

MINUTES OF THE MEETING OF THE TECHNICAL COMMITTEE OF THE ASBESTOS TEXTILE  
INSTITUTE AT THE ESSEX HOUSE, NEW YORK, N.Y.  
ON MARCH 10, 1954

In Attendance:

AMERICAN ASBESTOS COMPANY  
 E. C. Cutler

UNION ASBESTOS & RUBBER COMPANY  
 A. W. Summers

RAYBESTOS-MANHATTAN, INC.  
 H. W. Oliver  
 Dr. H.S. Haier

SOUTHERN ASBESTOS COMPANY  
 J. D. McCluer, Chairman

KEASBEY & MATTISON COMPANY  
 R. L. Lanz  
 B. L. Carpenter  
 C. R. Frederick

JOHNS-MANVILLE CORP.  
 J. L. Tucker  
 R. Jackson  
 K. Q. Beyard

RUTGERS UNIVERSITY  
 H. C. Shaw

This meeting opened at 10:30 A.M. immediately following a previous full membership joint meeting of the Technical, Sales Promotion, and Air Hygiene Committees on the subject of fellowship projects. This previous meeting is covered in a separate report.

The Technical Committee meeting separately followed the Agenda as previously arranged.

Regarding Specifications, representatives from member companies met with Detroit Arsenal Representatives the previous day on the acceptance of revised form of MIL-C-10316. This meeting is reported separately.

Dr. Shaw presented his report on the conference he and Mr. Frederick had with Mr. Chilcote on Specification SS-C-466. On this, they were not willing to change the nomenclature for grades to conform to A.S.T.M. Classification due to the monumental amount of work to change their inventories and records. They wish to delete all Twill Cloths and add one Plain Cloth 22P18 Underwriters' Grade. Note these changes on the Specification Sheet attached.

On Specification MIL-I-3053A the Committee has not yet drafted formal revisions on this. Members are requested to make recommended changes and send to Dr. Shaw.

On Specification MIL-C-4117, this has been formally revised by the Committee but no contacts with the Agency yet. This comes under the authority of the Wright Patterson Air Base, Dayton, Ohio. It was agreed to send two members to make this contact, Dr. Shaw and Mr. Tucker.

Specification MIL-II-11199A has been formally revised but no contacts made. This one is under the Quarter Master, Philadelphia, Pa.

Discussion on wet versus dry weaving followed. A preliminary canvass yielded these definitions by various members. Mr. Cutler defines wet weaving as wet warp and wet filling. Mr. Tucker defines dry weaving as warp and filling

that have not been wet or dampened. The relative humidity may be from 25 to 90%. The yarns that were wet twisted or spun and dried before weaving would be dry weaving. Damp weaving is warp or filling yarns having any slight degree of moisture applied to them and woven while still so dampened. Wet weaving is when warp or filling is wet with considerable amount of water and woven while so wetted.

Mr. Oliver defines wet weaving as any amount of moisture added to warp or filling, although there are degrees of this from wet to damp to atomized yarns. Mr. Asten defines wet weaving as damp warp and wet filling.

Dr. Maier indicates that any wetting or dampening of the warp or filling constitutes wet weaving, but that the degree of wetness will be different according to the manner of applying the moisture and condition of the yarn.

Although the definitions are similar, no two are exactly alike and it was decided to make a quantitative of tests on samples of Cloth both dry, damp, and wet woven. To accomplish this each member is to send Dr. Shaw four consecutive lengths from any convenient roll of Plain Cloth as follows:

- Sample A - First 2 yards, Dry Woven.
- Sample B - Next 2 yards Damp Woven - Warp Dry - Filling Soaked.
- Sample C - Next 2 yards Damp Woven - Warp Wet - Filling Dry.
- Sample D - Next 2 yards Wet Woven - Warp Wet - Filling Soaked.

Dr. Shaw will make the following tests. Tensile, Abradoflex Rating, Porosity, Heat Ageing at 300°C for 1 hour. General appearance, Hand, and possibly Absorption.

On Braided Tubing the members were canvassed for ideas on Standard A.T.I. Style Numbers. Mr. Tucker suggested a styling which would indicate the wall thickness, the I. D., and the Ft./Lb., such as 1/32 wall x 1/64 I. D. x 150 Ft./lb. would be styled as 1/32 - 1/64 - 150. Mr. Cutler suggests a system such as for 1/32 wall x 7/32 I. D. using the digit 3 for 32 and this would be styled 1373. And for 1/16 wall x 5/16 I. D. use the digit 6 for 16 and this would be styled 1656. For 3/32 wall x 9/16 I. D., it would be 3396. Mr. Lanz suggests that the first digit indicate wall thickness in 64ths. Follow this with letter B to designate Braided Tubing. The next digit indicates the number of braids and the last one or two digits indicates the cut of the yarn. This 4B110 would indicate 1/16 wall, single layer made from 10 cut yarn. Also 2B114 would be 1/32 wall, single layer, and 14 cut yarn. Southern suggested using the first one or two digits to indicate wall thickness and the following one or more digits to indicate I. D. such as, 32316 for 1/32 wall and 3/16 I. D., and 332214 for 3/32 wall and 2-1/4 I. D. Members were requested to give this further study, after taking the subject up with their respective sales departments.

Following this Mr. Summers, Chairman of The Cloth Committee reported on the Round Robin Test on identical samples of 22P16, Grade AA. Copy of his report is attached. Such good agreement between companies resulted it was not considered of value to repeat this test. Instead a compilation of all standard styles of Metallic Cloth will be made toward preparing a standard A.T.I. list of Metallic Cloths. Members are requested to send to Mr. Summers a list of all their standard Metallic Cloths with all the construction data.

Mr. Frederick, Chairman of the Tape Committee is starting a compilation on Ft./Lb. and construction data on all Plain Tapes from .015" to 1/4". He has received partial information on 1/32 and 1/16 so far and requests that all members

send to him data on these two sizes in all widths including Ft./Lb. and construction, and how packaged. Values he has received so far on these two sizes on Ft./Lb. aligns closely to values recorded in the A.T.I. Handbook.

Mr. Oliver, Chairman of the Braided Tubing Committee reported on a Round Robin Test of two sizes of Tubing  $3/8 \times 1/16$  and  $7/8 \times 1/16$ . Identical samples of each size being sent to each member. See attached report.

Agreement between companies was considered very good. However, considerable discussion arose on the best method of measuring wall thickness. Experience in these tests have led to the belief that slitting open the braid and measuring the thickness with a dead weight cloth gauge is more accurate than measuring it on a mandrel. Members are requested to review the present method given in A.S.T.M. under D-354-41 and reword this method in terms of what he thinks would be the best method. Members were also requested to make recommendations on tolerances for wall thickness, I. D. and Ft./Lb.

There being no further business the meeting was adjourned.

J. D. McCluer

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## A. T. I. ROUND ROBIN TESTS ON ASBESTOS CLOTH

Tensile Strength - Before and After Heating

22P16 AA Grade 500°F. 25 Hrs.  
Warp Specimen Only

| COMPANY  | TENSILE        |                      |                   | OVEN                      |                  |                 | LABORATORY |                        |
|----------|----------------|----------------------|-------------------|---------------------------|------------------|-----------------|------------|------------------------|
|          | As Rec'd.      | After Heating        | Strength Retained | Per Cent Wt. Loss         | Asbestos Content | Sample Position | Air Cir.   | Relative Hum. Temp. of |
| A. T. I. | Ave.           | 71.53                | 65.2              | 9.08                      | 90.45            | H               | C          | 30 74                  |
|          | Max.           | 78.00                |                   |                           |                  |                 |            |                        |
|          | Min.           | 62.50                |                   |                           |                  |                 |            |                        |
| SOUTHERN | Ave.           | 70.25                | 71.70             | 9.45                      | 90.74            | V               | NC         | Before Heating 40. 77  |
|          | Max.           | 86.00                |                   |                           |                  |                 |            | After Heating 30 74    |
|          | Min.           | 62.00                |                   |                           |                  |                 |            |                        |
| R. & M.  | Ave.           | 68.10                | 72.70             | 4.70                      | 92.0             | H               | C          | Before Heating 30 67   |
|          | Max.           | 78.00                |                   |                           |                  |                 |            | After Heating 33 66    |
|          | Min.           | 64.00                |                   |                           |                  |                 |            |                        |
| J. H.    | Ave.           | 65.60                | 62.2              | 8.20                      | 89.6             | H               | NC         | -- --                  |
|          | Max.           | 62.00                |                   |                           |                  |                 |            |                        |
|          | Min.           | 56.00                |                   |                           |                  |                 |            |                        |
| K. & M.  | Ave.           | 63.90                | 63.0              | 8.20                      | 90.3             | H               | C          | 40 78                  |
|          | Max.           | 71.00                |                   |                           |                  |                 |            |                        |
|          | Min.           | 51.00                |                   |                           |                  |                 |            |                        |
| UNION    | Grand Ave.     | 67.99                | 66.90             | 7.90                      | 90.61            |                 |            |                        |
|          | Max. Dev. from |                      |                   |                           |                  |                 |            |                        |
|          | Average %      | 5.29                 | 7.10              | 40.73                     | 1.11             |                 |            |                        |
|          |                | H - Horizontal       |                   | V - Vertical              |                  |                 |            |                        |
|          |                | C - Circulating Type |                   | NC - Non-Circulating Type |                  |                 |            |                        |

A. T. Summers  
Union Asbestos & Rubber Co.

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ROUND ROBIN TEST ON SAMPLES C RAIDED ASBESTOS TUBING

ATI-97

Sample 3/8" x 1/16" . UNARCO

| Inside   |          | Hand Mic.       |                                  | Pedestal Mic.    |                | 8 oz. Wt.         |  |
|----------|----------|-----------------|----------------------------------|------------------|----------------|-------------------|--|
| Company  | Diameter | Flat-36" on Rod | Wt./1 Yd. Flat                   | Wall Thickness   | Wall Thickness | 36" - Flat Length |  |
| J/M      | .375     | 36-3/4"         | 1080 Grs.                        | .075-.105        | .105-.106      | 36-3/4"           |  |
| R/M      | .375     | 35.5            | 1027 Grs.                        | .198(Both Walls) | None           | 36-5/8"           |  |
| American | .375     | None            | Wt. of 24" on                    | Machinist Mic.   | Machinist Mic. | None              |  |
| Asbestos |          |                 | Mandrel 670 grs. Calipers-7/32". | Calipers 1/2"    | Wide metal     |                   |  |
|          |          |                 | or 1005 grs./yd. Anvile .104     |                  | strips under   |                   |  |
|          |          |                 |                                  | anvile .106      |                |                   |  |
| K/M      | .375     | None            | 1023 Grs.                        | Machinist        | None           | None              |  |
|          | Loose    |                 |                                  | Caliper .115"    |                |                   |  |

Sample 7/8" x 1/16" . J/M

|          |            |        |                   |                  |               |         |
|----------|------------|--------|-------------------|------------------|---------------|---------|
| J/M      | .875       | 29"    | 1153 Grs.         | .075-.090        | .065"-.067"   | 36-3/4" |
| R/M      | .875       | 30.25" | 1249 Grs.         | .129(Both Walls) | None          | 36-5/8" |
| American | .875       | None   | Wt. of 24" on     | Same as above    | Same as above | None    |
| Asbestos |            |        | mandrel 1011 grs. | .0806"           | .0792         |         |
|          |            |        | or 1516 grs./yd.  |                  |               |         |
| K/M      | .875       | None   | 1235 grs.         | .085"            | None          | None    |
|          | very tight |        |                   |                  |               |         |

REMARKS:

J/M:

\* Braid was slit open. to obtain measurement.

Note: The 1/16" x 7/8" braid, when suspended without weighing, stretched from 36" to 36-1/4".

AMERICAN ASBESTOS TEXTILE CORPORATION:

Factor - 3/8" x 1/16" Mandrel Length = .969 Factor - 7/8" x 1/16" Mandrel Length = .805  
Weighted Length Weighted Length

K/M:

Wall Thickness Test Method:

Outside measurements were made while the sample was on the mandrel, at least three locations within the marked off two foot section, using a machinist Vernier Caliper.

With the sample between microscope slides, (contact in the long direction) close the caliper jaws to make good contact with the slides, but not tight enough to compress the walls of the tubing. The outside diameter is taken in millimeters reading to the closest one tenth, and converted to inches and decimal fractions, making allowance for the thickness of the two slides.

Outside diameter - Diameter of Mandrel = Wall Thickness

Marion Oliver  
Raybestos Manhattan, Inc.

| 36"-Flat Length | Yds./lb. |         | Yds./lb.  |          | Yds./lb.   |          | Yds./lb. |           | Carriers on Braider | Ends/Carrier | Picks/Inch | Ply of Yarn |
|-----------------|----------|---------|-----------|----------|------------|----------|----------|-----------|---------------------|--------------|------------|-------------|
|                 | Flat     | On Rod. | 8 oz. wt. | Yds./lb. | 16 oz. wt. | Yds./lb. | On Rod.  | 8 oz. wt. |                     |              |            |             |
| 37-1/4"         | 6.4      | 6.5     | 6.5       | 6.62     |            |          |          |           | 24                  | 2            | 6          | 2           |
| 37-1/8"         | 6.8      | 6.7     | 6.9       | 7.03     |            |          |          |           | 24                  | 2            | 5.4        | 2           |
| 37-1/8"         | 7.0      | 6.9     | None      | 7.16     |            |          |          |           | 24                  | 2            | 5.2        | None        |
| None            | 6.84     | None    | 6.86      | 6.88     |            |          |          |           | None                | None         | None       | None        |
| 36-3/4"         | 6.07     | 4.86    | 6.18      | 6.18     |            |          |          |           | 32                  | 2            | 5          | 2           |
| 37-1/4"         | 5.6      | 4.66    | 5.7       | 5.8      |            |          |          |           | 32                  | 2            | 5.2        | 2           |
| 44-5/8"         | 5.56     | 4.6     | None      | 5.7      |            |          |          |           | 32                  | 2            | 5.2        | 2           |
| None            | 5.66     | None    | 5.7       | 5.73     |            |          |          |           | None                | None         | None       | None        |

MS 004043

MT-003449

Report of Sales Promotion Committee

By  
A. E. Whitfield

ATI-97

March 10, 1954

1. The Secretary has received several requests from book stores to purchase the "Handbook of Asbestos Textiles" for resale. It has been determined by the Sales Promotion Committee that because of our obligation to A.S.T.I. we could not approve distribution of this character. It is recommended that inquirers be advised that these books are not for sale and that, if they will turn over to our Secretary their inquirers' names on their company letterhead, we will send each one a copy of the "Handbook of Asbestos Textiles" without charge.
2. The "Asbestos Magazine" in Philadelphia will, upon authorized notification by the Secretary, indicate in their list of books available that the "Handbook of Asbestos Textiles" may now be procured by submitting a request on company letterhead. The publication of our press release in an early issue of "Asbestos" has been authorized.
3. The Secretary reports that a copy of the "Handbook" has been sent to the Textile Institute, Manchester, England, and that a review of our publication will be carried in the Journal of that Institute which has a circulation to 7000 members.
4. The Secretary advised that there are approximately 5,000 copies of the "Story of Asbestos Textiles" still available and asked instructions as to their distribution.
5. The Secretary has been advised regarding a request by the Director of Industrial Arts Division of the State University of New York for 200 copies of literature on asbestos textiles. It has been suggested that the Institute send Dr. Kenneth W. Brown 200 copies of the "Story of Asbestos Textiles".
6. Concerning the visual aid display cases, it is our understanding that there is one on the way to England, and one each at the University of Washington, Rutgers University, Purdue University, Philadelphia Textile School, University of California and one at the Johnson's Company Mines in Thetford, Canada, which will also be exhibited at the Industrial Fair in Toronto.
7. In regard to correspondence by the Secretary with members of Technical and Sales Promotion Committees in reference to Federal Specification revisions, it was the decision of the Sales Promotion Committee that the Technical Committee should assume the responsibility of presenting the suggested revisions to the Government Agencies involved and not the Sales Promotion Committee.
8. During the course of the Sales Promotion Committee meeting there was a detailed discussion concerning the necessity for publicizing the availability of asbestos textile fibers. Mr. J. A. Bettis presented a detailed report in this regard and will again discuss the subject in the General meeting. (Report attached).

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9. Regarding the request that was received from Clancy Company, Syracuse, concerning specifications for asbestos cloth for theatre curtains, it was recommended that they be advised that, inasmuch as many of the states and cities in the country have their own codes covering requirements of this nature, we would be obligated to furnish cloth in accordance with those specifications.

Mr. Harris reported earlier to the Sales Promotion Committee regarding conversations with officials at Clancy Company in connection with the theatre curtain market. A copy of this report is attached as a part of the minutes of the General meeting.

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REPORTED BY:  
J. L. Tucker  
G. J. Harris

March 11, 1954

COMMITTEE REPORT  
THEATRE CURTAIN SALES

In October 1953 J. R. Clancy, Inc., commented on our "Handbook" and thought the Institute should promote a specification for Asbestos Cloth to be used for theatre curtains. The subject was studied and inquiry made as to the potential in this market.

Mr. C. E. Tompkins of the Clancy Company assayed the market and estimated that 115 theatre curtains are made of asbestos cloth per year, but that it would be possible to make 300 if the industry were to make a drive for this type business. If Underwriters were sold the value of asbestos curtains, and if they were pushed in clubs, schools, studios and movie houses he estimated 900 could be sold a year.

A check on the cloth producers, for this type business, did not show there was the amount of business estimated by Mr. Tompkins.

The average size of a curtain is from 55 feet to 60 feet long and 30 feet high. One curtain was made in 1938 and placed at Purdue University. This was a two faced curtain weighing 19-3/4 tons and of the "steel frame" type. It is believed this curtain is the largest ever produced.

There are five types of curtains. Steel Frame, Trip, Braille, Side Pull and Roll Cut. The last two are not good for fire protection because they cannot be well guided at the side. The first three have been supplied with various degrees of success and made of asbestos cloth.

The National Bureau of Standards conducted a series of tests in 1933 on various types of curtains for theatre use. A grade AAA wire inserted cloth produced the best results for a fabric type curtain. Various large cities have established codes covering curtains and a study of these codes show a wide variance in construction. Where asbestos cloth is specified the grade may run from Underwriters to AAA, and usually the cloth is approximately 3.00 pounds to the square yard and wire inserted. The city of Chicago stipulates that where the seating capacity of a theatre is over 500 a steel curtain must be used. Some codes only mention a "flame-proofed" fabric and do not require asbestos cloth.

It is believed that J. R. Clancy wants the Institute to recommend a construction, and to back their recommendation with technical facts, and to promote the use of asbestos cloth for proscenium curtains with Underwriters. This subject was taken under advisement at the Sales Promotion Committee meeting on March 10, 1953 and their conclusion is as follows: In as much as most major cities and states have a building code setting forth installation and specifications for proscenium curtains, we recommend that established codes be followed. To instigate research and development leading to revision, or change, of existing codes would be extremely expensive in time and money when balanced against potential.

During recent months Mr. Maurice Sallee, Societe Francaise de l'Amiante, furnished the Institute with samples of materials manufactured and used quite

extensively in France and in other European countries. These materials are non-metallic and are in a variety of weaves and colors. The application would appear to be more directly associated with drapery installations and as fireproof interior decorations rather than strictly in the field of theatre curtains. These applications as developed and promoted by our Associate Member are of interest and serve to show a possible market if properly exploited, however, it is felt that this applications envisions a distinctly different set of conditions and requirements than are embodied in considerations for theatre curtains.

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REPORT OF THE TECHNICAL COMMITTEE OF THE ASBESTOS TEXTILE INSTITUTE  
For March 11, 1954 General Meeting  
Essex House, New York, N. Y.

By: J. D. McCluer, Chairman of Technical Committee

The Technical Committee had its first meeting of the year on March 10th, 1954.

Just prior to the meeting of the Technical Committee, full membership of the Technical, Sales Promotion, and Air Hygiene Committees met with the sub-committee on Fellowship Projects to discuss a proposed agenda of projects recommended by the Fellowship sub-committee. This sub-committee was composed of J. A. Bettes, Chairman, C. R. Frederick, and J. W. Weber. Mr. Bettes will give the report on this meeting.

The first item of business was to review the status of the several Military and Federal Specifications now in process of revision and acceptance by the proper Military or Federal Agencies. Mention should be made here of the meeting on the preceding day, Tuesday, March 9th, at this same place of representatives from member companies with two of the personnel from the Detroit Arsenal which is a segment of the Ordinance Department. These two men were Mr. John Reynar and Mr. Dale C. Johnson and they had authority to voice tentative approval on revisions on Military Specification MIL-C-10316. On changing the nomenclature of classification of grades, they were not willing to change from the existing form to that conforming to A.S.T.M. This proposal was rejected on the grounds that these materials are stocked and inventoried under the system set forth in the existing specification and to endeavor to change would be a monumental task.

Although they would not accept this change our point was well taken and they did consent to allowing an insertion toward the end of the Specification under the heading: "Industrial Grades. The Asbestos Industry supplied Asbestos Textiles in conformance with A.S.T.M. Classification." After that the A.S.T.M. Classification of grades follows. No opposition was offered to the balance of the revisions except for minor changes in wording. Their department on specifications is to make a thorough study of our revision including tensiles and will make a report to the Institute in the near future which may be approximately two months. It is encouraging that through the combined effort of the Sales Promotion and Technical Committees that a start has been made and there is indication we will get partial acceptance of our revised form on this specification. We feel that even partial acceptance on one specification may lead to partial acceptance on some of the other revised specifications which come under the jurisdiction of different agencies. Indications are that the various agencies are willing and interested in working with us and it would seem proper that we should continue our effort so as not to lose what we have gained.

In this same connection it should be reported here regarding the conference which Dr. Shaw and Mr. Frederick had with Mr. J. H. Chilcote of the Bureau of Ships - Navy Building in Washington, D. C., on Federal Specification SS-C-466. Results of this conference follows: Regarding changing nomenclature of grades to conform to A.S.T.M. Classification, this was rejected on the same ground as mentioned above in connection with MIL-C-10316. Aside from this rejection, the other exceptions taken to our revisions were

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minor. They wish to delete the broken twill cloths and add one of our standard cloths (22P18) not previously in the specification. They will accept in the glass cloth (82P10G) glass yarn 150-2/2 in place of the originally specified 225-3/2. This will be favorable to industry since the former is easier to procure and has about the same strength and other characteristics.

With these exceptions, the revisions as proposed have apparently been accepted by Mr. Chilcote and he has indicated he will offer them to the authorities in charge for inclusion in the revised specification which is to be developed in the near future.

On Specification MIL-C-4117 dealing with Cloths and Tapes this comes under the authority of Wright Patterson Air Base at Dayton, Ohio. At our meeting it was agreed that two representative Dr. Shaw and Mr. Tucker, make this contact in the near future.

Following this was a thorough discussion of wet versus dry weaving. The membership had previously been canvassed to get the various definitions of what constituted Dry, Damp and Wet weaving. The answers were various and no two were exactly alike.

Consequently it was decided that discussion would not settle the issue of what constituted each kind of weaving and that some quantitative method of measuring would have to be resorted to. It was agreed that each member send to Dr. Shaw four consecutive lengths of Cloth from a given roll of any convenient cloth, each consecutive length to be 2 yards long. The first would be labeled A and would be dry woven. The next would be slightly dampened by soaking the filling but with dry warp and labeled B. The next labeled C would be dry filling and wet warp, and the fourth labeled D would be filling soaked and wet warp. Dr. Shaw will make all tests on the four segments from each member to get relative characteristics of Cloth so woven. Tests would include tensile. Abradoflex rating, porosity, heat ageing at 300°C for 1 hour, and general appearance, and hand of the Cloth, and possibly absorption test.

Following, the committee chairmen on Cloth, Tape and Braided Tubing gave their individual reports. Mr. Summers, Chairman of the Cloth Committee showed that unusually good agreement resulted on the Round Robin test on identical samples of 22P16 Grade AA Cloth sent to each member, both on Before Heat and After Heat tensile. As well as good agreement on per cent weight loss on heat, ageing, and asbestos content. The work on Cloth is to be followed by completing the A.T.I. list of standard metallic cloths.

Mr. Frederick, Chairman of the Tape Committee is initiating a new project and is requesting ft./lb. and construction data on the standard plain Tapes which will eventually include tape from .015" to 1/4".

Mr. Oliver, Chairman of the Braided Tubing Committee reported results of a Round Robin test on two identical samples sent to each member. Under the various methods of testing ft./lb. there was very good agreement between individual companies. The best method of measuring wall thickness was discussed. Each member was requested to give consideration to the method of measuring wall thickness as given in A.S.T.M., and re-work this method in terms of what he thinks would be the best method. Experience gained within

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this committee has shown that possibly the A.S.T.M. method can be vastly improved. Members were requested to make recommendations on tolerances on wall thickness, I. D. and ft./lb.

On A.T.I. style numbers for Braided Tubing, a number of companies have suggested schemes for this. Committee members are requested to take these various suggestions as well as other suggestions up with their respective Sales Departments in a further effort to arrive at a standard scheme for styling the various sizes and submit their recommendation.

Messrs. Summers, Frederick and Oliver are to be commended on the excellent work they have done in their respective committees.

Regarding specification MIL-I-3053A, which has not yet been revised by the Technical Committee, it was agreed that all members after reviewing this with their respective Production and Sales Departments, and send to Dr. Shaw their recommended revisions.

A project to investigate the potential demand for, as well as kind of, cloth suitable for theatre curtains was given the Technical Committee at the last meeting. Mr. Tucker from the Technical and Mr. Harris from the Sales Promotion Committees were appointed to make an investigation on this. Mr. Harris will make the detailed report on this committee's findings.

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FELLOWSHIP REPORT

MYRIL C. SHAW  
RESEARCH FELLOW  
ASBESTOS TEXTILE INSTITUTE

NEW JERSEY CERAMIC RESEARCH STATION  
RUTGERS UNIVERSITY  
NEW BRUNSWICK, NEW JERSEY

REPORT NO. 28

March 11, 1954

**MS 004051**

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## Introduction

The Fellowship work during recent months has been devoted in large part to the consideration of the problem -- "The Determination of the Significance of the Iron Content of Asbestos". Much interest has been evidenced in this problem by the members of the Institute as well as the industry at large, particularly as represented by the A.S.T.M. membership. The importance of the subject is further emphasized by the recent action taken by the Fellowship Project Committee which placed the problem first on the list of recommended Fellowship projects.

The report herewith attached presents an account of our most recent endeavors in this investigation and serves to establish more specifically the limits which must be defined in resolving the problem. While definite conclusions are not at this point possible, it is felt that we now have established sufficient pertinent information which will serve to direct our future investigations and thinking along those lines that will be most fruitful and will eventually permit a satisfactory solution.

In addition to the above noted work, attention has been devoted to the continuation of the studies related to the determination of the elevated temperature-abrasion resistance characteristics of asbestos textiles. Some questions have been raised regarding the usefulness of such information as it might be related to the entire field of asbestos textiles and it has been recommended that perhaps such work should be confined to those textiles that may be subjected to the conditions which such a test will simulate. The selection of the proper materials for inclusion in this work has therefore posed a problem, the solution of which rests with the Technical and Sales Promotion Committees whose members are in a position to indicate those cloths that should be here tested. Recommendations in this regard are awaited.

During the past quarter, upon instructions from the Technical Committee, members of that committee were furnished forty warp-grab samples of a Grade A, 1.30 $\frac{1}{2}$  cloth for round-robin tests at an elevated temperature of 500°F. The results of these tests, as obtained by several of the members, are summarized in an attached report.

During the past quarter the Fellowship program has been under consideration by the Fellowship Project Committee and a new project list has been drafted for presentation at this meeting. The proposed list includes a number of projects which are quite diversified in character and would seem to offer a well-rounded program of investigations which should be of interest to most members of the Institute. However, there are perhaps, problems in addition to those listed, which it may be felt by some members should receive some attention by the Fellow and we trust that everyone will feel free to offer suggestions in this regard, at any time. Such suggestions will be referred to the Project Committee and will be acted upon by that group.

Examples of problems that have been addressed to our attention from time to time but which are not included in the present proposals include: 1) Aluminum clad asbestos textiles. What are the actual heat reflective properties of such materials and how does the vapor coated material compare with foil coated cloth in regard to its several unique characteristics? 2) What unique properties may be imparted to an asbestos textile which is constructed with yarn of one grade in the fill direction and a higher or lower grade yarn in the warp direction, 3) Is it possible and economically feasible to treat or process wet woven textiles so that the impregnation and lamination characteristics

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will be as good as dry woven materials, and 4) a problem which in its entirety is perhaps too great an undertaking for Fellowship consideration but which might be here given some attention, relates to the opening and fiberizing of asbestos.

These are but a few examples of some of the problems with which we are confronted, from time to time, however, interest in them has apparently been insufficient to warrant their inclusion in the Fellowship program, to date. There are, no doubt, other problems of equal or perhaps more immediate interest which should be addressed to our attention and we will be pleased to undertake any investigation which meets with the approval of the committee concerned with the establishment of the Fellowship program.

We welcome the opportunity extended to us to engage in the program of work as here proposed and will exert every effort to carry out the assignments in a manner that will provide practical and useful information and trust that it may be possible to promote notable technological advancements through these endeavors.

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## The Significance of the Iron Content in Chrysotile Asbestos

## Introduction

The iron content of chrysotile asbestos may be expressed in a number of different ways, some of which are factual and as such serve to reveal the over-all characteristics of an asbestos fiber so contaminated while other expressions are mere indications of chemical relationships which are possible and offer a convenient means of representing the presence of some compounds of iron but which do not necessarily give any indication as to the true identity of the compound or the properties which may be imparted as a result of its presence.

The varieties of iron oxide which occur most frequently in nature are  $\text{Fe}_2\text{O}_3$ , ferric oxide, and  $\text{Fe}_3\text{O}_4$ , ferroso-ferric oxide, the latter being mineralogically identified as magnetite. The element, Fe, is rarely found in nature, as such, due to its readily oxidizable character and likewise,  $\text{FeO}$  is a rarity in nature, usually being the product of man's efforts to produce such a compound or occurring as a by-product of a metallurgical operation.

For all practical purposes, the only iron compounds the manufacturers of asbestos products are directly concerned with are  $\text{Fe}_2\text{O}_3$ ,  $\text{Fe}_3\text{O}_4$ , the silicates of iron and perhaps some varieties of the hydrated iron oxide minerals. Of these, only  $\text{Fe}_3\text{O}_4$ , has any marked influence on the electrical properties of products containing such impurities.

However, the chemist or the analyst who is confronted with the problem of establishing the chemical constitution of an asbestos fiber, the true relationship of the individual combinations of the several elements contained is not important and is often sacrificed for the sake of simplicity of expression. For example, a general chemical analysis of chrysotile is usually expressed as follows:

|                         |            |
|-------------------------|------------|
| $\text{SiO}_2$          | 37-44%     |
| $\text{MgO}$            | 39-44%     |
| $\text{FeO}$            | 0.0-6.0%   |
| $\text{Fe}_2\text{O}_3$ | 0.1-5.0%   |
| $\text{Al}_2\text{O}_3$ | 0.2-1.5%   |
| $\text{H}_2\text{O}$    | 12.0-15.0% |
| $\text{CaO}$            | Tr.-5.0%   |

Actually, the silica is not present as so much free silica nor is the  $\text{MgO}$  present, as such, in the amount indicated, these two compounds being combined with the water to yield the structure  $(\text{OH})_6\text{Mg}_6\text{Si}_4\text{O}_{11}\cdot\text{H}_2\text{O}$ , which is the mineral that actually exists. Likewise, it is very unlikely that the iron is actually found to exist in the mineral as  $\text{FeO}$  but is so represented to indicate that an equivalent amount of divalent Fe is found to be present and, in the same manner, the identification of  $\text{Fe}_2\text{O}_3$ , is given to indicate the presence of an equivalent of trivalent iron in the amount established by an  $\text{Fe}_2\text{O}_3$  relationship.

$\text{Fe}_3\text{O}_4$  is considered to contain both divalent and trivalent iron with a ratio of one-third divalent to two-thirds trivalent being present. Therefore, in a proper analysis of the iron content of these materials with a view toward the determination of the magnetic iron proportions, the divalent iron, reported as  $\text{FeO}$  and the trivalent iron, reported as  $\text{Fe}_2\text{O}_3$ , should be considered in the relationship with respect to the probability of an ideal  $\text{Fe}_3\text{O}_4$  composition. It

may be considered likely that in asbestos most, if not all, of the divalent iron reported as  $\text{FeO}$ , exists as a constituent of magnetite. The trivalent iron, reported as  $\text{Fe}_2\text{O}_3$ , may be a combination of the iron in the magnetite and in a residual amount of  $\text{Fe}_2\text{O}_3$ . If a chemical analysis were to reveal a total absence of divalent iron it would be reasonable to expect that no magnetite would be present. However, in an analysis which showed 1%  $\text{FeO}$ , it would likewise be reasonable to expect, theoretically, that 3.22% of magnetite,  $\text{Fe}_3\text{O}_4$ , would be present.

It has been our purpose in this discussion to point out the significance of a proper and accurate understanding regarding the state of the iron which actually exists in the materials under investigation. An analysis report wherein the Fe is reported simply as total iron, without respect as to the state or valence, means nothing. Likewise, to present the same information in terms of  $\text{FeO}$  or  $\text{Fe}_2\text{O}_3$  is equally useless if these figures are mere calculations based upon the total Fe content without due respect to state of the Fe.

In those asbestos products, such as cloth, lap, roving and paper, which are intended for use as electrical insulators, the presence of  $\text{Fe}_3\text{O}_4$  is objectionable since such particles are electrical conductors and may establish points of electrical weakness in materials wherein they are found. The remaining varieties of iron bearing compounds mentioned earlier exert only minor degrading characteristics as far as electrical properties are concerned but do, on occasion, influence the color differences which may occur between the several varieties of chrysotile found throughout the world.

Perhaps the most striking failure of a chemical analysis to accurately portray the presence of and the qualities to be imparted by,  $\text{Fe}_3\text{O}_4$ , in particular, and the other varieties in general, is its inability to take into account the factor of grain size. The grain size and distribution of  $\text{Fe}_3\text{O}_4$  are, in many cases, as important as the amount present. A minority of large grains of these impurities, well dispersed throughout an asbestos product, can prove far more troublesome than the same amount of extremely fine grained material.

A truly qualitative determination of the compounds here under consideration for purposes of establishing the electrical properties of the whole material of which it is a part must necessarily provide information related to the amount and grain sizes present as well as the true chemical identity of the materials.

#### Review of Previous Reports

On previous occasions, the results of earlier work by the A.T.I. Fellow in connection with this problem have been presented, however, in order to bring this discussion up to date, it may be well to review some of these observations at this time.

Method of Determining Magnetic Iron Content. Various methods and devices for determining the relative magnetic iron content of asbestos have been investigated and the results indicated quite clearly that, of the methods pursued, the Mapes Analyzer method provided the most significant and reproducible information, providing the proper techniques were adopted in making such determinations. However, it was also established that the results of such tests must be given proper interpretations if the information is to serve any useful purpose. The grain sizes of the magnetite inclusions and the orientation of the grains,

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influence the results to a degree that tends to defy correlation. The relationship between chemical analyses for total iron and magnetic ratings, as determined on the analyzer, are, as a rule, quite remote.

The Hapes Analyzer does, however, serve a useful purpose in providing rough approximations of the magnetic iron content of a given material and when the results so obtained are judiciously evaluated, in the light of other contributing factors, information of significant value can be ascertained.

The instrument as set forth in A.S.T.M., D1118-50T is a satisfactory unit and if the details specified for its construction are closely followed, it should well serve as a universally acceptable tool. However, the testing technique and procedure now advanced for conducting the tests are not in sufficient detail to permit sufficiently accurate or reproduceable results to be obtained. Attention in this latter regard will be necessary in order to increase the usefulness of the test.

Effect of Grain Size. In an effort to establish the significance of grain size on the magnetic properties of a material, several investigations were pursued. It is well known that the magnetic iron content of chrysotile may occur as sizable pieces, with needles  $\frac{1}{4}$ " long and longer occasionally being observed. On the other hand, much of the magnetite is reduced to sub-macroscopic and microscopic proportions during mining and milling and as such is dispersed throughout a given batch of fiber. Unfortunately, the magnetite impurities usually occur between these two extremes and any determination of content of such materials must, of necessity, be taken as a mean or average of this distribution.

In order to substantiate the belief that grain size does markedly influence magnetic properties, a sample of known magnetic material was fractionated into four divisions of grain size and 0.5 grams of each fraction was thoroughly distributed in equal amounts of a known inert material, ZnO. Magnetic rating determinations were made on each sample and the results of this series of tests are tabulated as follows:

Table I

|                               |         |
|-------------------------------|---------|
| On 35 mesh.....               | 4.40 IR |
| Thru 35 mesh on 80 mesh.....  | 3.70 "  |
| Thru 80 mesh on 200 mesh..... | 3.50 "  |
| Thru 200 mesh.....            | 3.05 "  |

These results clearly demonstrate how influential the grain size of magnetic particles may be in evaluating the properties of materials containing such impurities.

A further demonstration of the significance of grain size to producers of asbestos textiles was demonstrated through a cursory study designed to ascertain the effect of fiber processing on the magnetic content. In this work, fibers from several different mines and in several different grades from the same mine, were studied and the results are set forth in Table II.

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Table II

|                | Millivolts          |        |              |
|----------------|---------------------|--------|--------------|
|                | <u>Carded Fiber</u> |        | <u>Waste</u> |
|                | A                   | B      | C            |
| Johnson #1     | 6.55                | 30.0   | 37.5         |
| Johnson 3K     | 4.80                | 20.20  | 25.00        |
| Johnson 3R     | 4.80                | 11.80  | 18.80        |
| Bell #1        | 11.75               | 25.00  | 23.25        |
| Bell #2        | 7.25                | 23.90  | 14.70        |
| Bell #3K       | 3.45                | 11.60  | 10.20        |
| Bell #3R       | 4.25                | 14.25  | 15.40        |
| King #2        | 14.40               | 40.00  | 46.50        |
| King #3R       | 3.35                | 7.30   | 12.60        |
| Danville #2    | 5.90                | 14.50* | ---          |
| Danville #3R12 | 2.85                | 4.40*  | ---          |
| Danville #3R34 | 2.90                | 3.90*  | ---          |
| Shebanie #1    | 1.00                | 10.20  | 16.00        |
| Shebanie #2    | .60                 | 0.50   | 9.00         |
| Shebanie #3    | 1.10                | 1.25   | 8.05         |
| C&G #1         | 1.25                | 13.20  | 4.80         |
| C&G #2         | .90                 | 8.05   | 7.10         |

B = Waste from Licker-in Cylinder & Doffer

C = Waste from Feed Rolls

\* = Card Fly

It will be observed that there are significant differences in the relative magnetic permeabilities over the range of fibers here investigated and that there are marked differences, in most cases, between the carded fibers and the waste fibers from the same mine. This latter observation clearly indicates how effective the processing operations may be in improving the purity of the resulting fiber.

However, a word of caution should, perhaps, be imparted at this point regarding this series of tests. It is entirely conceivable that, for example, even though Danville #2 shows an IR of 5.90 and the Danville #3R12 shows an IR of 2.85, the iron contents in the two samples may be very nearly the same. As was shown earlier, the finer grained materials exhibit the lower IR values and, in this case, the Danville #2 would in all probability have a higher content of large grained impurities than would the more highly processed 3R12 but, with the same reasoning, the 3R12 might well contain considerable amounts of the fine-grained residue resulting from the attrition of the larger particles which existed in the original material.

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These observations are merely offered to demonstrate the inconsistencies possible, due to grain size differences.

Effect of Orientation. Very often the magnetite which occurs in chrysotile is prismatic or needle-like in habit with one dimension being many times greater than the other two. When such is the case the magnetic properties demonstrate directional characteristics, with maximum forces being exerted parallel to the longer dimension of the crystal or particle.

A demonstration of this phenomenon was illustrated when samples of several asbestos textiles were subjected to test in the analyzer with each sample being tested in three positions. Included in this test were: 1) two cloth samples, 2) the yarns from the two cloths which were obtained by unraveling the cloth after the completion of the cloth tests and 3) a third yarn as received on the spool. The cloth samples were first tested with the warp direction parallel to the long dimension of the holder, secondly, with the fill direction parallel to the long dimension of the holder and thirdly, with the diagonal direction of the cloth parallel to the long dimension of the holder. The yarns were tested first lengthwise and secondly coiled so that the lengthwise direction of the yarn was perpendicular to the long dimension of the sample holder.

The results of these tests are set forth in Table III.

Table III

|                                 | <u>Warp</u> | <u>Fill</u> | <u>Diagonal</u> |
|---------------------------------|-------------|-------------|-----------------|
| Cloth #132<br>(3"x3")           | 4.10 mv     | 3.41 mv     | 3.80 mv         |
| Yarns #132                      | 4.4 mv      | 3.2 mv      |                 |
| Cloth #75<br>(3"x3")            | 2.95 mv     | 1.80 mv     | 2.40 mv         |
| Yarns #75                       | 3.10 mv     | 1.75 mv     |                 |
| Grade AAA yarn<br>10 cut, 2 ply | 6.7 mv      | 3.2 mv      |                 |

It will be observed that in every case, the maximum readings were established when the positioning was such that the greatest number of particles had been aligned in the direction of the magnetic field. Further, in the case of the yarns taken from the cloths, the readings for the yarn were higher than those of the cloth when the positioning was parallel to the field and lower for the yarn than for the same cloth when the positioning was perpendicular to the field.

The results here presented clearly demonstrate the influence of particle orientation on the results to be obtained by this method of analysis and should serve to alert those engaged in this work regarding the necessity of somehow accounting for this factor in any evaluations to be so attempted.

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Effect of Elevated Temperature, Magnetite is an oxide of iron which, under the proper conditions, can be further oxidized and thereby relieved of its magnetic properties. Elevated temperatures, with an excess of air, effectively provide the necessary conditions for such oxidation. For example, magnetite heated to 420°F retains only 80% of the specific magnetism held at room temperature, at 1000°F less than 50% is retained and at 1080°F the magnetic properties are eliminated through complete oxidation and the conversion of  $\text{Fe}_3\text{O}_4$  to  $\text{Fe}_2\text{O}_3$ .

To practically demonstrate this property, samples of N.B.S. Standard Magnetite were heated to three different temperatures and the MR value for the resulting materials determined. These results are set forth in Table IV.

Table IV

| <u>Temp.</u> | <u>MR</u> |
|--------------|-----------|
| Room         | 7.8       |
| 500°F        | 7.8       |
| 800°F        | 4.2       |
| 1200°F       | 0.1       |

The reason for concern regarding this property was prompted by the fact that one of the federal specifications which serves in the procurement of certain asbestos textiles, carries a section devoted to magnetic iron determinations and, in this, a heat treatment is involved. Such a procedure was obviously established without a thorough knowledge or understanding of the possibilities and should be reconsidered in the light of the facts.

With this review of our past endeavors, it becomes quite evident that the task of devising a technique whereby identification and the extent and influence of the magnetic portion of asbestos may be accurately evaluated, is quite complex. It seems apparent that no single test will give the information desired but rather that a correlation of the data procurable from several tests will be necessary. It has been our purpose in recent studies to investigate the possibility of correlating relative data in an effort to obtain a composite picture with significance.

#### Current Investigations

Earlier work has indicated that it will be necessary to correlate the following significant data if an effective determination of the over-all influence of magnetic iron is to be established: 1) Chemical Analysis, 2) Magnetic Rating, 3) Grain size distribution of the magnetic portion and 4) Orientation of the magnetic portion as it influences the magnetic rating determination. Each of these contributing factors has been given consideration with a view toward establishing a factorial contribution each might impart to a formulation which would provide significant conclusions.

As a basis for this work ten samples of asbestos materials were studied, including: 1) two samples of Underwriters lap, 2) one sample of Grade A lap, 3) four samples of Underwriters roving, 4) one sample of Underwriters Braid, 5) one sample of Underwriters tape and 6) one sample of Grade AAAA cloth. Five of these samples were submitted to a commercial testing laboratory for chemical

Table V

| Sample<br>Designation | Magnetic Analyzer |       |                         | Chemical Analysis |                                       |
|-----------------------|-------------------|-------|-------------------------|-------------------|---------------------------------------|
|                       | Millivolt         | IR    | $\text{Fe}_3\text{O}_4$ | Total Fe          | $\text{Fe}_3\text{O}_4$<br>Equivalent |
| 1                     | 2.02              | 1.42  | 2.60                    | 1.98              | 2.74                                  |
| 2                     | 0.15              | 0.12  | 0.25                    | 0.58              | 0.80                                  |
| 3                     | 3.79              | 2.37  | 4.30                    | 1.95              | 2.69                                  |
| 4                     | 0.33              | 0.24  | 0.55                    | 1.25              | 1.73                                  |
| 5                     | 0.65              | 0.52  | 1.05                    | 1.61              | 2.22                                  |
| 6                     | 2.30              | 1.61  | 2.90                    | -                 | -                                     |
| 7                     | 1.70              | 1.28  | 2.30                    | -                 | -                                     |
| 8                     | 1.00              | 0.83  | 1.50                    | -                 | -                                     |
| 9                     | 5.30              | 3.00+ | 5.60                    | -                 | -                                     |
| 10                    | 1.40              | 1.11  | 2.00                    | -                 | -                                     |

- 
1. Lap - Underwriters
  2. Lap - Grade A
  3. Roving - Underwriters
  4. Roving - "
  5. Roving - "
  6. Braid - "
  7. Roving - "
  8. Tape - "
  9. Cloth - Grade AAAA
  10. Lap - Underwriters

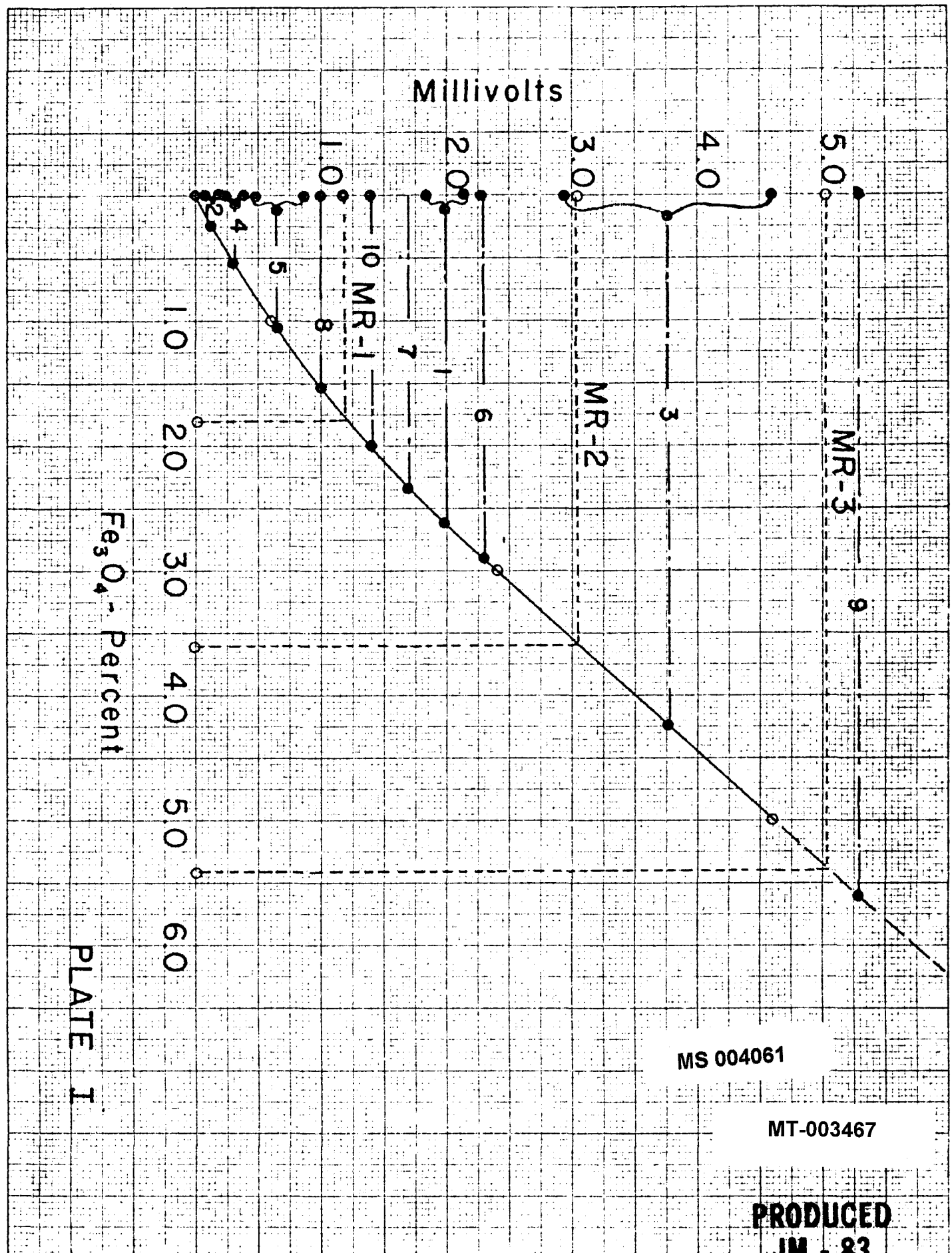
analyses of the iron content and nine of the ten samples were radiographically photographed in order that the grain size characteristics might be observed.

Chemical Analyses. The chemical analyses were made by Smith, Rudy & Company, Philadelphia and the results are set forth in columns 5 and 6, Table V.

Magnetic Rating. The magnetic rating determinations were made on the Mapes Analyzer in accordance with a technique which has been established in this laboratory as standard. In each case, five determinations constitute a test and the average of the five determinations is the recorded value. On samples 1 thru 5, tests were made with the specimens disposed in two directions and the average value of the results obtained in both directions was determined to be the overall average. The results of these determinations are set forth in Table V and also on Plate I.

In further explanation of Plate I, it should be pointed out that the solid curve represents the IR curve for our particular instrument plotted against  $\text{Fe}_3\text{O}_4$  percent, using U.S. Standard Iron Ore Magnetite, 29a and, Millivolt readings, as read on a Vacuum Tube Voltmeter. The dotted lines serve to indicate the limits for IR-1, IR-2 and IR-3, as established in conformance with A.S.T.M. provisions. The broken lines define the ratings established for the

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several samples here investigated, each line including the sample number to which it refers.

Further reference to the information here set forth will be made in a later discussion.

Radiographic Examinations. For sometime we have been interested in the possibilities of the useful purpose which radiographic photographs might serve in our efforts to interpret some of the information here accumulated. First efforts indicated that by this means, the magnetic particles in an asbestos mass might be illuminated for visual examination purposes. Subsequent work along these lines has proven equally interesting and although the results are perhaps not as qualitative as might be hoped for, they do serve to substantiate data procured by chemical and magnetic analyses methods.

Radiographs are here shown which have been taken of the several samples of materials included in this work. The photographs of the cloth, braid, tape and roving serve to visually express the presence of the magnetic particles and further show their actual sizes and the distribution throughout the products. In another photograph, samples of three roving specimens and two lap specimens are shown in the same picture. In this latter photograph the amount of each sample is ten grams, the weight used in making the MR determinations, and a rough comparison of the several samples is possible.

The usefulness of radiographic examinations as a means of interpreting and correlating magnetic iron contents in chrysotile is, at this point, not clear. Such a technique does permit a visual examination that is not otherwise possible and provides an opportunity to rather definitely establish the upper limits of grain size present. The very finely divided particles of magnetite are not, however, discernable and their contributing effects are therefore not readily ascertained by this technique. However, as has been earlier established, the larger particles of magnetic particles are the worst offenders and an evaluation of this characteristic may prove to be quite significant.

#### Summary of Investigation

Table V. Referring to Table V, it will be observed that the data is tabulated in terms of 1) Magnetic Analyzer data with a) Millivolt readings, b) corresponding IR values and c)  $\text{Fe}_2\text{O}_3$  equivalents, on the basis of the standardized IR-Millivolt relationships, and in terms of 2) chemical analyses with a) the Total Fe, as reported, and b)  $\text{Fe}_2\text{O}_3$ , as calculated on the basis of the Fe determinations. It will be observed that sample 3, an Underwriters Grade roving, exhibits the highest magnetic analysis value of the first five samples listed, having an IR of 2.37. However, the total iron content, Fe, by chemical analysis is shown to be only 1.95 as compared to 1.98 for sample 1, which, on the other hand, shows an IR of only 1.42.

Furthermore, sample 5 was submitted as a Ferrous Grade, roving and the total Fe, determined by chemical analysis, was found to be 1.61, which would indicate the grading to be true, however, the IR value for the material proved to be 0.52, a much lower rating than would be required for a Non-Ferrous roving.

An examination of the radiographs is helpful in interpreting these apparent inconsistencies. It will be observed that sample 3 contains large quantities of long needled magnetite whereas sample 1 shows considerably less of the large grained materials. The chemical analyses, of these two materials, however, indicates that the total iron content is very nearly the same and the question therefore arises as to whether the marked IR differences are the result of the significant grain size differences or reflect actual differences in  $\text{Fe}_3\text{O}_4$  content, the possibility of which is not revealed in the total iron content figure. Sample 5 is relatively free of excessively large particles and, although several small grains are to be found, the rating would indicate the material to be of a Non-Ferrous grade. Here again, it seems quite likely that the relatively high, 1.61%, Fe represents a combination of  $\text{Fe}_3\text{O}_4$  and either  $\text{Fe}_2\text{O}_3$  or some iron silicate.

Sample 2, a Non-Ferrous, Grade A lap, was the most iron free specimen here studied, showing a total iron of only 0.50 and an IR value of only 0.12. The radiographic photograph bears out these figures, showing practically no magnetite particles of discernable size.

Sample 6 thru 9 were studied only in the relationship of IR value to radiographic examinations. The interest here lies chiefly in the ability to visually evaluate and reconcile the IR value in general terms. Sample 9, for example, is a twill weave, Grade AAAA Cloth, and a comparison of the IR values with the radiograph would seem to lend reasonable correlation. Likewise, sample 8, an Underwriters grade, tape, has a reasonably good IR value and the radiograph permits an understanding why this should be so, since it is relatively free of large grained particles.

Plate I. The information set forth in table V relative to the magnetic analyses data is also reproduced on Plate I, whereon are plotted the IR values for all of the samples here studied. It will be observed that samples 2, 4, 5 and 8 are all registered below an IR value of 1; samples 1, 6, 7 and 10 have IR values between 1 and 2; sample 3 has an IR between 2 and 3 and sample 9 has an IR in excess of 3. It is interesting to note the characteristics of sample 3 which has an IR of very nearly 4 when tested in one direction and has an IR of slightly less than 3 when tested in the opposite direction. Referring again to the radiographs it will be seen that this sample contains a considerable amount of long fibered magnetite and the orientation of these particles markedly influences the IR values obtained. In this work, the average value was used but from a practical standpoint it would be much safer to consider the higher value.

The characteristic spread in values resulting from preferred orientation during test will be observed for samples 1, 2, 4 and 5 but to a much lesser degree. Here again the radiographs serve to account for some of these phenomenon.

The data here set forth simply serves to further substantiate earlier findings and the conclusions based thereon. The inclusion of the radiographic examinations serves to provide additional information that assists in accounting for some of the apparently inconsistent behaviors previously observed. The lack of a full appreciation of the several factors which enter into any consideration of the over-all picture of the problem here being engaged, has retarded the solution to date, however, it is hoped that through these endeavors most, if not all, of

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the factors have now been exposed and their contributing influences approximated. In the furtherance of this work efforts should be made toward the establishment of "factors of contribution" which will permit the formulation of all of the contributing elements into a statement of solution which may be applied in the solution of specific problems requiring such determinations.

### Conclusions

The significance of the iron content of chrysotile is dependent upon 1) the amount of iron present and the states or combinations in which it exists, that is, whether it is present as one or more of several possible oxides, silicates or hydrates, and 2) the grain size distribution of the iron bearing minerals.

1) The establishment of the amount of iron present, as determined by chemical analysis, should be such as to serve to identify the state or states of the Fe as it exists in one or more of the possible combinations to be found in chrysotile. With this information and through its utilization in a rational analysis, a reasonably accurate relationship of the chemical constitution may be ascertained. This information, in itself however, is not sufficient to establish the over-all significance of the properties to be imparted by the presence of such impurities in an asbestos material and must therefore be correlated with other relevant data if a composite picture of significance is to be established.

2) In the determination of the significance of the iron content of chrysotile, as it is related to the electrical properties of those asbestos products into which it is to be fabricated, the following contributing factors must be considered:

- a)  $\text{Fe}_3\text{O}_4$  content
- b) Grain size distribution
- c) Influence of preferred orientation

By means of a magnetic analyzer it should be possible to obtain an approximation of these three properties. The magnetic properties are definitely a function of the  $\text{Fe}_3\text{O}_4$  content, however, the state of subdivision and the orientation during such tests will markedly influence any evaluations thus made.

The spread or range of magnetic rating values obtained by inducing preferred orientation during the course of a test serves to indicate the presence of greater or lesser amounts of magnetic impurities which occur in needle-like proportions. Excessive amounts of long-needles of these impurities will induce a wide range of values when oriented in opposing directions for each set of determinations. Finer states of subdivision tend to reduce this characteristic.

Radiographic examinations offer an opportunity for visual examination of materials under observation and through a refinement in both the technique of procuring such photographs and in evaluating the results obtained, they may well serve as a useful tool in gaining pertinent information related to the problem at hand.

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In the continuation of this work, it is intended that investigations will be conducted to establish the following:

- 1) The relationship between  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$  and the total iron content. It is felt, at this point, that the magnetite content of asbestos bears a specific relationship to the divalent iron content and that perhaps a chemical analysis, which reveals the contents of the divalent and trivalent iron components, will most effectively serve to establish the significance of iron in asbestos.
- 2) The relationship between  $\text{Fe}^{2+}$  and magnetic properties as determined by the Napes Analyzer.
- 3) The usefulness of information which may be obtained from radiographs and the possibility of so interpreting such data so that it may provide quantitative data.
- 4) Correlation of the Magnetic Properties as a function of:
  1. Amount of  $\text{Fe}^{2+}$
  2. Grain size and distribution of  $\text{Fe}_3\text{O}_4$
  3. Orientation of  $\text{Fe}_3\text{O}_4$  grains.

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March 4, 1954

## Round -Robin Heat-Aging Test

| Sample<br>Letter | Tensile Strength |               |            | Weight Loss<br>% - 500° F. | Asbestos<br>Content |
|------------------|------------------|---------------|------------|----------------------------|---------------------|
|                  | As Received      | After Heating | % Retained |                            |                     |
| A                | Max.             | 71.0          | 47.0       |                            |                     |
|                  | Min.             | 51.0          | 33.0       |                            |                     |
|                  | Avr.             | 63.9          | 40.2       | 63.0                       | 90.3                |
| B                | Max.             | 86.0          | 58.0       |                            |                     |
|                  | Min.             | 62.0          | 43.0       |                            |                     |
|                  | Avr.             | 70.25         | 50.3       | 71.7                       | 90.7                |
| C                | Max.             | 82.0          | 47.0       |                            |                     |
|                  | Min.             | 56.0          | 33.0       |                            |                     |
|                  | Avr.             | 65.6          | 40.8       | 62.2                       | 89.6                |
| D                | Max.             | 78.0          | 58.0       |                            |                     |
|                  | Min.             | 64.0          | 40.0       |                            |                     |
|                  | Avr.             | 68.1          | 49.5       | 72.7                       | 92.0                |
| E                | Max.             | 78.0          | 60.0       |                            |                     |
|                  | Min.             | 62.5          | 40.0       |                            |                     |
|                  | Avr.             | 71.5          | 46.6       | 65.2                       | 90.45               |

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A. Keasbey & Mattison Company  
 B. Southern Asbestos Company  
 C. Johns-Manville Corp.  
 D. Raybestos-Manhattan, Inc.  
 E. Asbestos Textile Institute Lab.

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MINUTES OF THE MEETING OF THE TECHNICAL COMMITTEE OF THE ASBESTOS TEXTILE INSTITUTE  
HOTEL WARWICK, PHILADELPHIA, PA.  
JUNE 9, 1954

In attendance were:

Southern Asbestos Company  
 J. D. McCluer, Chairman

Union Asbestos & Rubber Company  
 A. W. Summers

Raybestos - Manhattan, Inc.  
 H. S. Maier  
 H. W. Oliver

American Asbestos Textile Corp.  
 E. C. Cutler

Johns-Manville, Corp.  
 J. L. Tucker

Keasbey & Mattison Company  
 C. R. Frederick  
 R. L. Lanz  
 B. L. Carpenter

Rutgers University  
 H. C. Shaw

Following the agenda the status of the several Federal and Military Specifications was discussed from the point of most recent developments. There has been no change in this since the March meeting on MIL-C-10316, SS-C-1466, MIL-M-11199A and MIL-I-3053A. However, on the latter MIL-I-3053A member companies have sent to Dr. Shaw their recommended revisions but no contact with an agency has yet been made.

During the past quarter a contact has been made by Mr. C. R. Frederick, Mr. J. L. Tucker, and Dr. H. C. Shaw with Mr. H. H. Brandt who is a Civilian in charge of Textiles at Wright-Patterson Air Base, Dayton, Ohio on Specifications MIL-C-7637 (U. S. A. F.) and MIL-C-4117. Proposed revisions on these two had previously been made by member companies. The former concerns a Chloroprene Polymer Treated Cloth. Table I concerns the base fabric which was accepted without change and Table II concerns the finished treated cloth. The proposed revisions on tensile strength, bursting and tearing strength were accepted. The agency wishes to add an additional test not previously a part of the specification and that is an adhesion of coating test which is a measure of the adhesion of the coating to the base fabric. Member companies concerned with manufacturing this Cloth are requested to send their recommendations to Dr. Shaw.

On Specification MIL-C-4117 tentative acceptance was obtained on the proposed revision of the Technical Committee dated December 1953 except as below noted. In the original specification the word "Grade" will be replaced with the word "Glass" as follows:

Class I Commercial Grade 75 - 79% No wire.  
 Class II Commercial Grade 75 - 79% Wire inserted.  
 Class III Grade AAA - 99% No wire.  
 Class IV Grade AAA - 95 - 99% Wire inserted.

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This change will be made in paragraph 1-2-2 and in Tables I, II, III, and IV. In Table I, the 40P10 Cloth under Type I was changed in Warp and Filling tensile to conform to that in the standard A.T.I. list of Cloths.

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In Table I, for all types, an allowable tolerance of plus or minus 1 was given for binder ends per inch and picks per inch.

In 3-1-2 the proposed revision was not acceptable. At this meeting a counter revision was made as follows:

"Wire inserted yarn shall consist of one or two brass wires twisted with the required number of Asbestos strands."

In 3-3-1 wherein is stated that 10% of the total number of rolls may contain two pieces the agency wants a minimum yardage on the shortest piece when two pieces are in one roll. The committee recommended that the shortest piece be not less than 20% of the length of a full roll. Other minor changes in the tentatively accepted specification may be noted from the specification as re-written under this date to conform to present revision.

Specification MIL-G-2333 was discussed by the committee. This contains only two Cloths, 40P10 and 40H14 and no revisions were necessary except to add the proper tolerances.

The work on testing Cloth woven under controlled degrees of dampness is reported in Dr. Shaw's fellowship report No. 29. The work is not complete and no conclusions can be drawn as yet. The results so far indicate that Cloth woven to some degree of dampness exhibits superior tensile and abrasion resistance. Work on testing the relative tensile and abrasion resistance at elevated temperatures of Asbestos Textiles, Asbestos-Glass Textiles and Glass Textiles is under way to the extent that samples of these have been submitted and work of testing them will proceed as soon as possible in view of other projects now in process.

The Cloth Committee under the guidance of Mr. A. W. Summers, Chairman of the Cloth Committee has accumulated data on eleven wire inserted Cloths from member companies. The Cloths are considered standard in the industry and this information is set forth in the table below as a basis for a standard A.T.I. list of wire inserted Cloths.

WIRE INSERTED ASBESTOS CLOTHS

| <u>LBS./SQ. YD.</u> | <u>A.T.I. STYLE NO.</u> | <u>KIND OF WIRE</u> | <u>WARP</u> | <u>FILLING</u> | <u>ENDS/INCH (WARP)</u> | <u>PICKS/INCH (FILLING)</u> | <u>GRADES AVAILABLE</u> |
|---------------------|-------------------------|---------------------|-------------|----------------|-------------------------|-----------------------------|-------------------------|
| 2.00                | 32H12                   | B                   | 1221        | 1211           | 19                      | 9                           | C., U.                  |
| 2.25                | 36H10                   | B                   | 1021        | 1011           | 18                      | 8                           | C., U.                  |
| 2.70                | 44H10                   | B                   | 1021        | 1021           | 18                      | 9                           | C., U.                  |
| 2.70                | 44H10                   | B                   | 921         | 921            | 17                      | 8                           | C., U.                  |
| 2.75                | 44H8                    | B                   | 822         | 811            | 14                      | 11                          | AAA                     |
| 2.80                | 45H8                    | B                   | 822         | 811            | 14                      | 10                          | C                       |
| 3.00                | 48H10                   | B                   | 1022        | 1021           | 18                      | 8                           | C., U., AAA             |
| 3.10                | 50H10                   | H-B                 | 1022        | 1022           | 14                      | 10                          | AAA                     |
| 3.25                | 52H10                   | B                   | 1021        | 1021           | 20                      | 10                          | AA                      |
| 3.50                | 56H10                   | M                   | 1022        | 1022           | 18                      | 9                           | AAA                     |
| 4.00                | 64H10                   | B                   | 1022        | 1021           | 22                      | 10                          | AAA                     |

M = Monel

B = Brass

## Minutes of the Meeting of the Technical Committee

Mr. Frederick, Chairman of The Tape Committee has accumulated the following data on 1/32" and 1/16" Plain Tapes as shown in the accompanying table.

PLAIN TAPES

| <u>WARP</u>       | <u>FILLING</u> | <u>ENDS<br/>1" WIDTH</u> | <u>ENDS/INCH<br/>(WARP)</u> | <u>PICKS/INCH<br/>(FILLING)</u> | <u>COMPANY</u>      |
|-------------------|----------------|--------------------------|-----------------------------|---------------------------------|---------------------|
| <u>1/32" Tape</u> |                |                          |                             |                                 |                     |
| 1820              | 1820           |                          | 24                          | 11                              | Union Asbestos      |
| 1820              | 1810           | 27                       |                             | 12                              | Southern Asbestos   |
| 1010              | 1410           |                          | 33                          | 11                              | American Asbestos   |
| 1610              | 1610           | 34                       |                             | 14                              | Johns-Manville      |
| <u>1/16" Tape</u> |                |                          |                             |                                 |                     |
| 1030              | 1020           |                          | 16                          | 8                               | Union Asbestos      |
| 1030              | 1020           | 18                       |                             | 9                               | Southern Asbestos   |
| 1020              | 1020           | 22                       | 18                          | 7-1/2                           | American Asbestos   |
| 1030              | 1020           | 19                       | 18                          | 8                               | Keasbey & Mattison  |
| 1030              | 1020           | 20                       |                             | 7-1/2                           | Johns-Manville      |
|                   |                | 18                       |                             | 7                               | Raybestos-Manhattan |

APPROX. FT./LB. AVERAGE1/32" TAPE

| <u>Width</u> | <u>E. - M.</u> | <u>Southern</u> | <u>American</u> | <u>J. - M.</u>             | <u>Union</u> | <u>K. &amp; M.</u> |
|--------------|----------------|-----------------|-----------------|----------------------------|--------------|--------------------|
| 1/2"         | 125.0          | 114             |                 |                            |              |                    |
| 3/4"         | 84.7           |                 | 87.4            |                            | 78.6         |                    |
| 1"           | 60.2           | 65              |                 | (66.0)<br>(93.1)<br>(66.1) | 55.5         |                    |
| 1-1/4"       | 50.0           |                 |                 |                            |              |                    |
| 1-1/2"       | 41.7           | 44              | 43.1            |                            | 39.5         |                    |
| 1-3/4"       |                |                 | 40.1            |                            |              |                    |
| 2"           | 32.2           | 34              | 32.3            |                            | 29.5         |                    |
| 2-1/2"       | 26.3           | 28              |                 |                            | 22.2         |                    |
| 3"           | 22.0           | 23              | 20.7            |                            |              |                    |

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1/16" TAPE

| <u>WIDTH</u> | <u>R. - M.</u> | <u>SOUTHERN</u> | <u>AMERICAN</u> | <u>J. - H.</u> | <u>UNION</u> | <u>K. &amp; H.</u> |
|--------------|----------------|-----------------|-----------------|----------------|--------------|--------------------|
| 1/2"         | 81.3           |                 |                 |                |              | 70.0               |
| 3/4"         | 50.0           |                 | 50.5            |                | 46.7         | 50.0               |
| 1"           | 40.5           | 40.9            | 41.0            | 41.4           | 37.0         | 39.0               |
| 1-1/4"       | 31.5           |                 |                 |                |              | 31.0               |
| 1-1/2"       | 26.3           |                 | 26.3            |                | 25.0         | 26.0               |
| 2"           | 19.4           | 19.0            | 22.1            |                | 18.9         | 20.0               |
| 2-1/2"       | 15.2           |                 |                 |                | 15.6         | 16.0               |
| 3"           | 12.3           | 13.5            | 14.7            |                | 13.2         | 13.0               |
| 3-1/2"       | 11.2           |                 |                 |                |              |                    |
| 4"           | 9.9            | 10.1            | 10.7            |                |              |                    |
| 4-1/2"       | 8.8            |                 |                 |                |              |                    |
| 5"           | 7.9            | 7.6             |                 |                |              |                    |
| 5-1/2"       | 7.1            |                 |                 |                |              |                    |
| 6"           | 6.6            | 6.9             | 7.9             |                |              |                    |

Tolerances recommended on total ends in Tape, + or - 2 from the nominal. On picks/inch + or -1 from the nominal. Width tolerance on 1" and under + or -1/32" over 1" + or -1/16". Thickness tolerance .030" and under + or -.003". From .030 to .050 + or -.005 over .050 + .010, -.005". Also recommended for thickness tolerance .0312+ .005" -0" on .0625 + .010" -0. Tolerance on weight was variously recommended at from 7% to 10% from the nominal. It was generally agreed that ft./lb. would better be expressed in minimum ft./lb., this to be in keeping with the thickness tolerance.

At the March meeting a request was made that members send to Mr. Oliver, Chairman of the Braided Tubing Committee their recommendations on tolerances and methods of testing. The following report by Mr. Oliver gives the various responses to this and forms a part of the minutes of this meeting.

"Since the last meeting of the Technical Committee, the above sub-committee has been active in regards to establishing a more accurate means of determining wall thickness of Braided Asbestos Tubing. Suggestions were received by Messrs. J. L. Tucker, of Johns-Manville and J. D. McCluer, of Southern Asbestos Company. Mr. E. C. Cutler has suggested that since his company manufactures no Braided Tubing that he be replaced on this committee. I feel that a replacement for Mr. Cutler should be designated.

Suggestions received are as follows:

MEASURING WALL THICKNESS

MT-003476

Johns-Manville - Mr. J. L. Tucker

1. Instrument - Cady gauge made by E. J. Cady & Co., 630 N. Harlen Avenue, River Forest, Illinois. Dead weight model, 1/2 inch thickness measurement, graduated in .0001 in., H inch throat, 9/16" anvil, \$126.50

## Minutes of the Meeting of the Technical Committee

Southern Asbestos Company - Mr. J. D. McCluer

1. Instrument - Dead weight gauge in accordance with A.S.T.M. D-39, Section 5.

Raybestos-Manhattan, Inc. - Mr. H. W. Oliver

1. Instrument - Same as Southern Asbestos Company proposal.

METHODJohns-Manville - (Two Methods)

- (a) Just place the Braid, as is, into the gauge, drop anvil, and reading should be divided by two for single wall thickness.
- (b) Slit the Braid with a sharp thin pointed pair of shears. Put single thickness of Braid into gauge; reading will be wall thickness.

Note: Pressure on Cady gauge is 8 lbs. per sq. inch.

Southern Asbestos Company

Slit tubing open and measure single wall thickness the same as Cloth in A.S.T.M. D-39, Section 5 (b).

Raybestos-Manhattan, Inc.

Same as Southern Asbestos Company

WALL THICKNESS TOLERANCESouthern Asbestos Company

When Nominal is  $1/64"$   
 When Nominal is  $1/32"$   
 When Nominal is  $1/16"$

Tolerance: plus  $1/64"$ , minus 0  
 Tolerance: plus  $1/32"$ , minus  $1/64"$   
 Tolerance: plus  $1/16"$ , minus  $1/32"$

Union Asbestos Company

Minus 0, Plus  $1/32"$ , all ranges.

Raybestos-Manhattan, Inc.

When Nominal is  $1/64"$   
 When Nominal is  $1/32"$   
 When Nominal is above  $1/32"$

Plus or Minus  $1/64"$   
 Plus or Minus  $1/32"$   
 Plus or Minus  $3/64"$

Johns-Manville

When Nominal is  $1/64"$   
 When Nominal is  $1/32"$   
 Greater than  $1/32"$

Plus or Minus  $1/64"$   
 Plus or Minus  $1/32"$   
 Plus or Minus  $3/64"$

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Keasbey & Mattison Co.

I have no report on their recommendations.

INSIDE DIAMETER TOLERANCEUnion Asbestos Company

No Recommendation.

Johns-Manville

|                    |            |
|--------------------|------------|
| 1/32" and less     | Plus 1/64" |
| Over 1/32" to 1/8" | Plus 1/32" |
| Over 1/8"          | Plus 1/16" |

Southern Asbestos Company

|                               |                     |
|-------------------------------|---------------------|
| 1/32" and less                | Minus 0, Plus 1/64" |
| Over 1/32" and including 1/8" | Minus 0, Plus 1/32" |
| Over 1/8" and including 1/4"  | Minus 0, Plus 1/16" |
| Over 1/4"                     | Minus 0, Plus 3/32" |

Keasbey & Mattison Co.

No Recommendation.

Raybestos-Manhattan, Inc.

|                                     |                     |
|-------------------------------------|---------------------|
| 1/32" and less                      | Minus 0, Plus 1/64" |
| Over 1/32" up to and including 1/8" | Minus 0, Plus 1/32" |
| Over 1/8"                           | Minus 0, Plus 1/16" |

WEIGHT

Recommendations range from 5 to 8 per cent, plus and minus."

As noted a few responses have not yet been received and it was requested that these be sent to Mr. Oliver as soon as possible.

Due to the variance in results obtained on measuring wall thickness, no one method has been selected by the committee as being the most reliable method. This subject is still under investigation.

Work on determining yarn diameters of singles and plied yarns has been initiated to the extent that samples have been sent to Dr. Shaw by member companies and he has arranged to measure these by Drop Hammer Micrometer and Shadowgraph both measurements to be made on the same part of the specimen.

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Another project on the list of approved projects is to investigate methods of determining per cent of dust in fiber. It was decided to initiate this project this quarter. Mr. Tucker of Johns-Manville will furnish a sample of fiber to Dr. Shaw who will divide this into smaller samples and send identical samples of fiber to each member company with procedural instructions. This will be approached from using a dry method and a wet method.

J. D. McCluer

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FELLOWSHIP REPORT

MYRIL C. SHAW

RESEARCH FELLOW

ASBESTOS TEXTILE INSTITUTE

NEW JERSEY CERAMIC RESEARCH STATION

RUTGERS UNIVERSITY

NEW BRUNSWICK, NEW JERSEY

REPORT NO. 29

June 10, 1954

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## Introduction

During the course of the meeting of the Asbestos Textile Institute held on March 11, 1954 the research program of the Fellowship was reviewed and revised to include investigations covering problems of current interest to the industry. Several of the projects listed in this most recently established program are continuations of studies which have been under investigation for some time and the furtherance of this work entails no great departures from techniques or procedures of the past, however, some of the remaining projects are substantially different from those heretofore covered and therefore require the establishment of test procedures and the procurement of the necessary equipment in order to properly carry on these studies.

The Fellowship program now consists of eight specific projects subdivided into three groups on the basis of priority of interest. Four of the projects are presently under active investigation, two additional projects are awaiting the procurement of necessary industry representative samples of wire inserted cloths and asbestos-glass and glass cloths before these studies are initiated. The seventh project is a cooperative effort with the Air Hygiene Committee related to fiber conditioning techniques and preliminary work in this endeavor has been initiated. The final project specifies that the Fellow keep advised regarding developments in the synthesization of asbestiform minerals and in this we have an ever continuing interest.

In addition to these specific Fellowship projects, three projects listed as Secretarial duties covering A.S.T.M. affiliations, federal specifications revisions negotiations and fiber availability publicity have been receiving attention as specific occasions have arisen.

During the coming months there will necessarily be some curtailment in the Fellowship work due to the transfer of the laboratory from Rutgers to the Philadelphia Textile Institute. It is now planned to make this move during the month of August and during a period of a week or so little, if any, investigational work will be possible. However, upon the establishment of our laboratory in the new quarters it is anticipated that the improved facilities will provide greater opportunities for the Institute and should markedly increase the scope of the work which may be undertaken by the Fellow.

## Fellowship Work

The Fellowship projects being actively pursued at this time and the progress to date are covered in the following resume.

1. Determine the significance of total iron and iron in the several possible states of combination in chrysotile, upon:

- a) Magnetic Properties
- b) Electrical Properties
- c) Chemical Properties

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This project has been actively pursued for the past several months and much relevant data has been obtained and reported. However, most efforts to

correlate, within tolerable limits, magnetic properties with iron contents have not been too successful. The reasons for this lack of correlation have been recognized and were so reported in the last report issued covering this subject. Briefly, in review, the iron content as normally obtained through chemical analysis does not differentiate between the various states or forms in which the iron atom may be combined with oxygen and/or silicon and since the divalent iron is the chief contributor in the formation of the magnetic form of iron oxide, this information is necessary if a proper evaluation is to be made. Our efforts in recent months have been exerted in an endeavor to isolate this information and determine its significance.

Herewith reproduced in Table I are values for magnetic rating and total iron content which were set forth in Table V of Fellowship Report No. 28. Also included in this table are additional chemical analyses setting forth the divalent iron oxide (ferrous oxide) which have been determined through chemical analyses since issuing the earlier report.

Table I

|   | <u>IR</u> | <u>Total Iron</u> | <u>FeO</u> | <u>Fe<sup>2</sup></u> | <u>% Fe<sup>2</sup></u><br><u>Total Iron</u> |
|---|-----------|-------------------|------------|-----------------------|----------------------------------------------|
| 1 | 1.42      | 1.98              | 1.53       | 1.19                  | 60.0                                         |
| 2 | .12       | .58               | .27        | .21                   | 36.2                                         |
| 3 | 2.37      | 1.95              | 1.57       | 1.22                  | 62.5                                         |
| 4 | 0.24      | 1.25              | .48        | .37                   | 29.6                                         |
| 5 | 0.52      | 1.61              | .82        | .64                   | 39.7                                         |

It will be observed that Fe<sup>2</sup> content as obtained from the FeO determination bears a much more definitive relationship with the IR values than do the values of total iron content. Samples 2, 4 and 5 point up this observation most clearly. Samples 1 and 3 however still defy correlation of significance. Reference to the radiographic illustrations shown in connection with the last report serves to throw some light in this latter case since it was there shown that the grain sizes of the magnetite in these latter two samples were markedly larger than in the remaining three samples and that sample #3, in particular, contained much magnetite of large grain size and columnar in habit.

The burden of the evidence would here again seem to establish the significance of grain size as one of the important contributing factors in any determination designed to evaluate the electrical properties of chrysotile asbestos material on the basis of magnetic properties. From these few examples here cited it will be noted that in those specimens with relatively low IR values the grain size of the magnetite is small and the percentage of the total iron which is divalent ranges between 29.6% and 39.7%. On the other hand, in the two specimens with the highest IR values the grain sizes are much larger and the percentage of divalent iron in the total iron ranges from 60.0% to 62.5%.

One explanation which may be advanced for the above noted phenomenon may be ascribed to the possibility that the Fe<sub>3</sub>O<sub>4</sub> is a relatively unstable form of the oxide and oxidation is an ever present consideration. The extent and rate of oxidation is obviously a surface phenomenon and the greater the surface the greater will be the oxidation and the smaller the grain size the greater

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will be the exposed surface for such attack. Conversely, with the concentration of the  $\text{Fe}_3\text{O}_4$  in a few large pieces which present much less surface, the oxidation proceeds much more slowly and the magnetic form and influence of the mineral is preserved.

It may well be that the relationship of divalent iron to total iron (in terms of Fe) will serve to establish a significant figure. As before noted, the materials with the lower MR show a divalent iron percentage not over 39.7% while the higher MR values show divalent percentages in the neighborhood of 60%. An apparent inconsistency may be noted in samples 1 and 3 wherein the specimen with a 1.42 MR shows 60%  $\text{Fe}^{2+}$  while the second sample with an MR of 2.37 shows only 62.5%  $\text{Fe}^{2+}$ . This condition again reflects the influence of grain size since sample #3 shows much larger and greater numbers of larger size particles than does sample #1.

On the basis of the observations noted to date, it seems clear to this investigator that two significant factors must be taken into consideration and specifically identified quantitatively in order to define the properties imparted by the iron bearing portions of chrysotile fiber. The pertinent factors are 1) the divalent iron content and 2) the grain size of the iron bearing impurities. There appears to be a significant relationship between the divalent iron content as a percentage of the total iron content and grain size and it has been reasonably well established that magnetic rating is related to grain size.

The work to date has been based upon tests made on a relatively few samples of representative materials. It now seems apparent that if any conclusive evidence is to be gained it will be necessary to investigate a great many more varieties of the materials under question. Through such an extensive investigation a great amount of relevant data will be accumulated which may serve as a basis for the establishment of the significant relationships. Most of the materials studied to date have exhibited relatively low MR values and it is now the intention that materials covering a greater range of MR values be included in the work to be pursued.

2. Evaluate the influence of wet weaving versus dry weaving, upon:

- a) Tensile Strength
- b) Porosity (air)
- c) Absorption
- d) Abrasive Resistance

MT-003483

Representative samples of the materials to be included in this investigation have been received from six member companies of the Institute and the work has been initiated. After starting this work it became apparent that perhaps two additional properties which may be influenced by wet weaving versus dry weaving should be ascertained and included as significant data, namely, weight and asbestos content. The weight determinations have been made on those samples thus far tested and, as will be shown later, do vary with the process, however, whether this variation bears any important relevance will only be ascertained upon the final analyses of the complete work.

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To date, weight, tensile strength determinations and abradoflex tests have been conducted on seventeen of the twenty-six cloths submitted for test.

The results of the tests thus far conducted are set forth in the following table, however, since the work is not complete, no conclusions will be drawn at this point although pertinent observations will be related.

The weight changes resulting from the various treatments are set forth in Table II. It will be observed that, in every case, there is evidence of weight loss as a result of the treatment. The extent and significance of this loss will be analysed upon completion of the test work on all of the materials.

In this same connection, it was felt advisable to establish whether or not the weight loss represented a significant change in asbestos content and, if so, to what extent.

Table II  
Weight

|     | DWDF | WWDF | DWWF | WWWF |
|-----|------|------|------|------|
| (A) | 2.58 | 2.48 | 2.39 | 2.40 |
| (B) | 2.45 | 2.33 | 2.34 | 2.16 |
| (C) | 2.37 | 2.25 | 2.25 | 2.36 |
| (D) | 2.44 | 2.28 | 2.28 | ---  |

Table III sets forth the tensile strengths of the cloths thus far tested. Each horizontal column represents the tensile strength values for the warp and fill directions of the four varieties of cloth from one company. The vertical columns divide the cloths according to the warp and fill directions of test and according to the method of treatment where DWDF represents dry warp and dry fill, WWDF represents wet warp and dry fill, DWWF represents dry warp and wet fill and WWWF represents wet warp and wet fill.

Table III

Tensile Strength  
Grab Method

|     | DWDF |      | WWDF |      | DWWF |      | WWWF |      |
|-----|------|------|------|------|------|------|------|------|
|     | Warp | Fill | Warp | Fill | Warp | Fill | Warp | Fill |
| (A) | 147  | 62   | 155  | 72   | 145  | 77   | 159  | 83   |
| (B) | 128  | 60   | 134  | 73   | 139  | 61   | 140  | 69   |
| (C) | 122  | 53   | 131  | 54   | 126  | 53   | 132  | 45   |
| (D) | 132  | 56   | 139  | 70   | 140  | 67   |      |      |

In general, it will be noted that the wet warp only treatment improves the tensile strength in both the warp and fill directions. The wet fill only treatment likewise improves the fill direction strength in three of the four cloths and improves the warp direction strength in three of the four cloths. The wet warp only treatment appears to be slightly better than the wet fill only treatment. The wet warp and fill treatment markedly improves the warp tensile

strength but also shows improvement in the fill direction in two of the three tests.

These results are presented at this time merely as data and in their incompleteness cannot serve as the basis for conclusive evidence that one method yields superior results to any other. The full picture will be required before an educated analysis is possible.

Table IV presents the abradoflex data thus far procured on the samples thus far tested. In this table the same designations are carried as were set forth in Table III with the additional notations relative to the abradoflex test cycle. The first group of figures designated (A) represent the tensile strengths of the four sets of samples supplied by one member, tested in both the warp and fill directions at the various stages of the abradoflex test. It should be borne in mind that these tensile strength values are raveled strip tests, 1-3/4" wide.

Table IV

|         | DWDF       |            | WWDF       |            | DWWF       |            | WWWF       |            |
|---------|------------|------------|------------|------------|------------|------------|------------|------------|
|         | Warp       | Fill       | Warp       | Fill       | Warp       | Fill       | Warp       | Fill       |
| A.R.    | 159        | 90         | 181        | 117        | 181        | 113        | 222        | 110        |
| (I)     | 103        | 85         | 164        | 112        | 143        | 108        | 158        | 108        |
| A (II)  | 103        | 83         | 164        | 110        | 137        | 106        | 154        | 106        |
| (III)   | <u>52</u>  | <u>76</u>  | <u>107</u> | <u>100</u> | <u>110</u> | <u>103</u> | <u>115</u> | <u>105</u> |
| AB. RA. | 3266       | 8499       | 5999       | 8599       | 6078       | 9199       | 5267       | 9599       |
| A.R.    | 150        | 122        | 154        | 85         | 143        | 100        | 181        | 91         |
| (I)     | 82         | 87         | 97         | 76         | 119        | 98         | 116        | 82         |
| B (II)  | 64         | 80         | 80         | 74         | 95         | 97         | 113        | 81         |
| (III)   | <u>24</u>  | <u>(1)</u> | <u>32</u>  | <u>71</u>  | <u>58</u>  | <u>94</u>  | <u>77</u>  | <u>79</u>  |
| AB. RA. | 1645       | 6467       | 2156       | 8389       | 4088       | 9499       | 4266       | 8799       |
| A.R.    | 142        | 69         | 155        | 80         | 145        | 75         | 152        | 79         |
| (I)     | 74         | 68         | 108        | 77         | 103        | 70         | 130        | 77         |
| C (II)  | 58         | 65         | 102        | 75         | 92         | 69         | 112        | 76         |
| (III)   | <u>29</u>  | <u>42</u>  | <u>66</u>  | <u>73</u>  | <u>27</u>  | <u>20</u>  | <u>74</u>  | <u>25</u>  |
| AB. RA. | 2045       | 6199       | 4267       | 9199       | 1867       | 2699       | 4978       | 3199       |
| A.R.    | 156        | 102        | 151        | 106        | 133        | 102        | ---        | ---        |
| (I)     | 22         | 86         | 103        | 96         | 104        | 100        | ---        | ---        |
| D (II)  | 20         | 68         | 87         | 86         | 81         | 92         | ---        | ---        |
| (III)   | <u>(2)</u> | <u>56</u>  | <u>36</u>  | <u>29</u>  | <u>42</u>  | <u>(3)</u> | ---        | ---        |
| AB. RA. | 4011       | 5568       | 2467       | 2789       | 3168       | 7399       |            |            |

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A.R. ---- As Received

- I ----- Tensile Strength after 30 minute test
- II ----- Tensile Strength after 60 minute test
- III ----- Tensile Strength after 180 minute test
- AB. RA. --- Abradoflex Rating

In analysing these figures, for example, refer to group A where the warp test on the sample as received, without treatment, shows a tensile strength of 159 pounds. After 30 minutes of test the strength has been reduced to 103%, the same strength is found after 60 minutes and after 180 minutes the strength is 52 pounds. The resulting abradoflex rating is 3266. The same analysis is to be made for all of the data presented in this table.

It must be borne in mind when considering abradoflex ratings that such ratings set forth rate of attrition and must be related to the original tensile strengths if ultimate strengths are to be ascertained. For example, refer to Table IV, part (A), samples WNF. Here it will be observed that in the warp direction the tensile strength is reduced from 222 pounds to 115 pounds over the 180 minute cycle of the test, yielding a resulting abradoflex value of 5267 while in the fill direction test the tensile strength is reduced from 110 to 105 over the same test cycle yielding an abradoflex value of 9599. The end results show that in the warp direction 52% of the original strength or 115 pounds was retained while in the fill direction 95% of the original strength or 105 pounds was retained.

In endeavoring to analyse the results thus far obtained, representing approximately 2/3 of the total tests to be conducted, anomalies are quite apparent. Manufacturers A and B were apparently able to improve the abrasion resistance properties of the cloths here submitted by the various treatments since all treated cloths show improved characteristics over the untreated cloths. However, producer C shows improvement in only two of the three treatments in the warp direction and one of the three treatments in the fill direction. Producer D shows improvements in the warp direction tests due to treatment but marked inferiorities in the fill direction.

Here again insufficient data is available upon which to evaluate the overall picture and it will be necessary to complete the entire study before any analysis will be possible.

In connection with this test and in continuation of it, absorption and air porosity tests are to be run, however, no such tests have as yet been undertaken.

3. Determine elevated temperature serviceability characteristics: 1) Tensile strength retention, 2) abrasion resistance, for:

- a) Asbestos textiles
- b) Asbestos-glass combination textiles
- c) Glass textiles.

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The activity, to date, in connection with this project has been devoted largely to the accumulation of industry representative samples of materials suitable for inclusion in this investigation. Upon receiving the necessary samples for this investigation, the several tests will be initiated.

4. Investigate fibre conditioning techniques which will assist dust control and improve operating conditions.

- a) Methods used
- b) Agents, from the standpoint of effectiveness
- c) Agents, from the standpoint of undesirable properties.

A preliminary survey in connection with this project has been made and each member of the air hygiene committee has submitted comments regarding the several companies' endeavors in this connection. This survey is to be reviewed by the Air Hygiene Committee and the results of these considerations will serve to direct the future activities on this project.

5. Determine and compile industry-wide data on asbestos single and plied yarns, in cuts--8, 10, 12, 14, 16, 18, 24, 28 and 35 in regard to: a) Diameters (Drop Hammer Mic. and Shadowgraph.)

Work on this project has been devoted to the construction of a suitable instrument whereupon such determinations may be carried out. This construction has now been completed and the test work will be pursued at an early date.

The instrument to be used consists of a structure whereupon the yarn may be oriented in such a way that the micrometer readings and the shadowgraph readings may be taken at the same time while the yarn is held at a constant and reproduceable tension. The micrometer to be used is the standard Federal thickness gage and the shadowgraph is a Bauch and Lomb projector capable of projecting enlargements which may be read to the desired accuracies.

Most of the member companies have furnished a range of yarns representative of those manufactured by their respective companies and work on this project will be initiated at an early date.

6. Investigate methods of determining percentages of dust in asbestos fibre, with a view toward preparing a standard procedure.

- a) Wet method
- b) Dry method

There has been no test work conducted on this project to date, however, thought and literature reviews have been pursued and the initiation of experimental work will be undertaken in the near future.

7. Make preliminary investigation of the heat degradation characteristics of wire inserted or metallic cloth.

Work on this project has been deferred awaiting the accumulation of sufficient samples of material to permit an industry-wide evaluation. Upon receipt of the necessary samples the work will be undertaken.

Federal Specification revisions.

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During the past quarter the Fellow accompanied Mr. J. L. Tucker and Mr. C. R. Frederick on a trip to Dayton, Ohio where a conference was held with

Mr. H. H. Brandt in connection with proposed revisions in Specification MIL-C-4117 and MIL-C-7637A (USAF). The results of these discussions are attached as a part of this report and set forth the proposed specification revisions which were accepted and those which were rejected.

The Fellow is deeply appreciative of the time and efforts expended by both Mr. Tucker and Mr. Frederick in participating in these discussions and feels that only through such representative action can such negotiations be successfully conducted.

#### Conclusions

The Fellowship work is now proceeding under the directions established by the program set forth at the March meeting of the Institute. Most of the projects there included are now in some stage of investigation and during the coming months it is hoped that action can be initiated in those presently inactive.

During the coming quarter we will be in the process of moving our quarters and at such a time the regular routine of investigational work may be somewhat disrupted and the progress may not be as extensive as we may all hope for. We will, however, endeavor to schedule the work in such a way that a minimum amount of lost time will be experienced.

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Military Specification  
Cloth, Coated, Asbestos

The following sections have been tentatively accepted for revision. Those sections not noted are to remain as set forth in the latest revised issue as proposed by USAF.

Revisions Tentatively Accepted.

3.1.1 Asbestos.--The asbestos used in the yarn to manufacture the base cloth shall be made from spinning grade fiber chrysotile asbestos. It shall contain no filling material, except organic fiber.

3.1.4 Coating.--The coating shall be a chloroprene polymer compound to meet the requirements specified herein.

3.2.1 Base fabric.--The weight and construction of the base fabric shall conform to the properties listed in Table I.

Table I.--Base Cloth Properties

|                             | <u>Type I</u> | <u>Type II</u> |
|-----------------------------|---------------|----------------|
| weight, oz/sq.yd., min.     | 29 $\pm$ 7%   | 30 $\pm$ 7%    |
| Warp ends per inch, min.    | 20 $\pm$ 1    | 14 $\pm$ 1     |
| Filling ends per inch, min. | 10 $\pm$ 1    | 14 $\pm$ 1     |

3.2.2 Finished cloth.--The finished cloth shall conform to the requirements shown in Table 2.

Table 2 - Physical requirements

|                                         | <u>Type I</u> | <u>Type II</u> |
|-----------------------------------------|---------------|----------------|
| Thickness                               | .060 - .080   | .060 - .080    |
| Weight, lbs./sq. yd., min               | 4.50          | 4.75           |
| Breaking strength (grab method) lb.     |               |                |
| Warp, min.                              | 215           | 165            |
| Filling, min.                           | 120           | 150            |
| Bursting Strength (Mullen) points, min. | 260           | 210            |
| Tearing strength (tongue method), lbs.  |               |                |
| Warp, min.                              | 17.0          | 16.0           |
| Filling, min.                           | 12.0          | 12.0           |
| *Coating adhesion Test, lbs.            | 9.0           | 9.0            |

3.4 Color.--The color of the finished cloth shall be the black color of the compounded chloroprene polymer. A powder which is applied to the surface and which can be removed by rubbing with a damp cloth, shall not be cause for rejection.

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3.5.2 Note.--The section reads to the effect that such fabrics must be calendered. The Air Force agency is of the opinion that such a restriction is unwise and may result in the restricted procurement of such materials. It has therefore been suggested that the first sentence of this paragraph, 3.5.2, be made to read "The Coating shall be applied and vulcanized on both sides of the base cloth, approximately equal thicknesses on each side, and sufficiently thick to insure non-fraying of the asbestos fabric". Further, an additional test, coating adhesion test, shall be set forth in section 4, Sampling, Inspection, and Test Procedures, as applicable to and a part of this specification.

The coating adhesion test as recommended is a modification of Method 5970, CCC-T-191, as follows:

- 1) Cut sample strips 1" x 6" with the longer dimension in the warp direction.
- 2) Immerse one end of each strip to a depth of 1" in benzene for a period of one-half hour. Following this, wash thoroughly with distilled water and peel back the coating from the cloth for a distance of 2". Condition samples thus prepared for 24 hours at standard conditions, 70°F - 65% R.H.
- 3) Conditioned samples shall be tested on a 75# capacity Scott tensile tester. During each given test the weight pawls shall be disengaged so that a free swinging pendulum is engaged.
- 4) The test specimens shall be clamped in conformance with strip test procedures wherein a 2" x 1" or 3" x 1" anvils front and back, top and bottom are used. The distance between the upper and lower sets of jaws shall be 3".

Note. It is the desire of the agency that industry provide comments regarding this test and its desirability and as to the values as set forth in the final item in Table 2.

4.7.2 At least three 1 by 4 inch specimens, with the long dimension warpwise, from each sample shall be tested. The specimens shall be exposed for 24 hours at 260°F ± 5°. The specimens shall be bent over a cold (70°F) 3/8 inch rod within 5 minutes after removal from the source of heat.

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REPORT OF THE TECHNICAL COMMITTEE OF THE ASBESTOS TEXTILE INSTITUTE  
HOTEL WARWICK, PHILADELPHIA, PA.  
JUNE 10, 1954

BY: John D. McCluer, Chairman of Technical Committee

The Technical Committee had its 2nd meeting of the year on June 9th, 1954. Discussions covered the several specifications in process of revision, particularly MIL-C-4117 and MIL-C-7637 on which a recent conference was held with a representative from Wright-Patterson Air Base, at Dayton, Ohio. The committee of this conference consisted of Messrs. Frederick, Tucker and Dr. Shaw. General acceptance on constructions and tensiles as set forth in the standard list of A.T.I. Plain Cloths was obtained but there was much resistance on the part of the Agency to change any nomenclature. This has been the previous experience with other Agencies on other specifications and it now appears that in general the most we can expect to obtain at present is an acceptance, by the several Agencies contacted so far, of the A.T.I. recommendations on constructions and tensiles for the various Cloths in these specifications. The committee feels that this will add to uniformity, that is, a plain weave 2.50 lbs/sq. yd. Cloth will be specified under the same constructions, tolerances, and tensile regardless of which Military or Federal Specification it occurs in. This will be a step in the right direction which may lead to further changes later.

The project of determining the relative values of wet versus dry weaving has been initiated and considerable progress made though no final conclusions yet. Samples from member companies of Cloth woven under controlled degrees of dampness have been submitted to Dr. Shaw. Each member company submitted four specimens consisting of four consecutive 2 yard lengths from a given roll of Cloth, and each of the four specimens woven under a pre-described condition of dampness ranging from dry to damp to wet. Indications so far appear to indicate that Cloth woven with some degree of dampness is superior in tensile and abrasion resistance. Whether wet or damp woven Cloth can be subsequently napped to resemble a dry woven Cloth without possibly damaging the Cloth would be a subject for investigation. This project on Cloth should be complete and ready for a final report in the near future.

Following the list of projects as recommended at the last meeting, a project for determining the elevated temperature characteristics for (1) Asbestos Textiles (2) Asbestos-Glass Textiles and (3) Glass textiles, has been initiated to the extent of member companies supplying Dr. Shaw with suitable samples.

Within the Technical Committee are three sub-committees, one on Tape of which Mr. Frederick is Chairman, one on Cloth of which Mr. Summers is Chairman and one on Braided Tubing of which Mr. Oliver is Chairman.

The Tape Committee, newly formed this year, has collected data on 1/32" and 1/16" Plain Tape for the purpose of preparing a standard A.T.I. list with tolerances. Other sizes will be added to complete the table.

The Cloth Committee completed a list of standard Plain Cloths in 1953 and is now in process of making a list of wire inserted Cloths. Data accumulated so far indicate there may be approximately twelve wire inserted Cloths considered standard by the industry. One visible result which came from the A.T.I. list of Plain Cloths was the recent adoption as tentative of 15 Plain Cloths by A.S.T.M. The list was recommended by the A.T.I. to replace the list previously carried by A.S.T.M. and with exception of one minor change the list was accepted as recommended.

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Report of the Technical Committee of the Asbestos Textile Institute

The Braided Tubing Committee has been actively engaged in working out best methods of measuring wall thickness. This method of measurement as described in the various specifications is probably subject to more error than most other measurements on Asbestos Textiles. This project has been adopted by this committee and several other methods of measuring are to be tried in an endeavor to find a better method.

The Technical Committee is going to make a round robin test on determining per cent dust in fiber using a dry method and a wet method. Identical samples will be distributed to all members for testing under standard procedures. The dry method will be according to the Quebec Shaker Screen Method and the wet method will be on the basis of settling rate in water.

The project of getting a table of Yarn diameters of representative singles and plied Yarns has been initiated to the extent that member companies, have sent to Dr. Shaw samples of Yarns. Diameters will be determined by means of the drop hammer micrometer and by Shadow-graph.

One of the most important projects on the Fellowship list is working out the relation between the various forms of iron in Asbestos and its magnetic properties. It is desirable to know which form of iron is objectionable from a magnetic standpoint. Samples of Roving, Lap, Tape, and Braided Tubing have already been sent to Dr. Shaw, and these samples cover a broad range in their magnetic iron content. Dr. Shaw's work is not complete but already shows definite trends. It is hoped that as a result of this investigation that one single method for determining the amount of objectionable magnetic iron will be found which method will be accepted and adopted by all specifications. At present there is the A.S.T.M. method which expresses it in M.R. units and the Navy Calculation method expressing it in per cent by weight. Both of these methods have their limitations.

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REPORT OF SALES PROMOTION COMMITTEE  
HOTEL GARDNER, PHILA., PA.  
OCTOBER 7, 1954

At the previous meeting of the Asbestos Textile Institute the Sales Promotion Committee was assigned the work of attempting to have asbestos spinning fibers removed from the critical list in Washington and as a result of this assignment a special committee was formed including Mr. J. A. Bettis of Raybestos-Manhattan, Mr. George S. Fabel of Southern Asbestos Company, Chairman, and the writer.

On our first contact with Washington it was unfortunate that Mr. Bettis could not attend but he assigned Mr. J. A. Brown to substitute for him. This committee made first contact on 23rd June, 1954 with Dr. William Schultz who is in charge of stock-piling critical materials in the Office of Defense Mobilization. The meeting was also attended by his assistant, Mr. E. R. Gray. After explaining to Dr. Schultz the purpose of our meeting he indicated that had no authority to set in motion anything that would help us.

However, Dr. Schultz was very cooperative and suggested that we consult with the Office of the Assistant Secretary of Defense, Materials Branch, Supply and Logistics in the Pentagon and he made an appointment for us that same day. We had the opportunity to confer with Messrs. Franklin P. Huddle and Wm. W. Miller of that office as they were responsible for putting materials on the critical list.

At this conference we indicated the availability of three length fibers from Canadian Mines as represented in Mr. A. L. Penhale's letter dated 28th May, 1954. These figures were so impressive that Mr. Miller decided to take some action.

It developed at that meeting that the stock-pile of asbestos included No. 1 and No. 2 C&G Crocidolite and Amosite. Mr. Miller indicated that they had used the word "asbestos" very loosely when in reality they were talking about Chrysotile, Crocidolite and Amosite and he indicated that he would take immediate steps to correct this and did.

On the 26th day of August, 1954 Mr. Franklin P. Huddle sent us an excerpt from the Annual Materials Conservation Report, Defense Department, Volume I report of 1953 and this excerpt is quoted as follows:

"Asbestos is a fibrous mineral. Chrysotile asbestos is the principal type used in the spinning of fabrics. It comes mainly from sources in Africa and Canada. A shortage in supply (both currently and under mobilization) exists in certain grades of this material. In these grades the spinnable, non-ferrous fiber stock-pile procurement is moving slowly.

For the spinnable, non-ferrous grades of Chrysotile there is no satisfactory or complete substitute in certain dielectric insulation in military items. There should be continued emphasis on conservation and substitution measures in these grades. However, these supplies of ferrous, spinnable grade, Grade 3 and above of Chrysotile is favorable and expansion of production in the western hemisphere is taking place. There need be no emphasis upon reduction in Military uses of these ferrous grades.

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No projects to conserve Chrysotile asbestos were reported in 1952. Two projects were reported, both by the Navy, in 1953. Both were completed; one project involved changed design of electric shipboard cable, the other a plastic sealer. No estimate of saving was reported for the first, but a saving of 15,000 pounds of asbestos and a 15% reduction in cost was reported for the second project."

It will be noted from this that Chrysotile ferrous asbestos spinning fibers were removed from the critical list.

Mr. Miller indicated however that these fibers were put on the critical list by other departments, particularly in the Navy and if we were to get total relief we would have to contact the Navy Department in order to accomplish this.

Our Committee met on 26th August, 1954 in Washington and those present at that conference were Messrs. Wallace D. Barlow, Joseph Chikote, G. H. VanLear, of the Navy Department and Dr. Oliver Bowles, Bureau of Mines.

At this conference we again presented the figures supplied us by Mr. Penhale and these were broken down into the various grades as follows:

|    |   |              |      |
|----|---|--------------|------|
| 3F | ~ | 475          | tons |
| 3K | ~ | 21900        | "    |
| 3R | ~ | 23700        | "    |
| 3T | ~ | 6850         | "    |
| 3Z | ~ | 8915         | "    |
|    |   | <u>61670</u> | "    |

In the Asbestos Magazine issue of August 1954 there appeared an article offered by Dr. Oliver Bowles respecting the scarcity of spinning fibers and particularly non-ferrous spinning fibers.

Dr. Bowles told us at this conference that that article was written in May, 1953, and, of course, he now knows that there is no scarcity of these fibers and as a result of this he has written another article which will come out in an early issue of Asbestos Magazine giving the facts as they have been presented by the Quebec Asbestos Mining Association respecting ferrous fibers and also through the offices of Mr. J. D. Christian, General Manager, Cassiar Asbestos Corporation, Limited which indicated that about 10,000 tons of 3K spinning fiber was available annually and through the construction of an aerial tramway which should be completed next fall would increase this output to 20,000 tons.

From an Analysis of Cassiar Fiber it can be classed as non-ferrous and Dr. Oliver Bowles acknowledged this.

After these developments information reached us that a special committee was formed in Washington consisting of the following members:

Dr. Timothy C. May  
Commodity Industry Analyst for Light Metals  
and Non-Metallic Minerals  
Materials Branch, Production and Schedules Division  
Office of Asst. Secretary of Defense (Supply and Logistics)  
Room 3D-827 Pentagon

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Mr. G. W. Josephson  
 Chief, Construction and Chemical Materials Br.  
 Minerals Division, Bureau of Mines  
 Department of the Interior  
 Room 3510, Interior Bldg.

Mr. George W. Pollard  
 Chief, Iron and Steel Branch, Metals and  
 Minerals Staff  
 Office of International Materials Policy  
 Department of State  
 Room 407, State Annex 7

Mr. T. V. Wilder  
 Director, Materials Research and Analysis Div.  
 Emergency Procurement Service, GSA  
 Room 7008, GSA Region III Bldg.  
 7th and D Streets, S. W.

H. B. Sharpe, Deputy Director  
 Miscellaneous Metals & Minerals Division, BMSA  
 Room 4827 Commerce

Mr. W. W. Schultz  
 Chief, Non-Metallic Minerals Division  
 Office, Assistant Director for Materials  
 Office of Defense Mobilization  
 Room 4482, New GAO Bldg.

Mr. David H. Larrabee  
 Geologist, Mineral Deposits Branch  
 Geological Survey  
 Department of the Interior  
 Room G-230, GSA Building

Mr. R. H. Santagers  
 Commodity Specialist  
 Ceramics Division Tariff Commission  
 Room 226, Tariff Bldg.

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whose duty it was to inquire into all metals and minerals that were on the critical list. Our committee met with that Committee on Monday, 4th October, 1954 and again we presented all of the information which we had concerning the availability of asbestos spinning fibers, ferrous and non-ferrous that were available even in time of a National emergency,

It developed at this conference that the stock-piling of non-ferrous fibers consisted of No. 1 and No. 2 CGG. It was explained that at the time these were the only spinning grades of non-ferrous fiber available and it was further explained by our Committee that 3K Canadian non-ferrous fiber such as Cassiar could be used in a preponderance of asbestos textiles,

The Chairman of this Committee, Mr. H. B. Sharpe, indicated that they expected to complete their examination of the critical list in about six weeks

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Report of Sales Promotion Committee

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at which time we fully hope that all spinning fibers, ferrous and non-ferrous will be removed from the critical list.

As a matter of records here, Mr. Sharp was invited to attend the A.T.I. Meeting at the Warwick on 7th October and did so.

In our efforts to have an article published in the Wall Street Journal with respect to the availability now of asbestos spinning fibers Mr. J. A. Bettis and the writer called on Mr. Doyle F. Smee, Manager of the Philadelphia Office of the Wall Street Journal and presented him with considerable facts to substantiate our contention that asbestos spinning fibers are in plentiful supply. Mr. Smee agreed to check over this information and although he could not give us definite assurance he did indicate in his opinion we had material of sufficient value to warrant publication of such an article in his journal.

We also received a request from Dr. J. S. Felton, University of Oklahoma, School of Medicine, and University Hospitals in Oklahoma City in which they are setting up a course of study on air hygiene. Dr. Felton requested photographs of some of the illustrations that appear in the Handbook of Asbestos Textiles and the donors of these photographs were asked to contribute copies if they approved of Dr. Felton's request. These photographs were duly received and sent off to Dr. Felton, and we now have his acknowledgment of them and his many thanks.

Since there are two visual aid display cases now open for assignment it has been suggested that one of these be placed with North Carolina State University and steps will be taken to attempt this assignment.

Since there is some possibility of a display being erected in the lobby of the Bureau of Commerce Building in Washington, it would be our opinion that the second visual aid display case be held so that we can put it in this display when space is available.

Respectfully submitted,

A. E. Whitfield, Chairman  
Sales Promotion Committee

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REPORT OF THE TECHNICAL COMMITTEE OF THE ASBESTOS TEXTILE INSTITUTE.

HOTEL WARRICK, PHILADELPHIA, PENNSYLVANIA, OCTOBER 7, 1954.

BY JOHN D. McCLUER, CHAIRMAN OF THE TECHNICAL COMMITTEE.

The activities of the Technical Committee, during the first part of their meeting on October 6th, centered on reviewing the tentative issue of MIL-C-10316, dated August 10, 1954, from the Detroit Arsenal. This issue was, in effect, the agency's response to recommendations made by the joint efforts of the Sales Promotion and Technical Committees in March 1954, at which time they met with personnel from the Detroit Arsenal. The tentative issue was, in the main, about the same as agreed on at the March meeting, and only minor changes together with correction of some typographical errors were recommended by the Technical Committee.

Likewise, Specification MIL-C-7637, which is an issue from the Wright Patterson Air Base at Dayton, Ohio, was reviewed and revisions and additions recommended. Revisions involved giving tolerances to the base untreated fabric, as well as to finished treated fabric, which is finished with a rubber base treatment. The amount of tolerance on weight of the finished cloth was not finally agreed upon, and it is still an item to be established. A change in wording was recommended regarding manner of treating and an additional sentence was inserted regarding adhesion of treatment of the base fabric.

The Table on Metallic Cloths was again reviewed and several cloths added to the list which is intended to represent an ATI list of Metallic Cloths.

In the afternoon session, the Technical and Sales Promotion Committees met jointly and reviewed the two above specifications for final approval by both Committees. All revisions were approved by both Committees and MIL-C-10316 is now ready to be re-submitted to the Agency for their approval. Specification MIL-C-7637 will likewise be ready for re-submitting to the Agency as soon as the question of tolerance on weight is established. During this same joint session of the two Committees, the list of Metallic Cloths was again reviewed and jointly approved. This list will be presented to the Sales Promotion Committee for their use as they see fit, such as including it in the next revision of the ATI Handbook.

The Technical Committee then met singly and discussed the status on Braided Tubing. The Table on Ft. per lb. is in very good agreement between individual companies, and this part should be complete in the near future. Methods of measuring I. D. and wall thickness and tolerances on these is still under study and several good suggestions have been made which individual members will try.

Time did not permit discussion of Plain Tapes at this meeting although it is an active item on our agenda.

A round robin test will be run among the individual members on a proposed wet method of determining the percent dust in fiber. The method in general employs a method of getting a separation of dust from fiber by placing a weighed sample of the original fiber in a given volume of warm water to which a small per cent of Deceresol O T (wetting agent) has previously been added. The effect of the Deceresol is such that a slime is formed wherein each individual fiber separates to itself rather than forming a matted mass such as would form in pure

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water. After thoroughly mixing, a known portion of this slime can be taken and diluted and placed in a tall graduated glass cylinder. Advantage can be taken of the separated fibers which are slick and slimy in that the dust particles will not mat within the fibers but can slip between them. The fibers for the most part settle to the bottom while the dust particles remain in suspension. This allows a clean cut separation; the water suspension can be poured off, evaporated and the dust weighed while the fibers can be removed, dried and weighed. Mr. Tucker has agreed to send identical samples of a fiber to members and detailed uniform procedure will be issued. Mr. Hatchcroft indicated that his laboratory is equipped with a Clark Classifier, which is fairly expensive equipment, and he has agreed to run a test on the same fiber using the Clark Classifier for comparison with the other method.

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FELLOWSHIP REPORT

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PHILADELPHIA, PA.

REPORT #30

October 7, 1954

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## Fellowship Report

Presented herewith are two reports covering investigations which have been pursued during the past quarter. During this period the headquarters and laboratory of the Asbestos Textile Institute have been in the process of moving from Rutgers University to the Philadelphia Textile Institute and for this reason some of the activities of the Fellow have necessarily been curtailed. We trust that the work presented at this time will, therefore, be considered on the basis of this somewhat curtailed activity.

The first report covers the initiation of work related to the second project in Group A of the Fellowship program adopted March 11, 1954, namely, "Evaluate the influence of wet weaving versus dry weaving upon: a) Tensile Strength, b) Porosity, c) Absorption and d) Abrasive Resistance. Two of the four properties have been evaluated and the results thus far obtained would seem to justify the consideration of this problem as a proper subject for investigation by the Institute. The balance of the work to be included in this investigation will be undertaken within the next few months and it is hoped that an early conclusion of the investigation may be affected.

The second report covers the work assigned in the project listed as number two in Group B of the current project list, namely, "Determine and compile industry-wide data on asbestos single and plied yarns". The work here presented should serve as a basis for the consideration and discussion which may serve to guide the Fellow in a further pursuance of the subject at hand.

Regarding the status of the remaining projects on the Fellowship list, it may be understood that work will be initiated as quickly as time and facilities become available. At the time of this writing the heat aging test furnace has not been connected due to the fact that it was necessary to have the motor drive rewound to suit the power available at the school and the Brabender Moisture Tester and burnout furnace have not yet arrived, though they have been on order for three weeks. These pieces of equipment should become available momentarily and additional research work will be undertaken immediately upon their being placed in service.

We would again like to take this opportunity to invite all members of the Institute to visit the new laboratory and to call upon us for any services we may be able to provide. The accommodations which are now available are considerably more spacious than were provided at Rutgers and under the conditions as they now exist we are hopeful that the activities and services of these new research facilities will initiate a new era of growth and development for the Asbestos Textile Institute.

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## WET WEAVING VERSUS DRY WEAVING

## Introduction

The influence of wet weaving versus dry weaving and the intermediate stages of semi-wet or semi-dry, upon the physical properties of textiles so processed, has not been too well established on an industry-wide basis. Various types and degrees of wet weaving have been practiced within the industry for many years and the fabrics so processed have exhibited many unique and specific properties, as desired. However, the terminology and practices have been but vaguely standardized with the result that what one manufacturer may consider a wet woven product another manufacturer would call a semi-wet or damp woven material.

The adoption of wet weaving methods has, in many cases, been dictated as a corrective measure of dust control for hygienic purposes and the technique pursued by each manufacturer has been based upon a number of controlling factors such as, the efficiency of the dust control desired, the end product desired and the facilities available. Each manufacturer, of course, resolved the problem in a manner which best met his own conditions and requirements and as a result the final operations are essentially different in each plant.

As a result of these conditions there now exists a notable lack of unanimity in the thinking regarding the fundamental principles of wet weaving among those engaged in this practice. It is the purpose of those members of the Asbestos Textile Institute interested in the technical aspects of this problem to gain some enlightenment regarding the fundamental differences involved and to endeavor to establish a basis for evaluating the influence of wet treatments upon the characteristics of an asbestos textile.

The program of work proposed for this investigation includes the evaluation of a series of three cloths woven under three different degrees of wet weaving conditions and one cloth dry woven, to determine: 1) tensile strength, 2) abrasion resistance, 3) absorption and 4) air porosity. At this time, the first two properties have been determined and are being here reported. The absorption and porosity tests will be conducted in the near future.

The cloth samples included in this investigation were furnished by six member companies of the Institute and each manufacturer endeavored to follow, as closely as possible, predetermined specifications for the weaving techniques. The specifications for manufacture which were adopted established that three different types of wet weaving samples should be pursued and that from each of these processes, along with a sample of the same materials wholly dry woven should be submitted to the Fellow for this test. The wet weaving was to be accomplished by: 1) wetting the filling yarns only, 2) wetting the warp yarns only and 3) wetting both the filling and warp yarns.

All of the materials were in 36P10 construction with sample A being in Grade A, samples C, D and E in Underwriters Grade and samples B and F being in Commercial Grade.

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## Test Procedure

The cloth samples as received were unpacked immediately upon arrival at the laboratory and were permitted to air condition for a period of two weeks prior to being tested.

At the conclusion of the conditioning period the following test specimens were prepared from each sample of material: 1) Grab, Tensile Strength samples, warp and fill directions, six each, (4"x6"), 2) Abradoflex samples, warp and fill directions, fifteen each (2" x 13") and 3) Weight determinations were conducted on the remaining portion of each sample furnished, approximately two square feet.

Tensile Strength Determinations. The tensile strengths of the materials here under investigation were determined on the Suter Tensile Tester by the Grab method. The results of these tests are set forth in Table I.

The legends for all of the tables here set forth are as follows:

DWDF -- dry warp, dry fill  
 WWDF -- wet warp, dry fill  
 DWWF -- dry warp, wet fill  
 WWWF -- wet warp, wet fill

The letters A, B, C, D, E and F, heading each vertical column serve to identify the six manufacturers who supplied the cloths for these tests.

TABLE I

| Tensile Strength (Grab) |     |    |     |    |     |    |     |    |     |    |     |    |
|-------------------------|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|
| Treatment               | A   |    | B   |    | C   |    | D   |    | E   |    | F   |    |
|                         | W   | F  | W   | F  | W   | F  | W   | F  | W   | F  | W   | F  |
| DWDF                    | 147 | 62 | 128 | 60 | 122 | 53 | 132 | 56 | 125 | 56 | 129 | 60 |
| WWDF                    | 155 | 72 | 134 | 73 | 131 | 54 | 139 | 70 | 142 | 59 | 124 | 62 |
| DWWF                    | 145 | 77 | 139 | 61 | 126 | 53 | 140 | 67 | 121 | 56 | 131 | 65 |
| WWWF                    | 159 | 83 | 140 | 69 | 132 | 45 | 138 | 66 | 144 | 61 | 128 | 59 |

Abradoflex Tests. The abradoflex tests for these materials were conducted in accordance with established practice, using standard-sized samples 2" x 13" and the tests were conducted for the established 30, 60 and 180 minute cycles. Both abrasion resistance and crease resistance were determined. The results of these determinations are presented in Table II<sup>I</sup> and III.

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TABLE II

| Tensile Strength (Strip) and Abradoflex Rating |      |      |      |              |      |      |             |      |      |      |      |      |  |
|------------------------------------------------|------|------|------|--------------|------|------|-------------|------|------|------|------|------|--|
|                                                | A    |      | B    |              | C    |      | D           |      | E    |      | F    |      |  |
| Treatment and Test Cycle                       | W    | F    | W    | F            | W    | F    | W           | F    | W    | F    | W    | F    |  |
| DWDF                                           |      |      |      |              |      |      |             |      |      |      |      |      |  |
| AR                                             | 159  | 90   | 150  | 122          | 142  | 69   | 156         | 102  | 150  | 73   | 149  | 79   |  |
| 30                                             | 103  | 85   | 82   | 87           | 74   | 68   | 22          | 86   | 96   | 72   | 79   | 72   |  |
| 60                                             | 103  | 83   | 64   | 80           | 58   | 65   | 20          | 68   | 64   | 71   | 44   | 70   |  |
| 180                                            | 52   | 76   | 24   | 115 (failed) | 29   | 42   | 73 (failed) | 56   | 16   | 68   | 21   | 20   |  |
| Abradoflex Rating                              | 3266 | 8499 | 1645 | 6467         | 2045 | 6199 | 4011        | 5568 | 1046 | 9399 | 1435 | 2599 |  |
| WWDF                                           |      |      |      |              |      |      |             |      |      |      |      |      |  |
| AR                                             | 181  | 117  | 154  | 85           | 155  | 80   | 151         | 106  | 177  | 74   | 159  | 89   |  |
| 30                                             | 164  | 112  | 97   | 76           | 108  | 77   | 103         | 96   | 151  | 74   | 124  | 85   |  |
| 60                                             | 164  | 110  | 80   | 74           | 102  | 75   | 87          | 86   | 142  | 72   | 119  | 85   |  |
| 180                                            | 107  | 100  | 32   | 71           | 66   | 73   | 36          | 29   | 86   | 71   | 81   | 85   |  |
| Abradoflex Rating                              | 5999 | 8599 | 2156 | 8389         | 4267 | 9199 | 2467        | 2789 | 4989 | 9699 | 5178 | 9699 |  |
| DWWF                                           |      |      |      |              |      |      |             |      |      |      |      |      |  |
| AR                                             | 181  | 113  | 143  | 100          | 145  | 75   | 133         | 102  | 147  | 88   | 149  | 98   |  |
| 30                                             | 143  | 108  | 119  | 98           | 103  | 70   | 104         | 100  | 109  | 83   | 107  | 96   |  |
| 60                                             | 137  | 106  | 95   | 97           | 92   | 69   | 81          | 92   | 102  | 78   | 84   | 94   |  |
| 180                                            | 110  | 103  | 58   | 94           | 27   | 20   | 42 (failed) | 132  | 61   | 65   | 32   | 91   |  |
| Abradoflex Rating                              | 6078 | 9199 | 4088 | 9499         | 1867 | 2699 | 3168        | 7399 | 4277 | 7499 | 2167 | 9399 |  |
| WWWF                                           |      |      |      |              |      |      |             |      |      |      |      |      |  |
| AR                                             | 222  | 110  | 181  | 91           | 152  | 79   | 169         | 94   | 175  | 73   | 155  | 78   |  |
| 30                                             | 158  | 108  | 116  | 82           | 130  | 77   | 152         | 93   | 147  | 68   | 121  | 76   |  |
| 60                                             | 154  | 106  | 113  | 81           | 112  | 76   | 117         | 88   | 139  | 65   | 107  | 73   |  |
| 180                                            | 115  | 105  | 77   | 79           | 74   | 25   | 69          | 85   | 68   | 63   | 67   | 61   |  |
| Abradoflex Rating                              | 5167 | 9599 | 4266 | 8799         | 4978 | 3199 | 4179        | 9099 | 3988 | 8799 | 4378 | 7899 |  |

Note: 1) AR indicates strip tensile strength before test.  
 2) The numeral over the word "failed" indicates minutes of duration of test and not pounds.

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TABLE III

## Abradoflex Creasing

| Treatment<br>and<br>Test Cycle | A   |     | B    |      | C    |      | D    |      | E    |      | F    |      |
|--------------------------------|-----|-----|------|------|------|------|------|------|------|------|------|------|
|                                | W   | F   | W    | F    | W    | F    | W    | F    | W    | F    | W    | F    |
| DWDF                           |     |     |      |      |      |      |      |      |      |      |      |      |
| AR                             | 159 | 90  | 150  | 122  | 142  | 69   | 156  | 102  | 150  | 73   | 149  | 79   |
| 180 Minutes                    | 153 | 88  | 139  | 84   | 124  | 59   | 150  | 86   | 144  | 72   | 148  | 72   |
| Rating                         | 3.8 | 2.5 | 7.4  | 31.2 | 12.7 | 17.4 | 4.0  | 18.6 | 4.0  | 1.37 | 0.67 | 8.85 |
| WWDF                           |     |     |      |      |      |      |      |      |      |      |      |      |
| AR                             | 181 | 117 | 154  | 85   | 155  | 80   | 151  | 106  | 177  | 74   | 159  | 89   |
| 180 Minutes                    | 180 | 109 | 147  | 84   | 135  | 75   | 147  | 99   | 172  | 74   | 156  | 75   |
| Rating                         | 0.5 | 6.5 | 4.5  | 1.2  | 12.9 | 9.4  | 2.65 | 6.6  | 2.82 | 0    | 1.88 | 15.7 |
| DWDF                           |     |     |      |      |      |      |      |      |      |      |      |      |
| AR                             | 181 | 113 | 143  | 100  | 145  | 75   | 133  | 102  | 147  | 88   | 149  | 98   |
| 180 Minutes                    | 175 | 110 | 142  | 90   | 132  | 73   | 131  | 101  | 146  | 80   | 149  | 90   |
| Rating                         | 3.3 | 2.6 | 0.7  | 10.0 | 9.0  | 4.0  | 1.52 | .98  | 0.68 | 9.1  | 0.0  | 8.15 |
| WWDF                           |     |     |      |      |      |      |      |      |      |      |      |      |
| AR                             | 222 | 110 | 181  | 91   | 152  | 79   | 169  | 94   | 175  | 73   | 155  | 78   |
| 180 Minutes                    | 191 | 108 | 160  | 85   | 151  | 78   | 163  | 90   | 166  | 92   | 151  | 75   |
| Rating                         | 14. | 1.8 | 11.6 | 6.6  | 0.7  | 1.3  | 3.55 | 4.25 | 5.15 | 1.37 | 2.6  | 3.84 |

The tensile strength values here reported are for the strip test (1-3/4" x 6") regularly used in the Abradoflex evaluations.

Weight Tests. The determination of weight and the establishment of the influence of the type of weaving upon the weight was not included in the original program for this work. However, since it appeared to the investigator that possibly some information of significance might be forthcoming from such data, it was included as a part of this work. The results of these determinations are set forth in Table IV. The weights are presented as pounds per square yard.

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TABLE IV

## WEIGHT

| Treatment | A    | B    | C    | D    | E    | F    |
|-----------|------|------|------|------|------|------|
| DWDF      | 2.58 | 2.45 | 2.37 | 2.44 | 2.53 | 2.36 |
| WWDF      | 2.48 | 2.33 | 2.25 | 2.28 | 2.43 | 2.33 |
| DWWF      | 2.39 | 2.34 | 2.25 | 2.28 | 2.52 | 2.42 |
| WWWF      | 2.40 | 2.16 | 2.36 | 2.26 | 2.42 | 2.30 |

## Analysis of Results

The results of the series of tests here conducted serve to illustrate significant points of difference between the four weaving techniques pursued as they are related to physical properties of the finished materials. In addition, differences in the finished materials produced by the similar processing by different manufacturers serves to illustrate the effect of variations in manufacturing techniques.

Tensile Strength. In general, the cloths woven with wet warp and wet fill exhibited higher tensile strengths than cloths woven by any other method. However, manufacturer D and F showed slightly higher warp tensile strength for the cloths which were woven with dry warp, wet fill than for any of the other techniques, while manufacturers B, C, and D showed highest fill, tensile strengths for the wet warp, dry fill method and manufacturer F produced a cloth which showed the highest fill, tensile strength by the dry warp, wet fill method. In most of the latter cases, however, the tensile strength differences are quite small and the variations usually fall well within allowable tolerances.

Abrasion Resistance. The abrasion resistance characteristics obtained in this investigation are set forth in Table II where the actual strip, tensile strengths are tabulated along with the abradoflex rating.

In evaluating the results here presented it is necessary that the actual tensile strength values be considered along with the abradoflex rating, since the latter is a rate of attrition figure which, though apparently large, may not serve to present a clear analysis of the abrasion resistance characteristics of a given cloth. For example, a comparison of the abradoflex values for sample A, wet warp, wet fill, tested in the warp direction and sample F, wet warp, dry fill, tested in the warp direction, shows the former to have an abradoflex value of 5167 and the latter 5178. By a direct comparison of these values it might be concluded that the two samples are much the same, however, looking at the tensile strength values at the conclusion of the test it will be seen that the former breaks at 115 pounds while the latter breaks at 81 pounds. The abradoflex value does serve to clearly show that the rate at which the two materials lose tensile strength as a result of the abrasive action is the same, however, the tensile strengths at the conclusion of the test are considerably different, the difference being in the same proportional relationship as the difference between the original strengths.

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Reviewing the data here tabulated it will be seen that abrasion resistance in the warp direction is generally higher for those cloths which have been woven with wet warp and wet fill. Samples E and F are exceptions to this finding since the wet warp, dry fill woven cloths were found to exhibit the highest tensile strength after abrasion.

The cloths tested in the fill direction presented quite a different picture and one which is somewhat confused due to many apparent inconsistencies. For example, samples A and D showed highest strength retention in the wet warp and wet fill materials, samples B and F showed highest strength retention in the dry warp, wet fill materials, and samples C and E showed highest strength retention in the wet warp, dry fill material.

The reasons for the inconsistencies in the fill direction abrasion resistance noted are many and any attempt to analyse the results here obtained would be impossible since much of the relevant information such as original yarn twist, method and extent of wetting the yarn prior to weaving has not been made available to this investigator. It is undoubtedly true that the variations in the techniques of wetting the yarns with the resultant alteration in the cloth structure have contributed most notably to the variations obtained. The original tensile strengths are, for the most part, well within the range of reasonableness, however, through the wetting, the fill yarns in the several cloths during the weaving have been given a greater or lesser amount of exposure to the surface which is acted upon in abrasion, resulting in widely variable degrees of degradation due to abrasion. The filling yarns are normally well protected from surface abrasion through their embedment by the warp yarns, with the result that the warp yarns are first and most severely worn during abrasion. However, if, as is probably the case in some wet weaving, the filling yarns are brought to a more even surface with the warp yarns, then both will be worn more or less evenly and the fill direction with the fewer yarns per inch will degrade at a much more rapid rate. Sample C, dry warp, wet fill and wet warp, wet fill and sample D wet warp, dry fill and dry warp, wet fill are notable examples of this rapid attrition in the fill direction.

Weight Changes. The influence of wet weaving on the weight of the finished materials here investigated varied from 5.00% to 12.00%. In most cases, the dry woven materials were the heaviest and the wet warp, wet fill woven materials weighed the least. However, in Samples A and C the dry warp, wet fill cloths weighed the least and in Sample F, the dry warp, wet fill cloth weighed the most.

An explanation of this phenomenon would seem to rest chiefly with the possibility of a loss in asbestos content. Further work is contemplated in this connection wherein asbestos content determinations are to be made on all of the materials included in this investigation. It is felt that the amount of cotton present in all of these cloths is so small that the losses noted could not be ascribed to losses in this ingredient, however, a further investigation of this problem should serve to establish the significance of this observation.

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## Conclusions

The results of the tests conducted thus far in this investigation would seem to justify the apprehension which has been expressed by those engaged in weaving asbestos cloths under conditions of varying degrees of wetness. The properties of the end product are dependent on many factors including: 1) the characteristics of the original yarn, 2) the method and amount of wetting of either or both the warp and fill yarns, 3) the technique of weaving, 4) the extent of drying permitted or induced during weaving and 5) the calendering or lack of calendering of the finished cloth. These are but a few of the more obvious causes of inconsistency.

To endeavor to standardize any or all of these contributing factors would probably not be feasible, if indeed possible, however, an understanding as to how much each factor contributed to the over-all characteristics of a given cloth should permit the weavers to control their operations within the limits of manufacturing means and desired end results.

The results of this investigation would appear to indicate that total wet weaving promotes improvements in resistance to abrasion in most cases and the rate of attrition or the rate at which an asbestos textile is worn away as a result of abrasion can be markedly improved in both the warp and fill directions as is evidenced in cloth D. By wetting only the warp yarns improvement over the total dry weaving method is noted in both the warp and fill direction abrasion resistance in five of the six samples tested. Dry warp and wet fill type weaving shows improvement over the all dry weaving in three of the six samples tested.

Tensile strength improvements, while not outstanding, were in most cases quite marked and total wet weaving appears to offer the most promise in improving this property.

The properties thus far evaluated provide information relative to strength and wearability. There are, however, other important characteristics which may contribute to the usefulness of the cloths for particular applications which have not, as yet, been here investigated. Such properties as porosity to air and absorption of liquids will undoubtedly be affected by these weaving techniques to as great an extent, or perhaps greater, than those here shown. A continuation of this investigation should reveal further significant characteristics induced by unique weaving techniques.

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## DIMENSIONS OF SINGLE AND PLYED ASBESTOS YARNS

## Introduction

The dimensions of an asbestos yarn can be most simply defined in terms of "cut" or "diameter". The term "cut" refers to yarn length per unit weight, wherein the number of 100 yard units per pound yields a significant figure which is identified as the "cut" of the yarn and it is common practice in the industry today to so identify the various yarns. A 10-cut yarn, for example, is one that will run  $1000 \pm 80$  yards to the pound and a 35-cut yarn will run from 3220 yards to 3780 yards to the pound.\*

The significance of yarn diameter, on the other hand, appears to be important only in so far as it reflects the thickness of a finished textile into which it may be woven or in the ability of a textile to take a given treatment, wherein the diameter serves to indicate the tightness of the twist. There is apparently little effort exerted to control yarn diameters within specified limits as long as the proper "cut" is maintained and it is assumed that through the control of the "cut" dimension, the diameter will be held within the tolerable limits. However, it is well known that twist, amount and type of organic fiber, amount and grade or grades of asbestos fiber, and humidity conditions during spinning, may exert some influence on the diameter of a spun yarn. Variations in one or all of these factors may serve to yield yarns that, while they may be within the same cut range, will have significantly different diameters.

It is the purpose of this investigation to endeavor to determine: 1) whether or not the drop-hammer micrometer method is a sufficiently accurate method for determining yarn diameters or whether the shadowgraph technique or some other method might be developed which would provide more accurate or useful information, 2) what variations do exist in an industry-wide selection of asbestos yarns, and 3) whether or not yarns, on an industry-wide basis, are within a reasonable range in regard to diameters.

## Yarn Specifications and Constructions

Probably the most universally accepted specification for yarn construction is presented by the American Society for Testing Materials in Specification D 299-52T. In this, it will be observed, that the dimensions are set forth as yarn number ("cut") in Table I and no mention of yarn diameter is to be found anywhere in this presentation.

However, there have apparently been occasions encountered by some members of the industry wherein the need for yarn diameters has been required and such determinations have been made. A tabulation of such a set of determinations was recently transmitted to the members of the Technical Committee of the Institute. In this tabulation, the diameters for all yarns from 10 to 36 cut and 40, 45 and 50 cut are set forth for singles, 2 ply, 3 ply, 4 ply, 5 ply and 6 ply constructions.

\*A.S.T.M. D 299-52T

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A study of this latter tabulation reveals that the work is probably the mathematical development for ideal conditions and is not the results of actual measurements of typical yarns of commerce. For example, set forth below are figures taken from this tabulation.

| Cut | single | 2 ply | 3 ply | 4 ply | 5 ply | 6 ply |
|-----|--------|-------|-------|-------|-------|-------|
| 10  | .02412 | .0358 | .0438 | .0516 | .0568 | .0630 |
| 12  | .02196 | .0328 | .0401 | .0463 | .0519 | .0572 |
| 14  | .02035 | .0304 | .0372 | .0430 | .0481 | .0526 |
| 16  | .01905 | .0285 | .0348 | .0403 | .0450 | .0491 |
| 18  | .01795 | .0268 | .0329 | .0378 | .0423 | .0464 |
| 24  | .01554 | .0232 | .0282 | .0329 | .0365 | .0404 |
| 26  | .01494 | .0223 | .0274 | .0315 | .0351 | .0385 |
| 30  | .01391 | .0208 | .0253 | .0293 | .0328 | .0359 |
| 35  | .01287 | .0192 | .0234 | .0271 | .0303 | .0334 |

In reducing these figures to a common factor it will be found that for all cuts from 10 through 50, many of which are not set forth in the above tabulation, the relationships between the six constructions are constant as follows.

| single | 2 ply | 3 ply | 4 ply | 5 ply | 6 ply |
|--------|-------|-------|-------|-------|-------|
| 1      | 1.49  | 1.82  | 2.11  | 2.36  | 2.59  |

That is, the 2 ply yarn in all diameters has a diameter 1.49 times that of the single yarn, the 3 ply yarn has a diameter 1.82 times that of the single yarn, the 4 ply yarn has a diameter 2.11 times that of the single yarn, and so on.

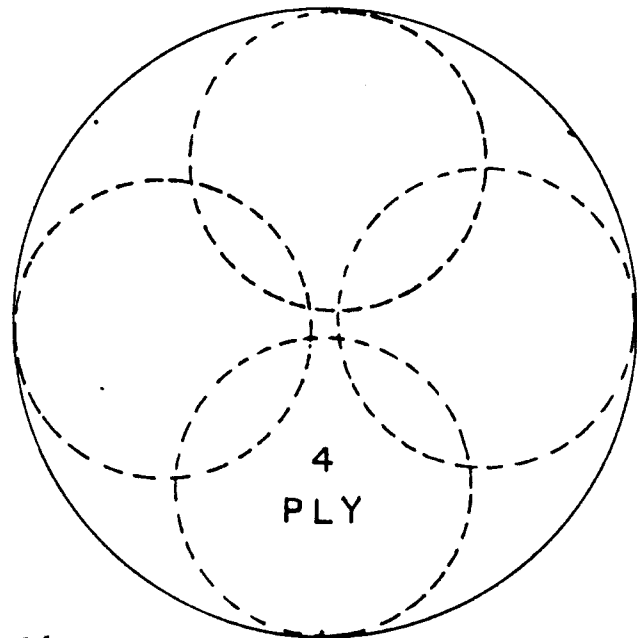
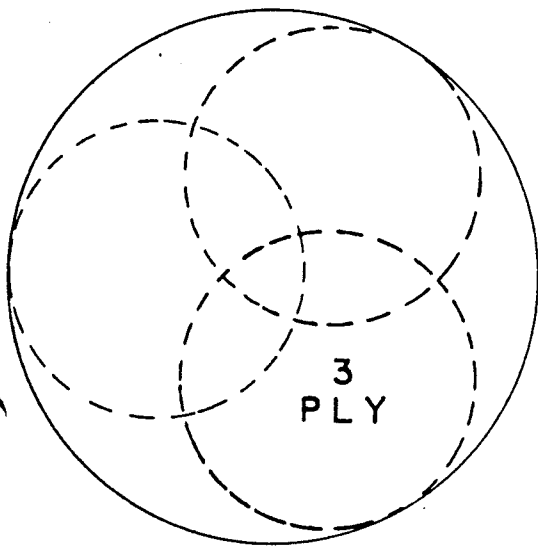
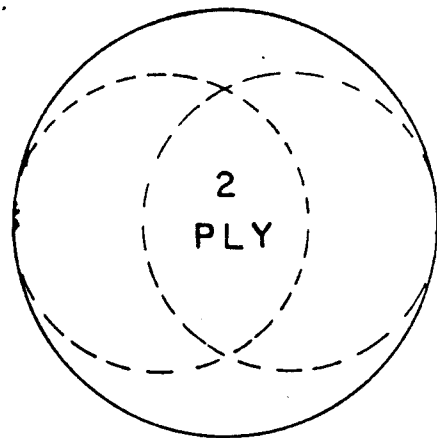
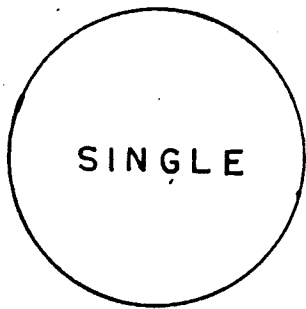
In order that there may be an appreciation of the scope of the dimensions with which we are here working, there is set forth in Plate I, a graphical presentation of the ideal constructions above noted. The single yarns are drawn as true circles in each of the figures and the several small dotted circles, representing the single yarns, within the larger circles are made to overlap in order that the proper number of yarns may be made to fit into the prescribed overall diameters for the several plyed yarns. This overlapping will, of course, not actually occur, nor will the yarns remain truly circular, but rather each yarn will become ellipsoidal and made to conform to the shape dictated by the plying operation. In the same manner, the final shape of the plied yarns will not conform to a true circular cross section as shown but will probably have a shape roughly approximating the outline represented by the group of several small dotted circles within one unit.

The grade and composition of the fibers which are to be made into the yarns and the amount of twist given the single yarn as well as the composite construction will chiefly determine the extent of compaction which will be imparted to the finished yarns. This compaction is reflected in both the yarn diameter and in the density or "cut" as yards per pound.

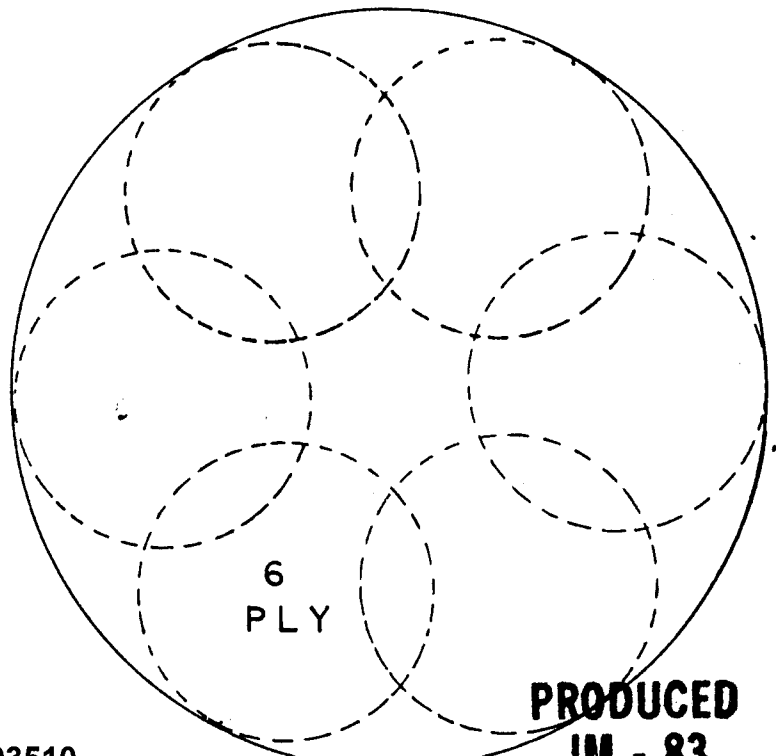
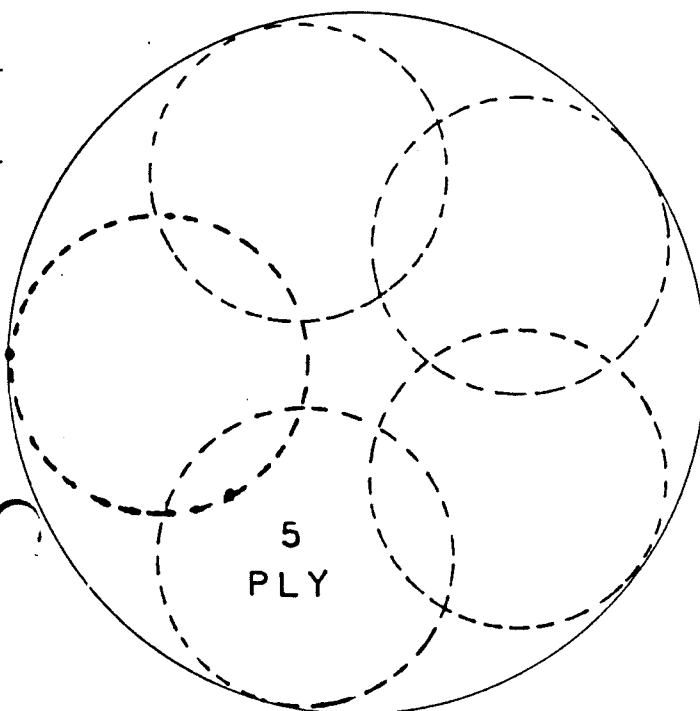
Each manufacturer apparently establishes the twist (T.P.I.) for a given yarn on the bases of end use and the operating characteristics of the spinning

# PLATE I

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equipment used. Whether the yarn is to serve as a warp yarn or a filling yarn in the weaving of a given textile may serve to establish the amount of twist to be given. The tensile strength requirements for a given yarn or for a textile of which the yarn is to be constructed may define the units of twist. The ability of a finished textile to take a treatment may also serve to determine how much twist will be required in order that the most desirable end product will be obtained.

These conditions and requirements are but a few of the many that may be taken into consideration when a manufacturer endeavors to establish the yarn characteristics for a given production. Through experience and the educated judgement of the manufacturer in constructing the yarns, the end use of the textiles produced therefrom are made to conform with the specified requirements and through such versatility have asbestos textiles been made to meet the multiplicity of industries requirements down through the years.

#### Determination of Yarn Diameters

The determination of the diameters of asbestos yarns has apparently never been the subject for unified or industry-wide consideration. The American Society for Testing Materials carries only one reference to a determination for yarn diameter and that refers to glass yarn in specification A.S.T.M. D578-52 wherein such measurements are made by optical means.

Most asbestos textile manufacturers are familiar with micrometer measurements for the determination of the thickness of asbestos textiles and many have adapted this procedure for yarn diameter measurements. Other operators have made such determinations using the ordinary hand micrometer.

Optical methods are perhaps suited for determinations of single filament yarns such as glass yarns, however, we question the adaptability of such a technique for the determinations of staple fiber yarns whether they be composed of asbestos, glass, or other fibers due to the inherent unevenness of such yarns. This point will be discussed in more detail later in this report.

Micrometer methods for yarn diameter measurements can be satisfactory, if properly conducted. The use of the hand micrometer requires perhaps greater care than the drop-hammer type micrometer, however, with the proper technique either of the micrometer methods should yield significant information. The standard drop-hammer type micrometer used in determining the thickness of asbestos textiles requires that the face of the anvils shall be  $0.375" \pm 0.001"$  and that the top anvil shall carry a dead weight of  $6 \pm 0.1$  oz. The use of this instrument as specified will normally yield reproduceable results, however, the weight of 6 oz. does cause excessive yarn compaction and distortion and the difference between hard twisted and soft twisted yarn diameters are exaggerated. This difficulty could be greatly reduced by lessening the dead load from 6 oz to perhaps 2 or 3 oz., or be measuring a greater number of yarns at one time.

It would seem appropriate and desirable to develop a suitable instrument by means of which the diameters of yarns in general and asbestos yarns in particular may be accurately determined. However, prior to such a development, the intended significance of such determinations should be established. For

example, what relationship is to be expected between the actual yarn diameters and the thickness of a textile material into which it may be fabricated. The weaving technique, construction, treatments and degree of calendering on the final product can materially alter finished cloth thicknesses irrespective of original yarn diameters. Therefore, before embarking upon such a development it would probably be fruitful if the problem was first analyzed with a view toward determining the use to which such information might be put and as such what relevancy there might be between the actual or absolute diameters and the useful or practical value.

However, these considerations are beyond the scope of this investigation and no further attentions in this regard will be expended at this time.

### Yarn Measurements

Instrumentation. As was stated earlier in this report, one of the objectives of this investigation was to determine whether or not some method other than the micrometer method might be more suitable for measuring asbestos yarn diameters. The use of the shadowgraph was suggested and a comparison of the shadowgraph and the micrometer methods served as the basis for a part of this work.

In order that a truly comparative set of tests might be carried out, it was deemed necessary that an instrument set-up be devised whereby the yarns under investigation might be measured by the two methods simultaneously in order that conditions of atmosphere, yarn tension and any other variable which might be introduced as a result of individual testing procedures might be eliminated. Such a set-up was made wherein a Federal Thickness gauge and a Bauch & Lomb Projector (shadowgraph) were mounted side by side, six inches apart, and as the yarns under test were reeled off the spools, they were fed through both instruments simultaneously and continuously. Readings on both instruments were taken at the same time at 36" intervals on the continuous yarn strand as it was unreeling from the spool. Ten continuous readings constituted one test.

Yarn Samples. The asbestos yarns included in this work were representative of materials produced by five of the member companies of the Institute. One member company furnished six spools each of five different types of yarn, a second company supplied two spools each of twelve types of yarn and the remaining three companies furnished one spool of each 7, 11 and 13 different types of yarn, respectively. In all, there were thirty-five types of yarn included in this work, covering ten different cuts, four different grades and in plys from single to four ply.

Yarn Measurements. The yarn measurement values are set forth in Tables I and II. Table I includes the values obtained by the micrometer method and Table II sets forth the shadowgraph values. Each of the five vertical columns represents the yarns submitted by each of the five participating companies. The horizontal columns identify each of the yarns as to cut, plys and grade.

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Table I  
Micrometer Method

|              | A     | B      | C     | D     | E     |
|--------------|-------|--------|-------|-------|-------|
| 35/1 - Und.  |       |        |       | .0129 | .0142 |
| 35/2 - Comm. |       |        | .0202 |       |       |
| 35/3 - Comm. |       |        | .0254 |       |       |
| 30/2 - Und.  |       |        |       | .0223 |       |
| 26/1 - Und.  |       |        |       | .0151 | .0141 |
| 24/1 - Und.  |       |        |       | .0169 |       |
| 24/2 - Comm. |       |        | .0280 |       |       |
| 18/1 - Und.  |       |        |       |       | .0188 |
| 18/2 - Comm. |       |        | .0268 |       |       |
| 18/4 - Und.  |       |        | .0400 |       |       |
| 16/1 - Und.  | .0199 | .0196  |       | .0169 | .0191 |
| 16/2 - Und.  |       |        |       | .0312 |       |
| 14/1 - Comm. | .0197 |        |       |       |       |
| 14/1 - Und.  |       |        |       | .0206 | .0192 |
| 14/2 - Comm. |       |        | .0318 |       |       |
| 14/2 - Und.  |       | .0316  |       | .0364 |       |
| 12/1 - Und.  | .0234 |        |       | .0221 |       |
| 12/1 - AA    |       | .02025 |       |       |       |
| 12/2 - Comm. |       |        | .0332 |       |       |
| 12/3 - Comm. |       |        | .0431 |       |       |
| 10/1 - Comm. | .0247 |        |       |       |       |
| 10/1 - Und.  |       | .0263  |       | .0279 | .0304 |
| 10/1 - AA    |       | .0238  |       |       |       |
| 10/1 - AAA   |       | .0224  |       |       | .0226 |
| 10/2 - Comm. |       |        | .0426 |       |       |
| 10/2 - Und.  |       | .03935 |       | .0439 |       |
| 10/2 - AA    |       | .0375  |       |       |       |
| 10/2 - AAA   |       | .0410  |       |       |       |
| 10/3 - Comm. |       |        | .0511 |       |       |
| 10/3 - Und.  |       | .05015 |       |       |       |
| 10/4 - Comm. |       |        | .0586 |       |       |
| 8/1 - Comm.  | .0274 | .0298  |       |       |       |
| 8/2 - Comm.  |       |        | .0477 |       |       |
| 8/2 - Und.   |       |        | .0776 |       |       |
| 8/3 - Comm.  |       | .0567  |       |       |       |

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Table II  
Shadowgraph Method

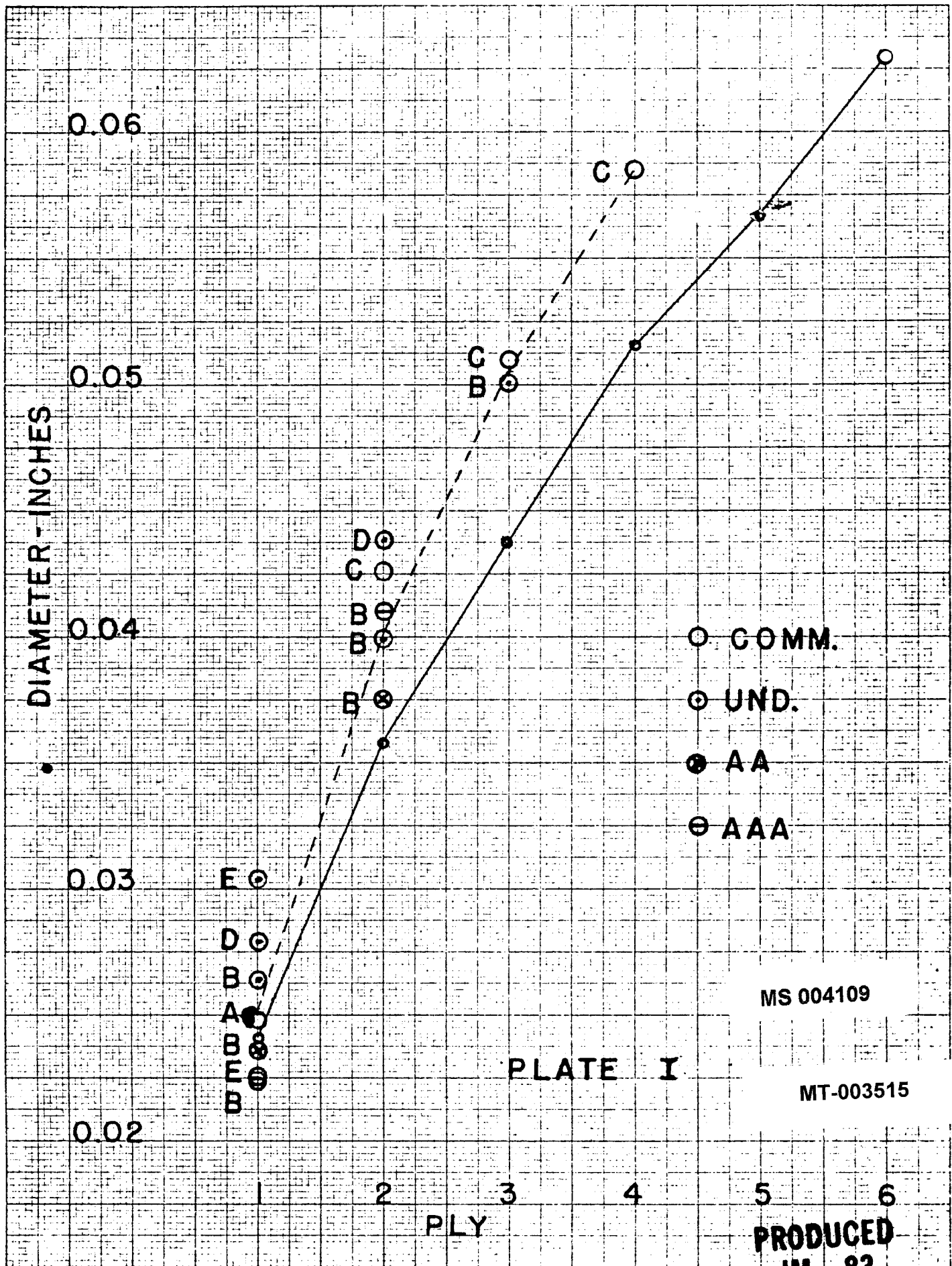
|              | A     | B      | C     | D     | E     |
|--------------|-------|--------|-------|-------|-------|
| 35/1 - Und.  |       |        |       | .0220 | .0194 |
| 35/2 - Comm. |       |        | .0260 |       |       |
| 35/3 - Comm. |       |        | .0325 |       |       |
| 30/2 - Und.  |       |        |       | .0315 |       |
| 26/1 - Und.  |       |        |       | .0195 | .0185 |
| 24/1 - Und.  |       |        |       | .0230 |       |
| 24/2 - Comm. |       |        | .0395 |       |       |
| 18/1 - Und.  |       |        |       |       | .0270 |
| 18/2 - Comm. |       |        | .0365 |       |       |
| 18/4 - Und.  |       |        | .0555 |       |       |
| 16/1 - Und.  | .0323 | .02775 |       | .0295 | .0285 |
| 16/2 - Und.  |       |        |       | .0385 |       |
| 14/1 - Comm. | .0335 |        |       |       |       |
| 14/1 - Und.  |       |        |       | .0395 | .0305 |
| 14/2 - Comm. |       |        | .0430 |       |       |
| 14/2 - Und.  |       | .0505  |       | .0419 |       |
| 12/1 - Und.  | .0351 |        |       | .0350 |       |
| 12/1 - AA    |       | .03375 |       |       |       |
| 12/2 - Comm. |       |        | .0495 |       |       |
| 12/3 - Comm. |       |        | .0565 |       |       |
| 10/1 - Comm. | .0396 |        |       |       |       |
| 10/1 - Und.  |       | .03725 |       | .0350 | .0430 |
| 10/1 - AA    |       | .03825 |       |       |       |
| 10/1 - AAA   |       | .03675 |       |       | .0299 |
| 10/2 - Comm. |       |        | .0485 |       |       |
| 10/2 - Und.  |       | .05775 |       | .0520 |       |
| 10/2 - AA    |       | .05775 |       |       |       |
| 10/2 - AAA   |       | .06375 |       |       |       |
| 10/3 - Comm. |       |        | .0690 |       |       |
| 10/3 - Und.  |       | .06975 |       |       |       |
| 10/4 - Comm. |       |        | .0703 |       |       |
| 8/1 - Comm.  | .0427 | .0445  |       |       |       |
| 8/2 - Comm.  |       |        | .0825 |       |       |
| 8/2 - Und.   |       |        | .0910 |       |       |
| 8/3 - Comm.  |       | .0790  |       |       |       |

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SUBJECT



## Analyses of Results

It will be observed that the shadowgraph readings are all much greater than the readings obtained on the micrometer and are in reality only estimates of true diameters since the fuzzy character of an asbestos yarn is so pronounced that accurate determinations are impossible. This being so, the reliability of such determinations was considered untenable and the micrometer measurements only were adopted as the basis for results which follow. In an effort to present some of the information here determined in a manner most readily understood the data procured for the 10 cut yarns is presented graphically on Plate 2.

In this graphical presentation there are two sets of values for comparison and reconciliation. The solid line defines the yarn dimensions for various plys of ten cut yarn on the basis of the ideal computation as described earlier in this report. The actual values obtained in this work for the several samples of 10 cut yarns received, measured by the micrometer method, are also plotted on this chart and the average values of all of those determined are connected by the dotted line. There are too few samples of three and four ply yarns to really justify the established averages as here shown, however, the trend of the curve would indicate that such results might be expected.

It will be observed that the ranges for values for the singles and 2 ply yarns as here measured are quite wide, ranging from .0224 to .0304 in the single yarns and from .0375 to .0439 in the two ply yarns. It is rather difficult to evaluate the effect of grade on diameter since only one manufacturer supplied more than two grades in these two types. In the singles yarn, one manufacturer supplied samples in Underwriters, Grade AA and Grade AAA, and the same grades of samples in the two ply yarns. In the singles yarn group, the diameter diminishes as the grade improves, however, in the two-ply group the Grade AAA yarn shows the greatest diameter, the Grade AA yarn shows the smallest diameter and the Underwriters grade is intermediate. However, in general, available information would seem to indicate that for yarns of the same cut the diameters will vary inversely with the grade. Reference to Table I will bear out this observation as in the case of company B, 10 cut, singles; company C, 8 cut, 2 ply; and company E, 10 cut, singles.

Referring again to Plate 2, it will be seen that the deviation of the actual measurements from the ideal determinations increases with the number of yarns plied. For example, the average overall yarn diameter for the two-ply yarn is .0045 inches greater than the ideal, the three ply yarn is .0060" greater than the ideal, the four ply is .0070" greater than the ideal, and so on. These same relative relationships appear to exist in the other yarns considered in this work.

## Conclusions

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As a result of the investigations here conducted several basic observations may be made, however, the number of yarns submitted and the number of tests which were therefore possible was so few that undefiable conclusions should not be drawn. Nevertheless, the data here determined and submitted would appear to indicate the following facts to be true.

1. The measurement of the diameter of asbestos yarns should be carried out on a direct reading type micrometer. Neither the ordinary hand micrometer nor the dead weight micrometer such as is used in the determination of cloth thickness are perfectly suited for such measurements and the development of a suitable instrument for such work would seem to be desirable.

The utilization of a shadowgraph for such determinations does not appear to have any merit due to the fuzziness and unevenness of asbestos yarns. The establishment of the true or absolute diameter of such yarns is very difficult, if indeed possible, by this means and must be a mere approximation on the basis of the images so reproduced.

The development of the most suitable micrometer for such determinations will probably require some study and investigation, however, it would seem, at this point, that perhaps an instrument with an elongated foot or anvil and a more sensitive gauge would prove most practical. With a foot, perhaps 1" in length and a lesser load on the top foot, there would be less of a tendency for distorting or compressing the yarn and in measuring over a greater length, an averaging effect would be probable.

2. The diameters of a series of asbestos yarns for any given cut may vary over quite a wide range depending upon, 1) the turns per inch, 2) the batch composition of the raw materials in relation to amount and grade of chrysotile, the amount and type of cotton, the extent and effectiveness of the fiber opening, and the conditions at the spinning frame, 3) the end use for which the yarn may be intended.

The data set forth in this report indicates that there may be marked differences in diameters between the yarns of like cut produced by different manufacturers, such differences undoubtedly being by design, in some cases, and by difference in manufacturing techniques inherent in each manufacturer's type of operation, in other cases. The differences noted between yarns of the same cut but different grades for the same manufacturer would appear to be, in general, consistent with all manufacturers. That is, for yarns of the same cut, the diameters decrease with increasing grades.

3. The diameter range for yarns of the same cut submitted by various manufacturers for this investigation appears to be in excess of a reasonable tolerance. For example, the diameters of three 10 cut, single ply yarns submitted by three different manufacturers were .0263", .0279" and .0304", a range of 0.041". According to the "ideal diameter table", the diameter difference between 10 cut and 11 cut single yarns should be .02412" less .02293" or .00119" and the difference between 10 cut and 14 cut single yarns should be .02412" less .02035" or .0377". In other words, the range found for the three Underwriters grade yarns measured, covers a greater difference than would normally be expected between 10 cut and 14 cut yarns. On the other hand, the one Commercial grade yarn submitted was within .00058" of the prescribed diameter; the Grade AA, .00032" off and the two Grade AAA yarns were off .00162".

In the case of the two ply, 10 cut yarns, the Underwriters Grade yarns covered a range of .00455" or nearly 3 cuts.

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However, it should be realized at this point, that the yarns here under consideration, although at variance as regards diameter, were presumably commercial items and as such were or could ultimately be incorporated into textiles which, again presumably, would meet with approval as far as specified or tolerable thickness is concerned.

4. Finally, the relationship between yarn diameters, as measured by presently known and accepted methods would seem to bear little or no significant relationship with finished textile thickness. Yarn density, expressed as "cut" would seem to provide more relevant information and through the control of this factor within limits, the unique characteristics of each manufacturers spinning and weaving techniques are engaged to the end that the final products of the industry are maintained well within specified limits.

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MINUTES OF THE MEETING OF THE TECHNICAL COMMITTEE OF THE ASBESTOS TEXTILE  
INSTITUTE, HOTEL WARRICK, PHILADELPHIA, PENNSYLVANIA - OCTOBER 6, 1954.

IN ATTENDANCE:

John D. McCluer, Chairman  
Southern Asbestos Company

Johns-Manville Corporation  
W. H. McAlpine  
K. Q. Beyard  
J. L. Tucker

Keasbey & Mattison Company  
R. L. Lanz  
C. R. Frederick  
C. H. Hutchcroft

American Asbestos Company  
E. C. Cutler

Philadelphia Textile Institute  
H. C. Shaw

Raybestos-Manhattan, Inc.,  
H. W. Oliver  
H. S. Haier

The first item of business was to consider the recent draft of MIL-C-10316 under date of August 10, 1954 as prepared by the Detroit Arsenal. This issue is the result of recommendations made by the joint efforts of the Technical and Sales Promotion Committees at the March 1954 meeting at which time two members of the Agency from the Detroit Arsenal were present, Messrs. Reynar and Johnson.

In paragraph 1-2-1, it was recommended that Grade A be changed from 98% to 99% to conform to ASTM grade AAAA, and that after each grade designation, the word "Minimum" be added.

Regarding the change of Grade A from 98% to 99%, there was considerable discussion. In this connection, Raybestos-Manhattan stated their position as follows:

"The asbestos content of Grade A cloth shall be a minimum of 99%. This minimum asbestos content will make the Grade A cloth conform to the AAAA grade recognized by ASTM and ATI, while the asbestos textile industry does not have a 98% minimum grade.

It is felt that Government grade A or ASTM grade AAAA should be specified for applications in which no organic content or inflammable material can be tolerated. This guaranteed minimum of 99% is only a precaution as the pure fiber going thru the cards may pick up a trace of cotton from the card clothing left behind by prior runs of mixes containing cotton. It seems the Arsenal would have need for the best quality obtainable and hence should not compromise with an in-between grade that does not have official standing in the producing industry."

However, since there was a difference of opinion on whether Grade A should be of 98% or 99%, a vote was taken wherein the majority of the companies favored 99% for Grade A.

At the end of paragraph 4-3-2 on Asbestos content a sentence was added as follows:

"The Asbestos content of Metallic Cloth shall be determined after removal of the wire."

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In paragraph 4-3-6-2, after heating, a phrase was inserted in line 5 after the word "air circulating oven" to specify the number of cubic feet of air per minute to conform to that as specified in the latest Westinghouse specification on cloth which is as follows:

Adjust the air flow for not less than 100 or more than 200 CFM with an admission of fresh air equivalent to 2 to 5 CFM.

In Table I, the first cloth under grade C, there apparently is a typographical error. The weight should be 1.40 instead of 1.50 and the ATI designation should be 22P16 instead of 24P16.

In Table II on metallic-wire inserted cloths, the column headed "Asbestos Content" was changed to "Grade" and under this heading, the letters indicating grade were substituted for the numerical values. Also in this table, an additional 3.0 lbs/sq. yd. cloth was added to the list slightly different from the one already included therein. A motion by Mr. Lenz, seconded by Mr. Tucker, and carried that the existing 3.0 lb. cloth be designated by 44T10K and that the one added be designated by 44T10 to differentiate the two cloths.

In Table III, the last column appears as "Industrial Designation". This was changed to "ATI Designation" to conform to the headings in Tables I and II. Other changes were minor, consisting of corrections of typographical errors.

On Specification MIL-C-7637 (USAF) which is an issue from Wright Patterson Air Base at Dayton, Ohio, the committee reviewed this and recommended certain changes for a final draft. In Table I, concerning the untreated base cloth, a tolerance of  $\pm 7\%$  was recommended on the weight and  $\pm 1$  for the number of ends and picks. An additional column for ATI designation was added. Regarding the weight of the finished treated cloth, there was a difference of opinion on the tolerance of weight. The only two companies who manufacture this cloth are Johns-Manville and Raybestos-Manhattan. J.M. favors using the weight values as minimum values, while R.M. favors using them as standard with a plus or minus tolerance. No agreement was reached and these two companies were requested to consider this matter further toward coming to a common solution.

In paragraph 3-5-2, the wording was changed as follows:

"The coating shall be suitably applied and cured and/or vulcanized on both sides of the base cloth. \_\_\_\_\_"

To paragraph 3-5-2, a line was added at the end of the paragraph as follows:

"If the coating cannot be separated from the cloth, the adhesion shall be deemed acceptable."

Otherwise, there were no changes recommended. The Agency has requested and is awaiting our Committee's revision of this specification.

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The ATI list of Metallic Cloths was again reviewed. One correction and three additional cloths were included in the final list, which is presented below.

October 6, 1954 - Revision

ATI List of Metallic Wire Inserted Asbestos Cloths

| Lbs.<br>Sq. Yd. | ATI<br>Style<br>No. | Kind<br>of<br>Wire | Warp<br>Larn | Filling<br>Yarn | Ends<br>Inch<br>(Warp) | Picks<br>Inch<br>(Filling) | Grades<br>Available |
|-----------------|---------------------|--------------------|--------------|-----------------|------------------------|----------------------------|---------------------|
| 2.00            | 32M12               | B                  | 1221         | 1211            | 19                     | 19                         | C.U.                |
| 2.25            | 36M10               | B                  | 1021         | 1011            | 18                     | 8                          | C.U.                |
| 2.70            | 44M10               | B                  | 1021         | 1021            | 18                     | 9                          | C.U.AA.             |
| 2.70            | 44M9                | B                  | 921          | 921             | 17                     | 8                          | C.U.                |
| 2.75            | 44M14               | B                  | 1421         | 1421            | 20                     | 10                         | AA                  |
| 2.75            | 44M8                | B                  | 822          | 811             | 14                     | 11                         | AAA                 |
| 2.75            | 44M8                | M                  | 822          | 811             | 14                     | 11                         | AAAA                |
| 2.80            | 45M8                | B                  | 822          | 811             | 14                     | 10                         | C.                  |
| 3.00            | 48M10               | B                  | 1022         | 1021            | 18                     | 8                          | C.U.AAA.            |
| 3.00            | 48M10X              | B                  | 1021         | 1021            | 20                     | 10                         | AA                  |
| 3.10            | 50M10               | M-B                | 1022         | 1022            | 14                     | 10                         | AAA                 |
| 3.25            | 52M10               | B                  | 1021         | 1021            | 20                     | 10                         | AA                  |
| 3.50            | 56M10               | M                  | 1022         | 1022            | 18                     | 9                          | AAA                 |
| 4.00            | 64M10               | B                  | 1022         | 1021            | 22                     | 10                         | AAA                 |

M = Monel

B = Brass

The above list is being presented to the Sales Promotion Committee for their use as they see fit, such as inclusion in the next revision of the A.T.I. Handbook.

In the afternoon session, the Sales Promotion Committee met jointly with the Technical Committee. Members of the Sales Promotion Committee present were:

Keasbey & Mattison Company  
A. E. Whitfield, Chairman

Raybestos-Manhattan, Inc.  
J. A. Bettes

American Asbestos Company  
A. J. Scanlan

Southern Asbestos Company  
G. J. Harris  
J. T. Griffis

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Johns-Manville Corp.  
E. A. Schuman  
W. G. Hoffer

Union Asbestos & Rubber Co.  
A. R. Byrnes

The two committees meeting jointly again reviewed the recommendations in MIL-C-10316 and MIL-C-7637 and made joint approval of them. Also, the list of Metallic Cloths as prepared by the Technical Committee was jointly approved.

The Technical Committee then met singly and discussed the Table on Braided Tubing. A few additions and changes were made and some data is yet to be received from individual companies. Mr. Tucker proposed a method for

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measuring I.D. by using a tapered mandrell. He showed models of two mandrells made from aluminum metal, one tapered from a point at one end to 1" diameter at the other end. The other mandrell tapered from 1" diameter at one end to 2" diameter at the other end. Each mandrell was approximately 15" long.

The method of using is to slide the tubing on to the tapered mandrell up to where a snug fit is obtained and note the diameter of the mandrell at that point. A cylindrical mandrell of that diameter is then inserted in the tubing and the O. D. determined from which the wall thickness can be calculated. It was suggested that individual companies try this method.

## BRAIDED TUBING TOLERANCES & METHODS OF TESTING

| Company                    | I.D. Tolerance                                                                | Wall Thickness Tolerance                           | Weight Tolerance | Methods of Test I.D.              | Wall Wt.           |
|----------------------------|-------------------------------------------------------------------------------|----------------------------------------------------|------------------|-----------------------------------|--------------------|
| Southern Asbestos          | 1/32"x1 less -0+1/64<br>Over 1/32 Incl, 1/8<br>-0 +1/32<br>Over 1/8 -0+1/16   | Nom 1/64 ±1/64<br>" 1/32 ±1/32<br>Above 1/32 ±3/64 | ±7%              | Tapered 1/2Diff<br>Mandrell OD-ID | Flat               |
| Raybestos-Manhattan, Inc.  | DITTO                                                                         | DITTO                                              | DITTO            | DITTO                             | DITTO Flat         |
| Johns-Manville             | DITTO                                                                         | DITTO                                              | DITTO            | DITTO                             | DITTO Flat         |
| Union                      | NOT                                                                           | REPORTED                                           |                  |                                   |                    |
| Keasbey & Mattison Company | 1/16 & under -0+1/64<br>over 1/16 Inc, 1/4<br>-0 + 1/32<br>over 1/4 -0 + 1/16 | 1/32 ±1/64<br>1/16 to 1/8 ± 1/32                   | ±10%             | DITTO                             | DITTO NOT REPORTED |

A project of trying a wet method for determining per cent dust in asbestos fiber will be tried as round robin test. The method in general consists of making a slurry of a weighed sample of fiber in warm water to which previously has been added a small per cent of Deceresol O.T. (Wetting Agent). The effect of the Deceresol is to distinctly separate the fibers from each other forming a slick slime. When this is diluted with more water and placed in a tall cylindrical glass jar, the fibers being separated and slick, allows the dust particles to slip between them. The fibers will for most part settle to the bottom, others to the top but the dust remains suspended in the tall column of water. This gives a means of separation. The fiber can be removed and dried and weighed, while the water containing the dust can be evaporated and the dust weighed. Detailed procedural directions will be issued to all members. Mr. Tucker agreed to send identical samples of Canadian 3R-34 fiber to all members.

Time did not permit discussion of plain tapes, although it is an active item on our agenda.

In connection with Military and Federal Specifications, a standing committee was appointed to meet with the appropriate Agency when and if it becomes necessary for the Asbestos Textile Institute to contact the Agency relative to specifications. This committee consists of J. L. Tucker, C. R. Frederick and E. C. Shaw.

John D. McCluer

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MS 004116

## MINUTES OF THE MEETING OF THE TECHNICAL COMMITTEE OF THE ASBESTOS TEXTILE INSTITUTE AT HOTEL WARWICK, PHILADELPHIA, PENNSYLVANIA, DECEMBER 1, 1954.

### IN ATTENDANCE

Southern Asbestos Company  
John D. McCluer, Chairman

Raybestos-Manhattan, Inc.  
M. S. Maier  
M. W. Oliver

Keasbey & Mattison Co.  
R. L. Lanz  
C. R. Frederick

Philadelphia Textile Institute  
M. C. Shaw

American Asbestos Co.  
E. C. Cutler

Johns-Manville Corp.  
Wilbur Van Tine  
K. Q. Beyard  
J. L. Tucker

The first item of business was to consider the Interim Federal Specification SS-C-00466A of October 8, 1954 issue which is a specification developed by the Navy Department, Bureau of Ships. This revision is the result of the Institute's recommendations in February 1954 at which time Dr. Shaw and Mr. Frederick contacted Mr. Chilcote of the Agency. The Agency has accepted the tensile values recommended at that time by the Institute. This brought up discussion in our present meeting as to whether we should retain these values which were adopted by the Institute at a time when fiber was less plentiful and more inferior in quality than at the present time. In the discussion, it was pointed out that if we raised the tensile values of cloths mentioned in this specification, we would in order to be consistent, need to re-evaluate the tensile values in the entire ATI list of cloths in the light of present day realistic values. This led to a motion by Mr. Lanz which was seconded by Mr. Tucker and unanimously carried, that the Technical Committee review the tensile values in the entire ATI list of cloths in cooperation with the Sales Promotion Committee.

No further action was taken at this time by the committee toward re-evaluating the tensile values in the subject specification but this was deferred until the afternoon joint session with the Sales Promotion Committee. However, a few other changes were recommended by the Committee. It was recommended that Grade A Class 3 Cloth, which is the Asbestos-Glass combination cloth, be classed as class 5, since this cloth is known as class 5 in the original SS-C-466 and has been catalogued by the Agency as class 5 for a long time. Also, that the "After Heat" tensiles be given a uniform per cent retention of the "As Rec'd" values. That the weight tolerance of Grade C, Class 1 wire inserted cloth be 7% instead of 5% to conform to the 7% allowed in all other cloths in this specification. That an additional sentence be added to paragraph 4-3-1-3 as follows:

"The Asbestos content of glass reinforced or wire inserted cloth be determined after the glass or wire has been removed."

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That the construction of Grade A Class 2 be left unchanged, that is,  $19 \pm 1$  ends, by  $10 \pm 1$  picks per inch. That the Agency be requested to clarify what constitutes a "unit" as mentioned in Paragraph 5-1-2-3.

Specification MIL-C-4117 was again reviewed for further comments. In Table I Type II cloth, the picks should be  $11 \pm 1$  to conform to the ATI list and also to MIL-C-10316. Also, the color stripe should be Blue to agree with Paragraph 1-2-2. In Type III cloth, change picks to  $10 \pm 1$  to agree with ATI list and change thickness in same cloth to  $.070" \pm .010"$ . Also, in Type III Cloth, have alternate construction of filling with one or two wires. In Table II Types VII and VIII tapes should have thickness tolerance of  $\pm .032"$  Type IX tape, after 5 Binders per inch should be added  $\pm 1$ . It was suggested that the Agency clarify what constitutes a unit of tape as mentioned in Paragraph 5-3-1. It was recommended that the color stripes as shown in Paragraph 1-2-2 be indicated for cloth only but not for tapes. In Table II Type VI tape, the warp should be 1030 instead of 1020 yarn. Specification MIL-C-10316 was likewise reviewed and comments made as follows. To improve the wording of first sentence in Paragraph 4-3-1 to:

"A strip 4" in width shall be cut along each selvage edge of the sample and discarded."

In Table III for Grade B Cloth, the temperature for heating the cloth should be 750°F in order to be consistent with the other grades. In Table I, as a Grade C Cloth, add 21 P 16 with construction same as in ATI list.

In the afternoon session, the Sales Promotion and Technical Committees met jointly. Members of Sales Promotion Committee present were:

Keasbey & Mattison Co.  
A. E. Whitfield, Chairman

Union Asbestos & Rubber Co.  
A. E. Byrnes

Raybestos-Manhattan, Inc.  
J. A. Bettis

Johns-Manville Corp.

E. A. Schuman  
W. G. Hoffer  
F. J. Wakem

Southern Asbestos Co.

J. T. Griffis  
G. J. Harris

In discussing the Interim Federal Specification SS-C-00466A, the Sales Promotion Committee recommended to the Technical Committee that the tensile values be revised back to the values shown in the original SS-C-466. The values in the interim specification are the same as those adopted in the ATI list at a time when good fiber was not available. The contention for this recommendation was that it would strengthen the statement recently made that quality fiber is now available in sufficient quantity, and also that it would tend to prevent manufacturers who are non-members of the Institute from meeting the specification with inferior cloth. After considerable discussion without reaching a unanimous decision, it was apparent that no conclusion could be reached in time to respond to the Agency by December 15, which was the dead line for response to the interim specification.

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To obtain a possible extension of time, Dr. Shaw talked to Mr. F. M. Gantt, Bureau of Ships, Washington, D. C., by telephone during the course of the meeting and obtained a verbal extension of time until January 15, 1955. In the meantime, two member companies agreed on values which they recommend for cloths in this specification. Values shown below. These two companies were Raybestos-Manhattan, Inc. and Southern Asbestos Company. The other four companies were requested to let Dr. Shaw know by December 8th, whether these same values will be acceptable to them.

|         | Tensile - As Received |         |
|---------|-----------------------|---------|
|         | Warp                  | Filling |
| Grade A |                       |         |
| Class 1 | 100                   | 45      |
| Class 2 | 80                    | 40      |
| Class 5 | 90                    | 60      |
| Grade B |                       |         |
| Class 1 | 100                   | 45      |
| Grade D |                       |         |
| Class 1 | 130                   | 55      |
| Class 2 | 85                    | 45      |

The Technical Committee then met singly and covered Braided Tubing, Plain Tape and Dust in fiber determination. The data presented to date indicates that three member companies agree on tolerances for I. D. and wall thickness. All agree on  $\pm 10\%$  tolerance from the nominal on ft/lb and all agree on the Flat method for measuring ft/lb. The problem ahead involves averaging the ft/lb. for any given style as made by all manufacturers and using these average values as the nominal in an ATI list. Three member companies agree on following tolerances and other members are requested to advise Mr. Oliver whether these are acceptable to them.

| I. D. Tolerance       |            | Wall Thickness Tolerance |             |
|-----------------------|------------|--------------------------|-------------|
| 1/32" & less          | -0 + 1/64" | Nominal 1/64"            | $\pm 1/64"$ |
| Over 1/32" incl. 1/8" | -0 + 1/32" | Nominal 1/32"            | $\pm 1/32"$ |
| Over 1/8"             | -0 + 1/16" | Nominal<br>above 1/32"   | $\pm 3/64"$ |

Mr. Tucker agreed to bring a tapered mandrell for measuring I.D. and a Cady gauge for wall thickness to our March meeting for members to use on samples of tubing which they had previously measured by their conventional method. This for comparison of results.

On plain tape, considerable data has been accumulated, tho enough has not been assembled for a complete list. Members were requested to send to Mr. Frederick all missing data as soon as possible. Data assembled so far indicates tolerance on ft/lb. to range from  $\pm 7\%$  to  $\pm 10\%$ , on total ends  $\pm 2$ , on picks/inch from  $\pm 1/2$  to  $\pm 1$ , on width for 1" and under  $\pm 1/32"$  and for widths over 1"  $\pm 1/16"$  on thickness  $\pm .003$  for thin tapes to  $-.005"$ ,  $+.010"$  on thick tapes. On per cent dust in fiber determination, Mr. Tucker has supplied each member with identical samples of willowed 3R-3L fiber. He indicated that the willowing had

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been very slight so that the sample was substantially the same as received from the mine. Using the same sample, Mr. Hutchcroft of Heasbey & Mattison used a Clark Rotray-screen classifier. In the test, two discs having 1/4" and 1/8" circular perforations and two screens of 30 and 100 mesh were employed with the -100 mesh fraction being defined as dust. Following are the results of the evaluation.

| <u>Fraction</u> | <u>Weight Per Cent</u> |
|-----------------|------------------------|
| Plus 1/4" disc  | 39.9%                  |
| Plus 1/8" disc  | 16.9%                  |
| Plus 30 mesh    | 12.9%                  |
| Plus 100 mesh   | 5.7%                   |
| Minus 100 mesh  | 24.6%                  |

Using the method suggested by Southern Asbestos and described in the recent memorandum, sufficient time has not been available for a complete round robin test. Southern reported 16.95% dust in the same sample by this method and only 6.03% dust by the Quebec Shaker screen method. In any case, there is considerably more dust in fiber than will be shown by the Shaker screen method. More will be reported on this or by the use of other methods by the time of the next meeting.

John D. McCluer

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