are too small for the gas molecule to enter. A rough idea of the different results is shown by asbestos which may show an area of 2 sq meters by air permeability and about 20 sq meters by gas adsorption. In the case of quartz this ratio is only about 3 to 1 instead of 10 to 1, presumably because of the smoother surfaces and lack of internal pores.

Suter-Webb

This is the test used to measure the length of asbestos fibers by physical means. It is a tedious technique and the results are highly dependent on the proficiency of the operator.

Fiber length is measured on a 200 mg sample which has been thoroughly combed out in a special metal wire comb. After combing, the fibers are placed in a series of similar combs spaced 1/8-inch apart and with one end of each fiber protruding no more than 1/8-inch from the set of combs. Combs are dropped from the other end of the fibers until the first fibers appear as shown in Figure 9. These are extracted from the comb and weighed. Their length is taken as 1/8-inch times the number of combs remaining plus 1/16 in. Another comb is dropped and the fibers extracted and weighed. This process is repeated until all the combs are dropped. The average length of the fibers can then be calculated from the sum of the weight times the length for each group divided by the total weight.

Water Elutriation Test

This is a technique used to measure the amount of bundles or grit content in asbestos fiber. It is not a practical test for fiber grades above 4D.

The apparatus consists of a 3-inch diameter vertical glass tube approximately 4 feet tall with water and air inlets at the bottom and appropriate methods for measuring the rate of flow.

In operation the tube is filled half way with water and a slurry of 10 grams of fiber in water is added. Air is bubbled through the mixture to insure dispersion and then the air rate is set at 50 cc/minute. Water is turned on at 3500 cc/minute with the overflow going out the top and carrying with it the finer particles and highly opened fiber. After 9 minutes, the air is turned off and the water flow rate is increased to 5400 cc/minute for another 5 minutes. Figure 10 shows a unit in operation with the more crudy and longer fiber concentrated near the bottom of the tube.

At the end of the test, the tube is drained into a beaker to collect the crude and grit materials. These are filtered, dried, and weighed. If desired, the crude can be separated from the grit by pulping the fiber and decanting it off. The remaining grit is filtered out, dried, and weighed.

Air Elutriation

This is a technique used to separate fine particles (below 40 μ) from asbestos. The unit consists of an inverted long-tapered cone with an air inlet and a mechanical agitator at the bottom, Figure 11. The top is connected to a dust bag which filters the air leaving the system.

The sample of fiber is charged into the unit through a small door in the side of the cone. The air flow and agitator are started with the flow adjusted to give a minimum rate of 0.395 ft/sec through the largest part of the cone. Anything smaller than 40 microns will be carried out to the dust bag at this velocity and anything larger will remain in the cone. At the end of the 9-minute test period, the air and agitator are shut off, the stopper at the bottom of the cone is removed, and the material in the cone is transferred to a Ro-Tap screen. The screen is Ro-Tapped for one minute without the hammer. The amount of fiber remaining on the screen is classified as fiber, that in the pan is listed as granular, and the dust content is obtained by the difference between the sample weight and the combined weights of the fiber and granular.

A 5-gram sample is used for group 3 fiber and a 10-gram sample for all others. In determining granular content, a 35 mesh screen is used for all groups except group 7 which uses a 28 mesh screen. Although the sample is separated into three fractions by this test, the names of the fractions are based on particle size rather than actual shape or character. For instance, the dust fraction is anything smaller than 40 microns and I assure you that there is a lot of fiber in that portion. Likewise, there may be large granular particles in the part called fiber and a lot of fiber in the granular fraction. However, the test is useful to the asbestos fiber industry.

Alpine Test

This test separates a fiber sample into three fractions as in the air elutriation test but uses a fine screen instead of air elutriation to separate the dust fraction. A 200 mesh screen is generally used and the fines are pulled through the screen by a vacuum while a circulating air knife keeps blowing the fiber off the screen to stir the fiber and prevent screen blinding. A unit is shown in Figure 12. The plus 200 mesh fraction can be separated into fiber and granular parts by a one-minute Ro-Tap, as in the Air Elutriation test. A 10-gram sample is used and the test is run for 10 minutes.

Color

In many applications, the color of asbestos fiber is not of any great concern but there are a few cases where it is of prime importance. One of these is in asbestos-vinyl floor tile where the modern pastel shades cannot tolerate a dark asbestos without extensive use of whitening agents.

In testing for color a dry pellet of asbestos is made by compressing a 10-gram sample of fiber in a 1-1/8-inch diameter cylinder with a stress of 16,000 psi on the asbestos pellet. In this condition the pellet can be easily handled.

The color is measured in a photovolt photoelectric reflection meter with green, amber, and blue filters. The unit is calibrated with a standard reflectance plaque by setting the galvanometer at the reading specified for the plaque. The fiber pellet is substituted for the plaque and the color rating read directly off the galvanometer. A good color asbestos will range from 60 to 70 units as compared to a value above 90 for titania.

Chemical Analysis

Standard techniques are used to make chemical analyses of asbestos, and I am not going into any detail on the specific procedures used. Suffice it to say that the more common tests are for cations and water content. The elements most commonly tested for are magnesium, silicon, iron, aluminum, and calcium. A more complete analysis would include nickel, potassium, sodium, phosphorous, titanium, manganese, cobalt, mercury, copper, lead, and sulfur. All of these are generally reported as the more common oxide. Water can include both the absorbed water driven off at about 220F which is usually in the range of one to two per cent, and combined water which is driven off by ignition at 1800F and may include other volatiles or oxidation. Combined water will vary from 12 to 14% for chrysotile but is only about 2% for the amphiboles (blue, amosite, anthophyllite).

In addition to these determinations, it is very common to determine the total water-soluble content and the water-soluble chlorides. A 10-gram sample is soaked in 100 ml of distilled water for 24 hours at room temperature. An aliquot portion is evaporated and the dried residue is proportional to the content of water-soluble material. Another portion of the water filtrate is tested for chloride content. The Volhard method which precipitates the chloride with silver nitrate is generally used because it gives the accuracy desired in the parts per million range generally encountered. The test is carried out at a neutral pH using a potassium chromate indicator. It is accurate down to about 10 parts per million. Water solubles will generally be in the range of 0.10% to 0.35% while chlorides will vary from a trace to 0.20% (2000 ppm).

pH

Determinations of pH can be made by any standard method but a pH meter utilizing a standard glass and calomel electrode is a convenient technique. Special care must be taken in these measurements because a higher value will be obtained if the electrode tips are in the slurry than if they are in the supernatant liquid.

Values can range from 9.20 in the supernatant liquid to 10.33 in the slurry on the same sample.

Electrical Properties

Volume Resistivity

This test procedure follows the requirements given in ASTM D-257. Essentially it consists in compressing about 20 grams of asbestos at 260 psi in an insulated cylinder with a cross-sectional area of one square inch. The resistance of the asbestos plug is measured after one minute at 500 volts d.c. and is reported in megohm-inches. Tests are generally run after the asbestos has been conditioned under three different atmospheres. First the sample is dried for 16 hours at 230F and tested. The same sample is then conditioned for 72 hours at 75F and 50% relative humidity and tested. Finally, the same sample is tested after conditioning for 16 hours at 75F and 91% relative humidity. Our test laboratory is maintained at the second condition and a saturated sodium tartrate solution will give the third condition. Values for resistivity will range from about 500 for the best chrysotiles under the dry condition to less than 0.005 for a poor chrysotile at 91% humidity.

Magnetic Rating

This is an empirical number that relates the electromagnetic effect of an unknown sample of asbestos vs a standard sample. I will cover only the basic mechanism. Ten grams of asbestos are placed in a test tube in a coil which forms one arm of an inductance bridge. The other arm is a similar inductance coil and the rebalance required measures the magnetic rating.

This test measures the magnetic effect of iron compounds in the sample and depends on the permeability, size, shape, and orientation of the particles as well as the quantity. The procedure is given in ASTM D-1118. Magnetic ratings for asbestos will range from zero to as high as 4.6.

Conductance

This is a test that is used to give an indirect measure of the ionic water solubles in asbestos. A 50-gram sample of asbestos is extracted overnight with 500 ml of water at room temperature and the conductivity, or rather resistance, of the filtrate is measured. Conductance is reported in terms of micromhos/cm, and asbestos will give values in the range of 100 to 300 micromhos/cm.

Conductivities are often expressed in terms of equivalents of sodium chloride but this does not mean chlorides have to be present. Any ionizable salt would increase the conductivity and the value simply states that the same conductivity would be obtained if that quantity of sodium chloride were in the water. Equivalents of sodium chloride of about 0.05 to 0.14% correspond to conductances of 100 to 300 micromhos/cm.

References

1. The Properties of Asbestos.II.The Density and Structure of Chrysotile. F. L. Pundsack, J. of Physical Chemistry, 60, 361 (1956).

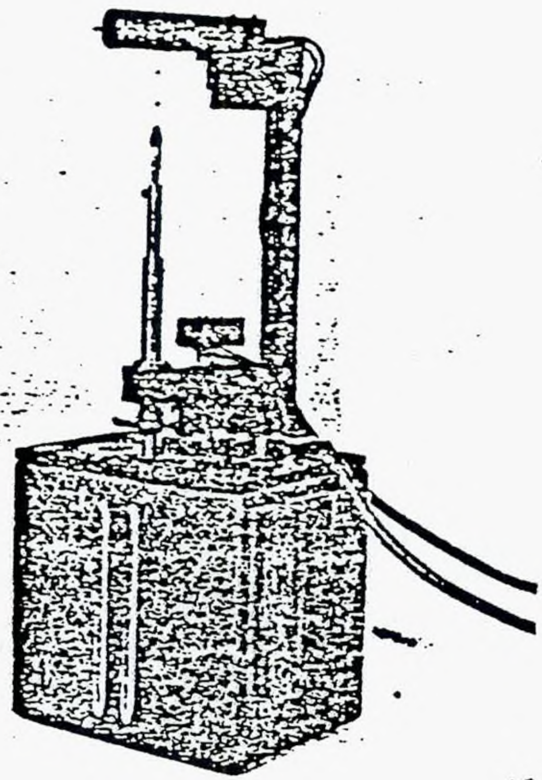

FIGURE 1. TENSILE TESTER

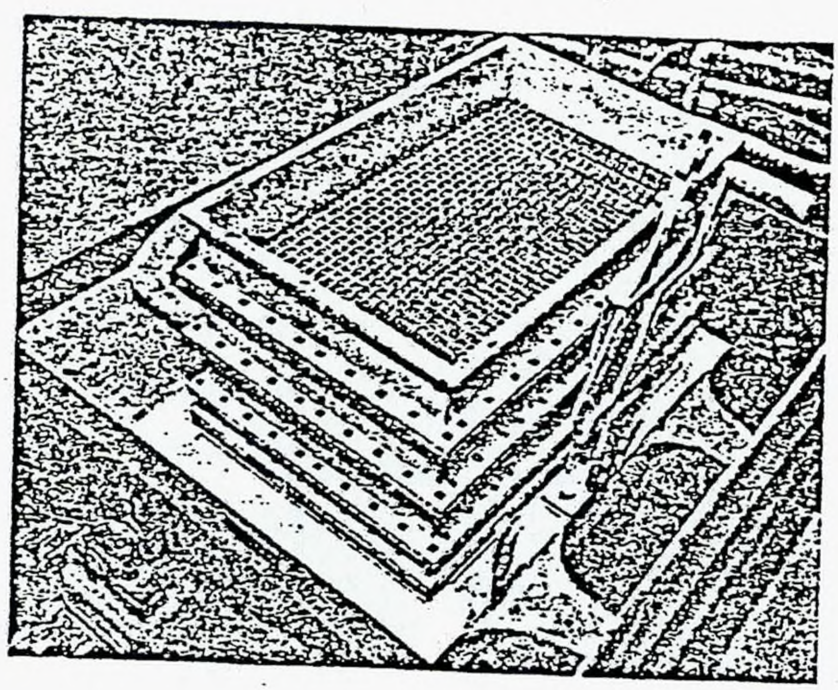

FIGURE 2. QUEBEC STANDARD TEST UNIT

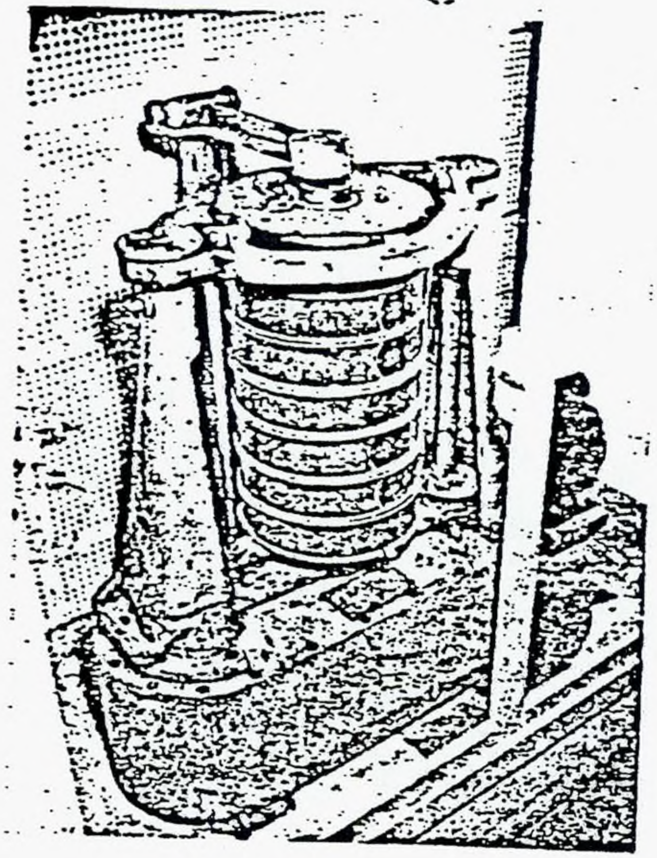

FIGURE 3. RO-TAP TEST UNIT

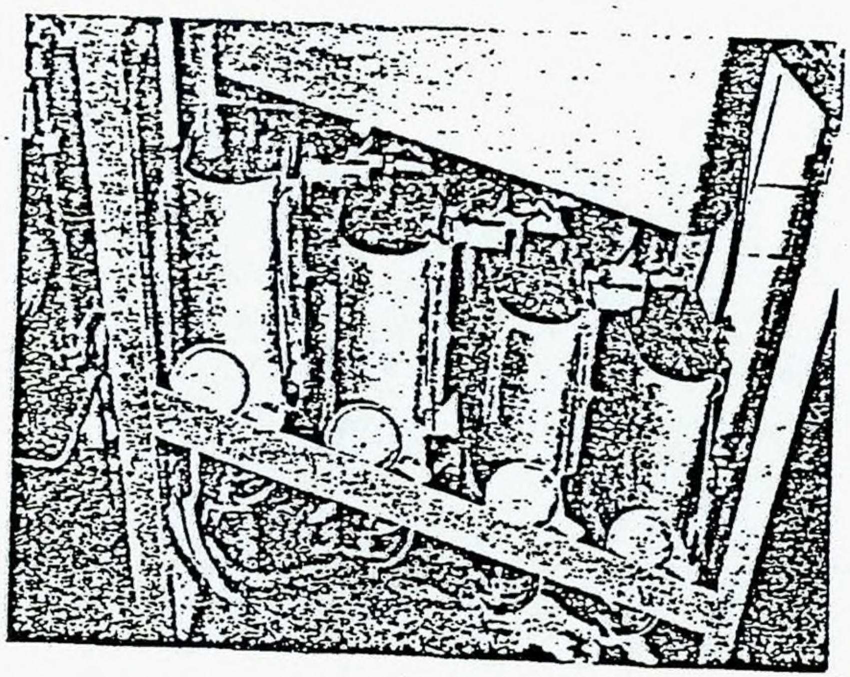

FIGURE 4. BAUER McNETT TEST UNIT

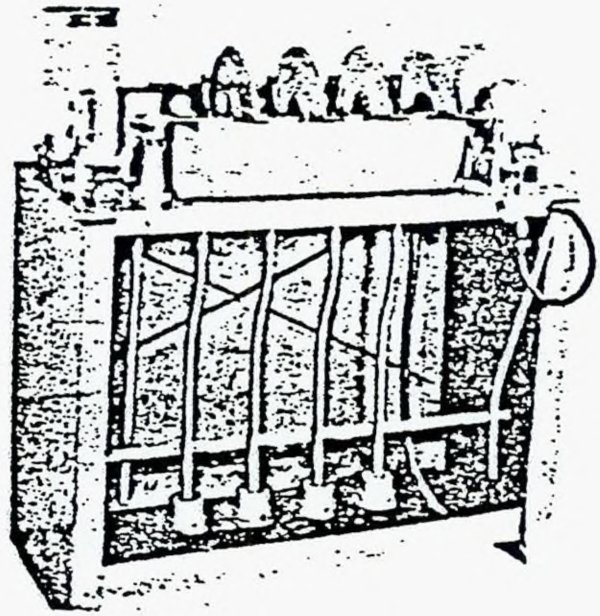

FIGURE 5. CLARK CLASSIFIER

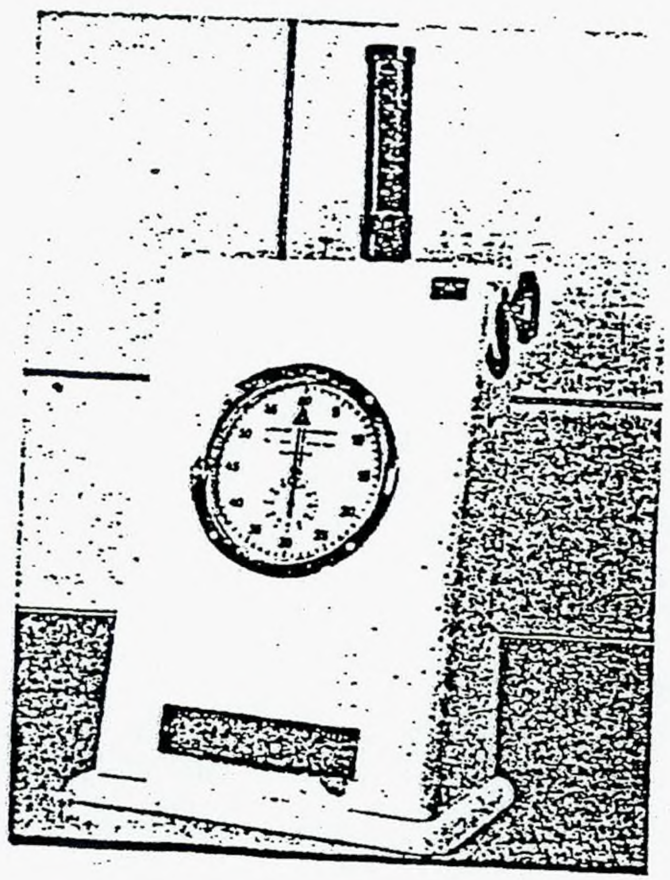

FIGURE 6. DYCKERHOFF TESTER

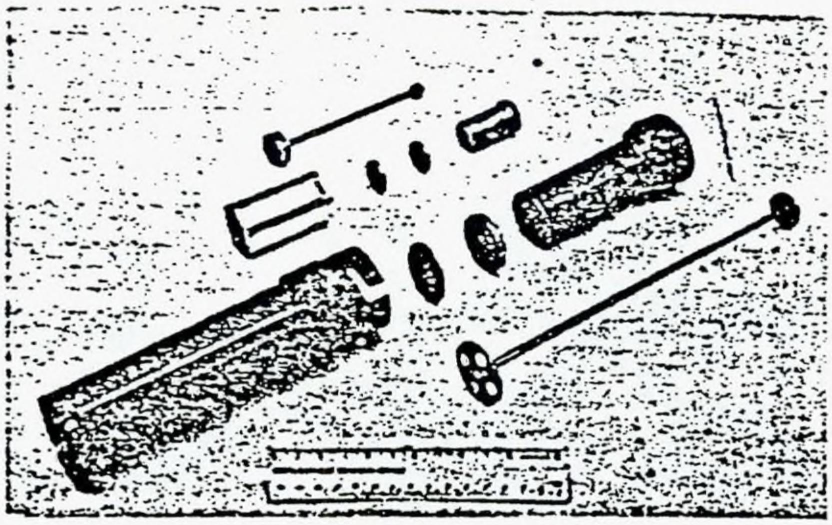

FIGURE 7. DYCKERHOFF SAMPLE CELL

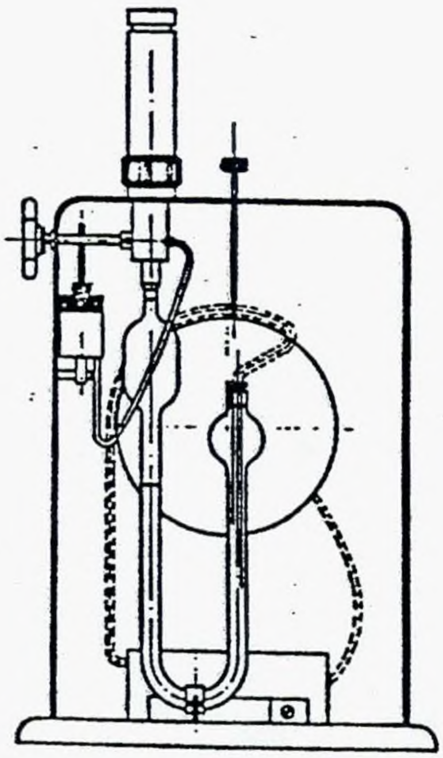

FIGURE 8. MECHANISM OF DYCKERHOFF TESTER

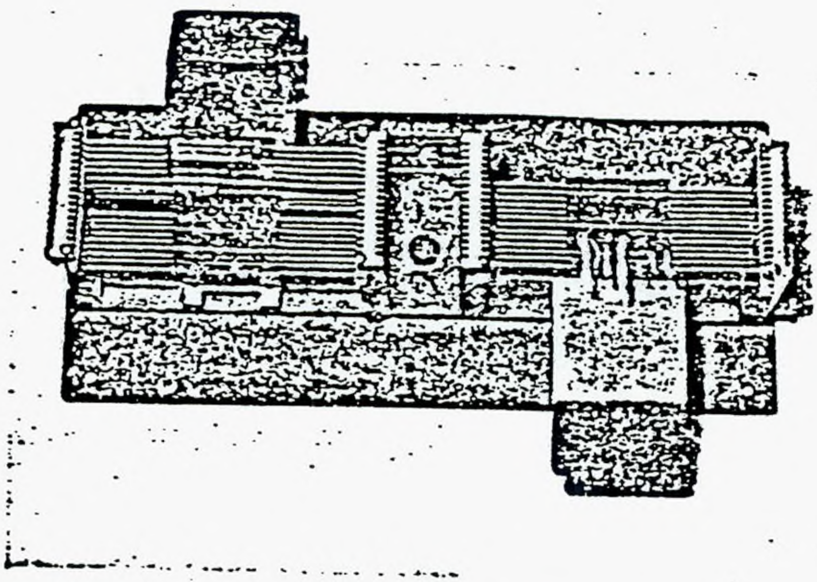

FIGURE 9. SUTER-WEBB TEST UNIT

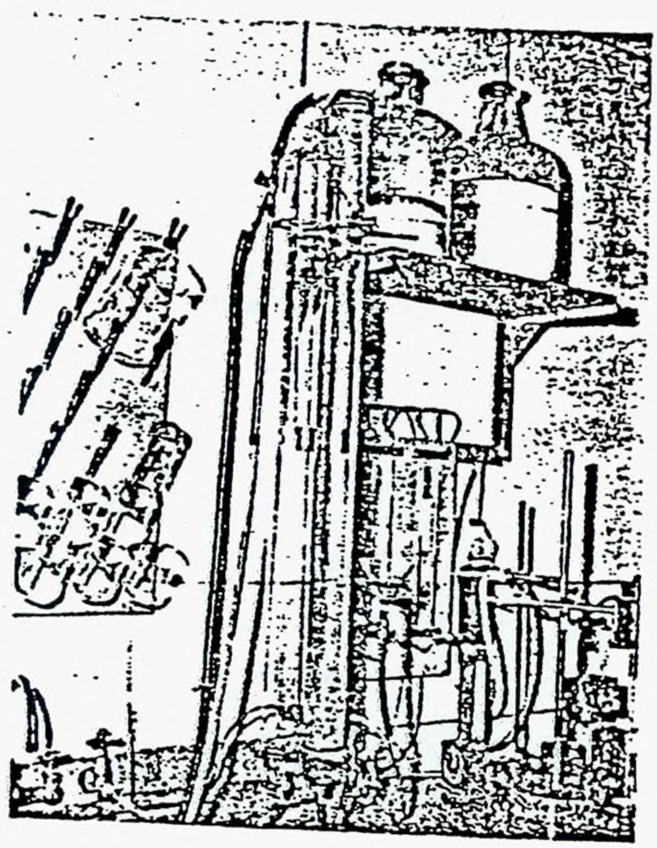

FIGURE 10. WATER ELUTRIATION TESTER