FELLOWSHIP REPORT

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REPORT #48

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Fellowship Report

Introduction

The work of the Fellowship during the past quarter has been directed to attention of two principle problems. The first, a continuation of studies designed to further establish the properties of "Cerbestos" materials and to endeavor to determine industrial applications for such materials; and the second, the revision and clarification of two Federal specifications, namely MIL-C-10316 and MIL-C-4117.

The urgency with respect to the time for action with regard to the specification work served to place the major emphasis on this problem, however the "Cerbestos" work was pursued as time allowed.

Cerbestos

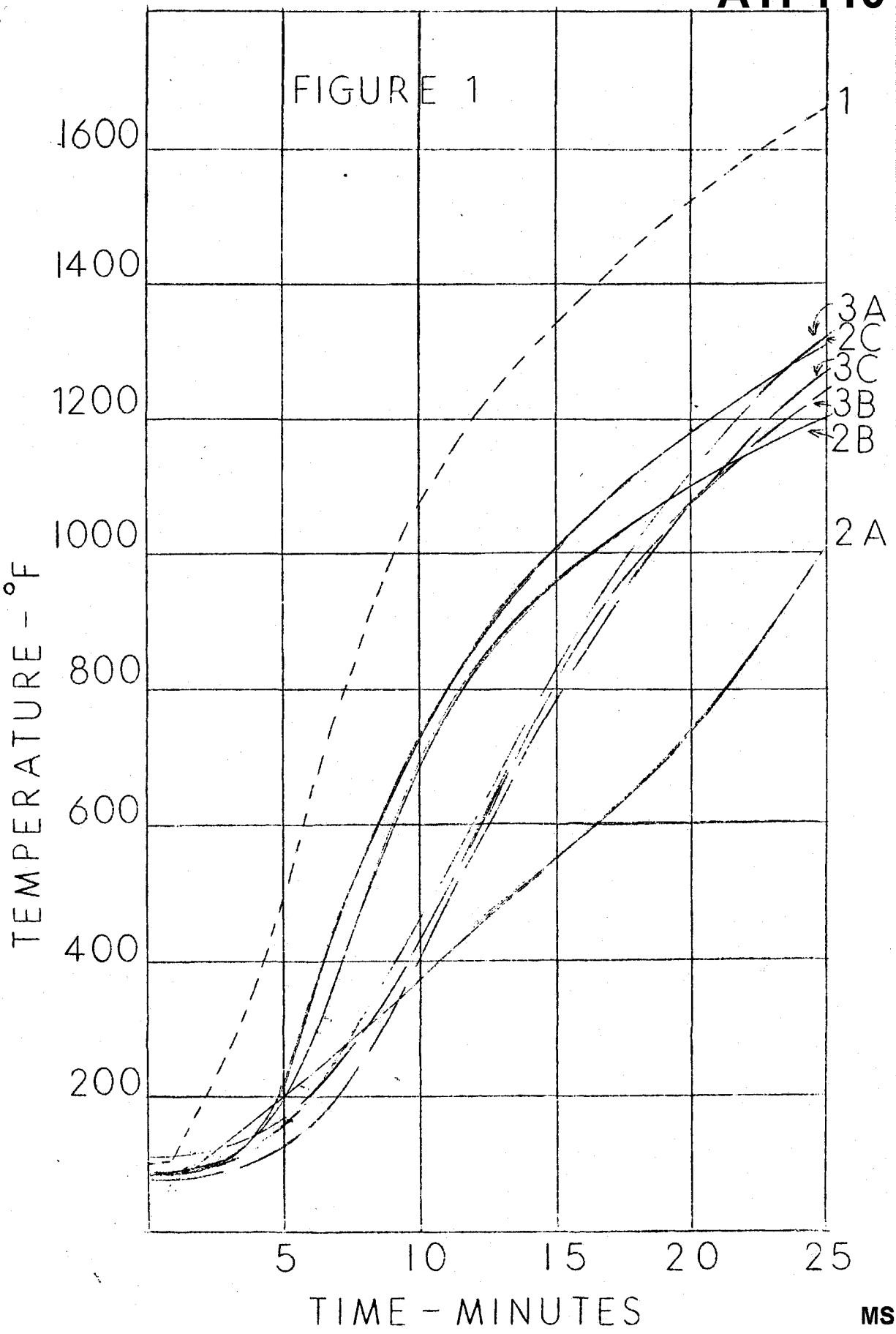
The studies conducted in this investigation were primarily designed to establish the influence of various ceramic coatings upon the thermal reflective insulation and conductive characteristics and the thermal endurance properties of materials so treated.

Reflectivity and conduction properties have been studied by means of a special furnace which was designed for such investigations. In this test, samples 12" x 12" in size are used and are so mounted in the furnace that the heat developed by a flat plate heater element is directed toward and strikes the sample at an angle of 45°. The heat that is transmitted through the sample by conduction is measured by means of a thermocouple mounted within a closed cell immediately above the sample. The radiated or reflected heat is measured by means of a black iron collector or receiver plate so mounted within the furnace at an angle of 45° to the sample that it will receive the incident radiations eminating therefrom. A thermocouple attached to this plate determines the temperature rise induced through reflected heat energy.

The information gained through these tests serves to give comparative or relative conductive and reflective properties for the materials so tested however, it is not intended that the values so determined will be in any way absolute in character.

As a result of these tests it has been determined that the "Cerbestos" treatment does influence both the conductive and the reflective properties, reducing conduction and increasing reflectance. Figure 1 serves to illustrate comparative relationships for these characteristics. In this graphic presentation the dotted curve marked #1 describes the temperature gradient for the duration of the test, attaining 1620°F in 25 minutes. Curves 2A and 3A present the characteristics of aluminum foil when subjected to this test, with 2A describing the temperature gradient for the top cell indicating the conductive properties and 3A describing the temperature gradient for the radiation receiver. Curves 2B and 3B present the properties of a typical "Cerbestos" material, with 2B indicating thermal conductivity and 3B the thermal radiation properties. Curves 2C and 3C present the same characteristics for the base asbestos cloth used in the "Cerbestos" formulation.

FIGURE 1



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It will be noted that the A curves for aluminum foil present the maximum in reflective radiation properties with the radiation receiver showing a temperature of 1080°F while the conductivity cell was only at 700°F., when the heater plate element was at 1500°F. In the case of the plain cloth, C, at 1500°F heater element temperature, the conductivity cell temperature was at 1170°F while the radiation receiver was at 1030°F. Finally, the "Cerbestos" material, B, under the same conditions, the conductivity cell temperature was at 1090°F while the radiation receiver temperature was at 1060°F.

In analysing this data which is typical of a great many tests, it has been found that even though the Cerbestos treatment somewhat increases the density of the final product, certain features involving the refractive index of the ceramic additives contribute to the improved reflective properties. Further studies in this endeavor are being pursued, however, nothing can be reported in this regard at this time.

In addition to the conductivity determinations, tests have been pursued in an effort to establish general high temperature serviceability characteristics. Most of this work has been carried on using tubular samples 2" inside diameter by 8" long. The test procedure consisted of inserting coaxially through the tube a globar heating element and enclosing both ends of the tube so that in effect a tubular furnace was constructed with the "Cerbestos" tube serving as the heat confining or shell member. Using such a device it has been possible to attain temperatures up to 2500°F and hold these temperatures for any desired period of time, some tests having been conducted over a period of several days.

The thermal endurance properties are definitely improved as a result of the "Cerbestos" treatment. The elevated temperature tube tests show the "Cerbestos" materials to possess notable strength and structure even after several days of conditioning at 2400°F. It would now appear that the strength and structure characteristics in the range from 2400°F to 2600°F are the most desirable since it is within this range that the thermochemical reaction between the ceramic oxides and the asbestos fibers yields a structure containing a very viscous glass having not only reasonably good strength but also a range of ductility or plasticity that might well serve some useful purposes.

We have not yet had the opportunity to endeavor to promote this material through contact and conference with possible consumers of such products. It has been our purpose to endeavor to become as well informed as possible regarding the possibilities and capabilities of this material before attempting to find applications for it in industry and in those processes requiring materials with elevated temperature serviceability capabilities.

Recent articles carried in publications covering ordnance and rocket work have referred to specific applications of ceramic material adaptions to meet present high temperature requirements in rocket and jet engine designs. It would seem that if "Cerbestos" materials offer anything of value to meet current demands, an effort to determine the areas of application should be determined immediately if full recognition and advantage is to be gained.

(1) "Missiles and Rockets, March 2, 1959.

Rocket exhaust gas impingement -- For testing the sensitivity of heat-resistant material to high-temperature, high-velocity gases, a specimen was mounted in the exhaust jet of a 220-lb.-thrust liquid propellant rocket. A series of six tests at an average of 60 seconds duration was completed satisfactorily. Although ARF did not name the material, it can be assumed that it was Armour's ceramic-coated metal."

(2) "Ordnance, March-April, 1959.

High-Temperature Material. -- A material that can live through the searing blast of a 5,000-degree Fahrenheit rocket-engine exhaust, unchanged by heat shock or erosion, has been announced by Avco's Research and Advanced Development Division, Wilmington, Mass. Called Avcoite, the new material is a specially designed and highly developed reenforced ceramic that resists gas erosion at extreme temperatures and eliminates structural failure due to heat shock. It is claimed that negligible changes in rocket nozzle throats have resulted at temperatures of 5,000 degrees Fahreheit for test durations of more than 60 seconds with actual rocket motors."

(3) "Ordnance, March-April, 1959.

Large Ceramic Shapes. --Very large and strong ceramic shapes have been produced by Horizons, Inc., Cleveland, Ohio, by a system of winding glass filaments coated with a ceramic colloid and firing at about 1,000 degrees Fahrenheit. Commercail glass fibers that will withstand a temperature of 1,200 degrees are used. The ceramic bonding agent gives a higher heat-resistant temperature to the structure so that it may be used for continuous temperatures to 1,200 degrees. Missile bodies and large radomes are typical applications visualized for the products. The specific gravity runs from 1.5 to 2.2, the flexural strength from 10,000 to 23,000 pounds per square inch, and the dielectric strength is 450 volts per mil."

From these articles it will be noted that the combination of ceramic materials with metals and even glass are finding successful applications in the machines and missiles of today. There is no reason to believe that ceramic-asbestos combinations such as "Cerbestos" should not be equally as adaptable and acceptable.

Federal Specifications

During the past quarter steps have been taken which if continued should result in clarifying the confusion which has been identified with most Federal Specifications.

Our interest at this time is primarily concerned with MIL-C-10316 and MIL-C-4117. Both of these specifications are in the process of being revised and brought up to date and the task of rewriting and reissuing the revised specifications has apparently now been assigned to the agency of the Ordnance Department located at Watertown Arsenal, Watertown, Mass.

In December, 1958, we were informed that this agency had issued a revised Specification MIL-C-4117 and upon inquiry learned that they had also rewritten MIL-C-10316 for revision purposes. Upon receiving copies of the proposed revisions we were alarmed to see many obvious errors and inconsistancies in these two proposed revisions. The membership of A.T.I. was informed regarding these matters and suggestions and recommendations were solicited. Following these actions and with the establishment of our position with regard to the proposed revisions, the Ordnance Agency was contacted and arrangements were made to meet with them at Watertown for the purpose of reviewing the two specifications in question.

On February 17, we met with Mr. C. C. Moore representing the Watertown

Agency, Mr. Reyner and Mr. Piekarski representing the Detroit agency. The results of our deliberations are embodied in the attached proposed revised specifications.

In these revisions we have accomplished several major breakthroughs and can but hope that as these revisions pass through the maze of red tape to ultimate fruition that they will bear some resemblance to what we have here proposed. First, it was suggested that MIL-C-10316 should cover asbestos cloth exclusively and MIL-C-4117 should cover asbestos tape exclusively. Secondly, recognition and inclusion of A.S.T.M. designations for grade were accomplished, except that the words "Commercial" and "Underwriters" were not acceptable due to an implied commercialized nomenclautre. In overcoming this, the initials C.G. have been used for Commercial grade and U.G. have been used for Underwriters grade. Thridly, industrial designations such as 36P10, 45M8 have been included in the cloth lists. These innovations cover the principle changes that have been included and there are probably further revisions which should be made that have been overlooked. The careful study by all interested parties will be appreciated.

It will be noted that in these specifications, as in all Federal Specifications, the test methods to be used are set forth in CCC-T-191a. In most cases, the test methods here established are the same as or very similar to A.S.T.M. methods, the latter presenting the methods our industry most generally recognizes. However, we are now confronted with a test method variation which we must consider and reconcile. The test method in question is for thickness measurements of cloth and tape. The A.S.T.M. calls for an instrument having 0.375" diameter anvils, top and bottom, and a 6 oz. weight. The CCC-T-191a method calls for 1.129" diameter anvils and a 10 oz. weight.

It is our purpose to make a study comparing the two test methods in an effort to determine the range of variations between the two methods. We have a standard A.S.T.M. instrument in our laboratory and the physical testing laboratory of the Philadelphia Textile Institute now has on order a thickness gage, conforming to that designated for CCC-T-191a. Delivery is expected within the next month and our studies will proceed immediately upon its arrival.

Conclusions

The work being carried on with the "Cerbestos" materials would seem to indicate that great versatility with respect to composition, methods of forming and temperature serviceability are possible. Our immediate concern rests in finding possible points of application. We would appreciate learning where such materials might serve some useful purpose.

The specification work, if it can be pursued in the direction of its apparent present course, should yield some of the fruits of the Institute's efforts for the past ten years. Our efforts toward clarification have finally fallen upon receptive ears. It now remains to be seen how effective those who have accepted will be in convincing their superiors regarding the merits of these endeavors.

FELLOWSHIP REPORT

MYRIL C. SHAW

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PHILADELPHIA, PA.

REPORT #49

June 11, 1959

FELLOWSHIP REPORT

During the past quarter we have directed our efforts principally toward the revision of the following Federal Specifications: - MIL-C-10316A, MIL-C-4117A, MIL-I-3053A and SS-C-466a. Conferences have been held with the representatives of the agencies concerned and progress in each instance can be reported.

In the case of Specifications MIL-C-10316A and MIL-C-4117A, the Watertown Arsenal has practically completed these revisions and on our second visit to that agency on May 5, both specifications in their final forms were reviewed. There are still a few points that need clarification, however, it is hoped that this work may be completed within the next few weeks so that the copies for formal review can be issued by the agency in the very near future.

In the case of MIL-I-3053A, we visited with Mr. Van Lear and Mr. Siefert on May 13, to discuss the possibility of initiating certain revisions within this specification. Both men were in general agreement with our original proposals regarding the iron requirement provision of this specification. It was further suggested that we review the entire specification and make suggestions as to ways and means of clarifying the requirements and specifications for all of the materials included.

In pursuing this suggestion, we have rewritten the subject specification and set the format so that it closely follows that used in the Watertown Specifications. The nomenclature, terminology and the A.S.T.M. grading system in the rewritten specification is the same as was followed in the revised specifications MIL-C-10316A and MIL-C-4117A. Further, we have endeavored to organize the subject material in a more logical sequence than has been offered heretofore.

This rewritten specification has not, as yet, been given to representatives of the Bureau of Ships but upon conclusion of a review of this material at this meeting of the A.T.I. it is hoped that we may be able to immediately confer with those representatives.

The final specification under consideration, namely SS-C-466a, also under the authority of the Bureau of Ships, probably offers the greatest challenge in our efforts to obtain some semblence of unanimity in terminology in Federal Specifications covering asbestos textiles.

We met with Mr. Chilcote on May 13, for the purpose of proposing certain format and nomenclature revisions for the subject specification. However, we were informed at that time that that agency had already revised their specification, had submitted the proposals to the printer and would be in a position to send out these revision proposals for review within a few weeks. A few days following our visit, we received from Mr. Chilcote copies of the proposed revisions. The new proposals did not follow our suggested revisions that would place this specification in uniformity with the other specifications we have recently worked with. In addition to the problems related to format, nomenclature and terminology, the agency has added several new cloths all of which are apparently intended to serve the same purpose or end-use as cloths already listed. In the most recently proposed revision, there have been added to the most recently effective specification, dated July 15, 1955, three special light-weight cloths,

referred to as class 3 and two additional asbestos and glass cloths (making 3 in all). Also there are requirements related to napping which are not clear but are considered by some to be of a nature that will perhaps exclude most manufacturers from supplying such materials. We have, therefore, also re-written this specification, in part, setting up the format and terminology to conform with the proposals on the three previously discussed specifications. We have not at this time deleted any of the cloths nor questioned the napping feature as included in the most recent revisions. These matters are subjects for consideration by the Sales Promotion and Technical Committees in session during this meeting.

Following the review of the proposed revisions as offered by the Bureau of Ships and the revisions as offered by the writer, it is our hope that a formal critical review may be drafted by this association that may be offered to the Bureau of Ships for consideration at an early date.

During the course of our review of the several specifications as noted, two subjects of prime importance have been given special consideration, namely, cloth and tape thicknesses and heat aging.

An article in which we report the results of our recent investigation of cloth and tape thicknesses is attached as a part of this report.

Heat aging as the term is applied in two of the four specifications here under consideration refers to two different tests. In specification MIL-C-10316A, heat aging at temperatures up to 800°F is specified and the method of test that has been adopted is the A.S.T.M. method, Designation D 1573 - 58T. However, in specification SS-C-466a, a low temperature heat treatment is specified and we again, as we have in the past, object to the test as it is here set forth. The reasons for our objections to this section of the specification are set forth in our statement which is attached as a part of the proposed revisions for SS-C-466a.

In conclusion, we would suggest that every effort should be made to conclude a critical review of the subject specifications at the earliest possible date so that the results of our efforts may be submitted to the responsible Federal agency or service as soon as possible. It is our hope that it will be possible to have all reviews and considerations concluded so that the reports may be authorized for submission to the services prior to July 1st.

THICKNESS -- ASBESTOS CLOTH AND TAPE

Introduction

The thickness of an asbestos cloth or tape may or may not be significant when defining the characteristics of such materials but will depend upon the use to which they are to be put. Certain electrical tape applications and some packing and gasket applications have space limitations which make thickness an important consideration. However, there are other applications where the thickness requirements are not critical but these dimensions are specified for procurement or purchasing purposes as a means of controlling and assuring product uniformity of the materials so covered.

The consideration of thickness on this occasion is not concerned primarily with the question as to whether or not the inclusion of such properties in a given specification is desirable or essential, but rather is related to the method by means of which such data is obtained. For many years the asbestos textile industry has assumed the A.S.T.M. method for such determination, as covered by the method set forth in Designation D 39-49 and using the gage as described in Designation D 76-53, to be the universally accepted method. However, recent considerations in connection with the revision of several Federal specifications have revealed that the test method applicable for the thickness determination of the textile materials covered in the subject specifications and apparently all Federal specifications must conform to that set up in CCC-T-191b, Method 5030.

A review of the two methods and the results of a comparative investigation by both techniques is here offered.

Test Methods

The two test methods with which we are here concerned follow:

ASTM Designation: D 39 - 49 .... Thickness

5. (a) Gage. - The gage used for the measurement of thickness of woven fabrics shall conform to the requirements prescribed in Section 12 of the Standard Specifications for Textile Testing Machines (ASTM Designation: D 76).

(b) Procedure. - Place the fabric upon the anvil of the gage, smoothly but without tension. Lower the presser foot upon the fabric gradually (without impact), allow to rest upon it for 10 sec, and then observe the reading of the dial. Make similar measurements at not less than five different places, uniformly distributed over the surface of the fabric exclusive of the area adjacent to either selvage, and within one tenth the width of the fabric or within 3 yd of either end of a role or piece. Report the average of the five or more measurements as the average thickness.

ASTM Designation: D 76 - 53 .... Thickness Gage

12. (a) The gage used for measuring thickness of textile materials shall conform to the requirements set forth in Paragraphs (b) and (c), unless otherwise specified.

(b) The gage shall be of the dead-weight type equipped with a dial graduated to read directly to 0.001 in. The presser foot shall be circular with a diameter of 0.375 ± 0.001 in. The presser foot and moving parts connected therewith shall be weighted so as to apply a total load of 6 ± 0.1 oz. (equivalent to a pressure of 3.4 psi.) to the specimen. The presser foot and anvil surfaces shall be plane to within 0.0001 in. and parallel to each other to within 0.0001 in.

Method 5030 ..... Thickness of Cloth CCC-T-191b

1. Scope.
1.1 This method is intended for determining the thickness of woven or knitted cloth. It is not suitable for pile or napped cloth.
2. Test Specimen
2.1 The test specimen shall be a suitably located (see 4.1) area of the cloth at least as large as the presser foot of the gage (see 3.1), free from knots, lumps, creases, folds, or other raised places which are not representative of the cloth surface.
3. Apparatus
3.1 Gage of the dead-weight type equipped with a dial graduated to read directly to 0.001 inch. Unless otherwise specified in the material specification, the presser foot shall be circular with a diameter of 1.129 inches ± 0.001 inch, and with the moving parts connected therewith weighted so as to apply a total load of 10 ounces ± 0.1 ounce to the specimen. The anvil shall be not less than 1.129 inches in diameter. The presser foot and anvil surface shall be plane to within 0.0001 inch, and shall be parallel to each other to within 0.0001 inch.
4. Procedure
4.1 No measurement shall be taken within one-tenth the width of the cloth from either edge when possible. Narrow cloth shall be measured along the center line. The measurement of a roll of cloth shall not be within 3 yards of either end.
4.2 The specimen shall be placed upon the anvil of the gage, smoothly but without tension. The presser foot shall be lowered upon the specimen gradually and without impact, allowed to rest upon it for 10 seconds, and the dial reading taken to the nearest 0.001 inch.
5. Report
5.1 Unless otherwise specified in the material specification, five specimens shall be tested from each Unit-of-Product.
5.2 The thickness of the Unit-of-Product shall be the average of the results obtained from the specimens tested and shall be reported to the nearest 0.001 inch.

Thickness Gage Brands:

ASTM - Federal Products Corp.
Providence, R. I.

CCC-T-191b - Randall & Stickney
Waltham, Mass.

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An analysis of the two gages reveals that the instrument used in the CCC-T-191b method provides a 10 ounce load on a one square inch area or a load of 0.625 pounds per square inch during measurement, while the ASTM method provides a 6 ounce load on a .11 square inch area or a load of 3.4 pounds per square inch during the period of measurement.

On the ASTM gage the area of contact is approximately 1/9 that of the CCC-T-191b gage and the load, per unit area, applied during measurement on the ASTM gage is approximately 5 times that on the CCC-T-191b gage. Obviously then, the resultant thickness measurements for materials that exhibit any compressibility, as do most textiles, will be lower when measured by the ASTM method than when measured by the CCC-T-191b method.

Comparative Thickness Determinations

In an effort to determine the significant differences that would be obtained when both techniques are pursued, samples of asbestos textiles of recent manufacture were obtained from several of our member companies and simultaneous tests were pursued. In this work, five samples, 4" x 6", were taken across the full width of the roll of cloth and three measurements by both techniques were obtained on each of the five samples.

The results of these determinations are set forth in Table I.

Results

It will be observed that in all cases the thicknesses determined by the ASTM method are less than those obtained by the CCC-T-191b method. The average differences between the results obtained by the two methods are fairly constant reflecting the influence of greater area and lesser unit load in the case of the CCC-T-191b method.

In this investigation, only two cloths were studied that had a yarn cut as high as 24, two 17P24 cloths being measured; two cloths in style 22P16 with 16 cut yarns were included and five 26P14 style cloths with 14 cut yarn were also included. In the 17P24 cloths the difference between the two methods showed a variation of from .003" to .004", while in the 22P16 cloth the range was from .005" to .006", and in the 26P14 cloths the range over five samples was from .004" to .006". The ranges in those cloths having 8, 10 and 12 cut yarns were from .006" to .009". These observations merely serve to point out the influence of yarn construction upon the resultant cloth thickness properties.

The greatest variations in thicknesses were induced by calendering. Whether or not the cloth was calendered and the extent to which this operation was pursued seemed to be the primary means of establishing the thicknesses of the cloths here studied. Particular attention is called to style 36P10 cloths in Commercial grade and in Grade AA. In the case of the Commercial grade cloths one sample was found to have an average thickness of .070" when measured by the ASTM method while the second sample measured .088". The same cloths measured by the CCC-T-191b method showed thicknesses of .076" and .093" respectively. In the case of the 36P10, Grade AA cloths, the ASTM readings were .060", .080" and .091" and the CCC-T-191b method readings were .066", .087" and .098"

respectively. The standard cloth list, based upon the ASTM method sets forth .070" as the approved thickness.

The accepted tolerances on thickness for cloths, again based upon the ASTM method, are:

For cloths 0.050 and under	± 0.005
For cloths over 0.050	+ 0.010 − 0.005

It will be observed that the permissable tolerances, when considered only on the basis of A.S.T.M. measurements, are exceeded in many instances, as in styles 34P10, 36P10, 40P10 and 53 T12.

Since the conditions of test under the CCC-T-191b method are different it is reasonable to assume that the standards to be proposed for each cloth under this latter method will mecessarily have to be proportionately higher and the establishment of acceptable standards for this latter method is therefor the subject of concern at this point.

Conclusions

The subjects with which we have been here concerned have been related to 1) the thicknesses of those cloths listed in the several Federal Specifications when tested in accordance with Federal Specification CCC-T-191b, Method 5030, and 2) determining the relative merits of the ASTM method when compared with the CCC-T-191b method.

1) We have set forth in Table I, column 7, recommended thicknesses based on the CCC-T-191b, Method 5030, for those cloths included in this work and which were representative of current materials of manufacturer. Two exceptions are noted, namely style 36P10, C.G. and 36P10, Grade AA. It would seem that an industry-wide consideration of the variations found in the two above noted groups should be given attention in an effort to bring these figures within tolerable limits.

It should also be observed that the figures obtained on the basis of the ASTM method measurements exceed the tolerable limits in the cases of 36P10, C.G.; 36P10, U.G.; 36P10, AA; 40P10, C.G.; 40P10, AAA and 53T12.

2) With regard to the relative merits of the two methods of test, it would seem that the test method set forth in CCC-T-191b, wherein the gage with the larger foot is utilized, should contribute to more reproduceability than is afforded by the ASTM gage with the smaller foot and anvil. The data accumulated to date would seem to bear out this observation.

The question that now presents itself is -- should consideration be given to the possibility of revising all of the data related to thickness that has been accumulated over the years, in conformance with the CCC-T-191b method or should two sets of standards be recognized?

Thickness -- Asbestos Cloth and Tape

Table I

Style	Grade	Number of Samples	Method of Measure A.S.T.M.	Method of Measure CCC-T-191b	Recommended Thickness A.S.T.M. Standard Cloth List	Recommended Thickness CCC-T-191b Proposed
17P24	U.G.	2	.031 .037	.034 .041	.035	.038
21P10	C.G.	1	.060	.065	.055	.062
22P16	AAA	2	.059 .047	.064 .053	.051	.056
22P10G	U.G.	4	.057 .052 .058 .059	.062 .060 .066 .066	.052	.062
26P14	U.G.	4	.051 .056 .057 .056	.055 .062 .062 .062	.053	.056
26P14	AA	1	.052	.058	.053	.056
34P10	U.G.	1	.084	.092	.062	.090
36P10	C.G.	2	.088 .070	.093 .076	.070	?
36P10	U.G.	5	.086 .072 .080 .077 .081	.092 .079 .088 .084 .089	.070	.083
36P10	AA	3	.091 .080 .060	.098 .087 .066	.070	?
36P10	AAA	3	.087 .091 .081	.092 .097 .088	.070	.091
38P12	AAA	1	.074	.079	.065	.080
40P10	C.G.	2	.090 .085	.097 .093	.075	.093

Thickness — Asbestos Cloth and Tape

Table I -- Continued.

Style	Grade	Number of Samples	Method of Measure A.S.T.M.	Method of Measure CCC-T-191b	Recommended Thickness A.S.T.M. Standard Cloth List	Recommended Thickness CCC-T-191b Proposed
40P10	U.G.	4	.081 .075 .074 .083	.086 .080 .079 .091	.075	.083
40P10	AA	2	.071 .081	.077 .086	.075	.090
40P10	AAA	1	.088	.095	.075	.090
53T12	AAA	1	.092	.099	.080	.095
56T8	--	1	.106	.115		.115
59T12	AAAA	1	.087	.094	.080	.090

FELLOWSHIP REPORT

MYRIL C. SHAW

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PHILADELPHIA TEXTILE INSTITUTE

PHILADELPHIA, PA.

REPORT #50

September 11, 1959

INTRODUCTION

The Fellowship activities during the past several months have been devoted, chiefly, to two main projects, namely, (1) Federal Specification clarification and revisions and (2) the further development and study of "Cerbestos" materials. However, in addition, certain consideration and actions have been pursued in carrying out the assignment given the Fellow as Chairman of the task group for Subcommittee A-4, D 13 of the American Society for Testing Material, concerned with asbestos content determinations for unique or unusual asbestos textiles which may contain glass or other inorganic fibers in addition to asbestos. Also, we have prepared and supplied new standard magnetite samples to be used in the calibration of the standard Mapes analyser in accordance with recommended A.S.T.M. practice.

FEDERAL SPECIFICATION

Special efforts have been directed to the attention of the Bureau of Ships specification SS-C-466b. The Bureau of Ships issued proposed revisions to this current operative specification on April 1st and set August 12, 1959 as the final date for submission of comments to the proposed revisions. We have made an effort to pursue this matter and to keep the Asbestos Textile Institute membership advised as developments occurred. On June 18, the writer along with Mr. Griffis, President of A.T.I. and Mr. George Goll, Government representative for Keasbey & Mattison Company, met in Washington, D. C., with Mr. Chilcote to discuss the new proposals as offered and to clarify certain points of contention. The proposals as discussed at this conference were then incorporated in a new draft of the proposed specification and this new issue was circulated among the members of the Institute for further consideration. Following a reconsideration of these latest proposals the member companies of the Institute submitted further suggested revisions which were incorporated into a composite form that was formally submitted as the Institute proposal.

During the course of the considerations there were suggestions that all of the cloths listed in the old class 3 group and in the old class 5 group were not necessary and there were recommendations that these groups might be cut down to one or two cloths each. However, reconsideration dictated that all of the cloths as listed be carried.

Also, there was criticism directed to the use of the term "napped" for the old class 3, 0.70# cloth. By strict definition we feel that the term is incorrect as here applied and could eventually lead to some misunderstanding. However, if there is complete understanding and agreement between the supplier and the consumer as to what is implied and what is expected, there is perhaps no need for concern.

In our composite recommendations covering the proposed specification, as submitted to the Bureau of Ships, the suggestion was made that the format and nomenclature be made conform with established practices in specification writing and to incorporate the grading system for cloths as established by the American Society for Testing Materials rather than the "one of many" grading systems currently found in Federal Specifications. Also, it was recommended that the tensile strengths for the several textiles included be in conformance with the Asbestos Textile Institute Standard Cloth List. These recommendations covered our suggestions for inclusion in the proposed revisions.

Action concerning all of the recommendations received in connection with the proposed revision is apparently being taken at this time and the specification in its final approved form should be issued in the near future.

Endeavors concerned with revisions for Specification MIL-I-3053A, MIL-C-10316A and MIL-I-4117A have also been going forward and progress can be reported. Specification MIL-I-3053A was practically rewritten to conform with accepted format and nomenclature and a meeting with Mr. Van Lear and Mr. Seiffert following this rewriting seemed to indicate that general acceptance of our recommendation would be accomplished. The final two specifications, namely MIL-C-10316A and MIL-I-4117A have not received any further consideration by us since the last meeting. These specifications, in the form offered at that time, are currently being studied at the watertown Agency and further word in this connection is expected in the near future.

CERBESTOS

Further investigation and developments in connection with Cerbestos materials have been designed to advance our knowledge with regards to its application in known fields of interest. For example, in our discussion with Army Ordnance representatives we were queried as to the possibility of applying such materials to high temperature exhaust systems such as might be found in heavy tank or automotive equipment. In such applications temperatures well over 1000°F may be encountered and the abuse is such that present-day conventional mufflers have but very short life. However, such applications do require ruggedness, strength and the ability to withstand thermal shock.

We have also been queried as to the insulation properties of such materials at temperatures of from 1000° up to 3000°F and higher.

Our research and experience with this material is far too meagre to enable us to give a quick answer to inquiries such as these and even with some such data it is reasonable to assume that conditions of test and application will serve to alter and determine the limits and usefulness of these materials as they are placed in service.

However, we have endeavored to pursue investigations designed to throw some light on a few of the questions that have been directed to us. There are here on display just a few of the great many samples and specimens that have been made and tested thus far. Our standard test specimen is the tube 12" long with a 1" hole and an outside diameter of a dimension satisfactory to meet the requirements for a specific test. The ceramic slip compositions have been varied to meet temperature serviceability requirements and the type of asbestos cloth used has also been varied as can be seen. We have included in this group samples of "Fiberfrax" cloth and a sample of Fiberfrax-asbestos combination cloth both of which have been given the "Cerbestos" treatment.

Also included is a sample of metal clad "Cerbestos". The type of metal and the thickness were not what we desired when this work was initiated, however, the sample as here fabricated did serve to provide a test unit which exhibited the general characteristics and properties of the construction as originally envisioned. Such a metal cased or clad refractory unit offers unlimited

possibilities and it is felt that with the ease of fabrication as embodied in the "Cerbestos" technique many new areas of development may be opened.

The nature of "Cerbestos" materials and the method of affecting the structure of such materials have been fully covered in earlier reports. In our current work improvements have been made in the ceramic slip compositions and more refractoriness has thereby been affected. Also, glazing and surface treatments have been attempted and while the present "state of the art" leaves much to be desired, there is sufficient promise in the prospects to warrant further consideration and work.

The heat treated samples here displayed have been so treated by (1) total immersion in a Globar furnace at temperatures up to 2500°F for periods up to 8 hours and (2) by internally or "core heating" the tubes by means of a Globar heating element contained in and running the full length of the specimens, such treatments being conducted at temperatures up to 2600°F for periods of 24 hours. Also, be means of the second mentioned technique, heat loss or insulation characteristics have been given a cursory study.

As a result of the studies here undertaken it is obviously clear that "Cerbestos" materials to be used as tubing or that may be subjected to heating from within can be formulated to withstand temperatures above 3000°F for several hours. As for the serviceability at temperatures of 5000°F, 10,000°F or 15,000°F for periods of from a fraction of a second to up to 10 seconds, we have no experience and the facilities available to us for such studies do not appear to promise anything capable of such temperatures within the foreseeable future. However, it is inconceivable to me that these materials would not stand such conditions if, as reported, plastic formulations have been found to do so.

With regard to the insulation properties of these materials the graphic presentation as set forth in Figure I serves to illustrate this characteristic. This data is typical of the general "Cerbestos" compositions and the rate of heating is as rapid as our present equipment will permit.

It will be observed that a peak temperature of 2500°F was attained within the tube in 25 minutes and, as this temperature was maintained for an additional 35 minutes, the outside or shell temperature reached a maximum of 650°F in 35 minutes. The typical heating-up and cooling-down gradients are shown and the temperature differences at any given temperature for the rate illustrated can be ascertained.

In conducting this test on the metal-clad sample it was observed that there was no tendency for the "Cerbestos" liner to release or become loosened from the metal shell but rather the fit appeared to become ever tighter. This is reasonable to expect when it is realized that the thermal expansion of the inner or Cerbestos material, at 2500°F, is considerably greater than that of the metal shell at 675°F. This condition serves to place the "Cerbestos" liner under compression, a state which affords the greatest strength properties for all types of ceramic materials below the point of viscous flow.

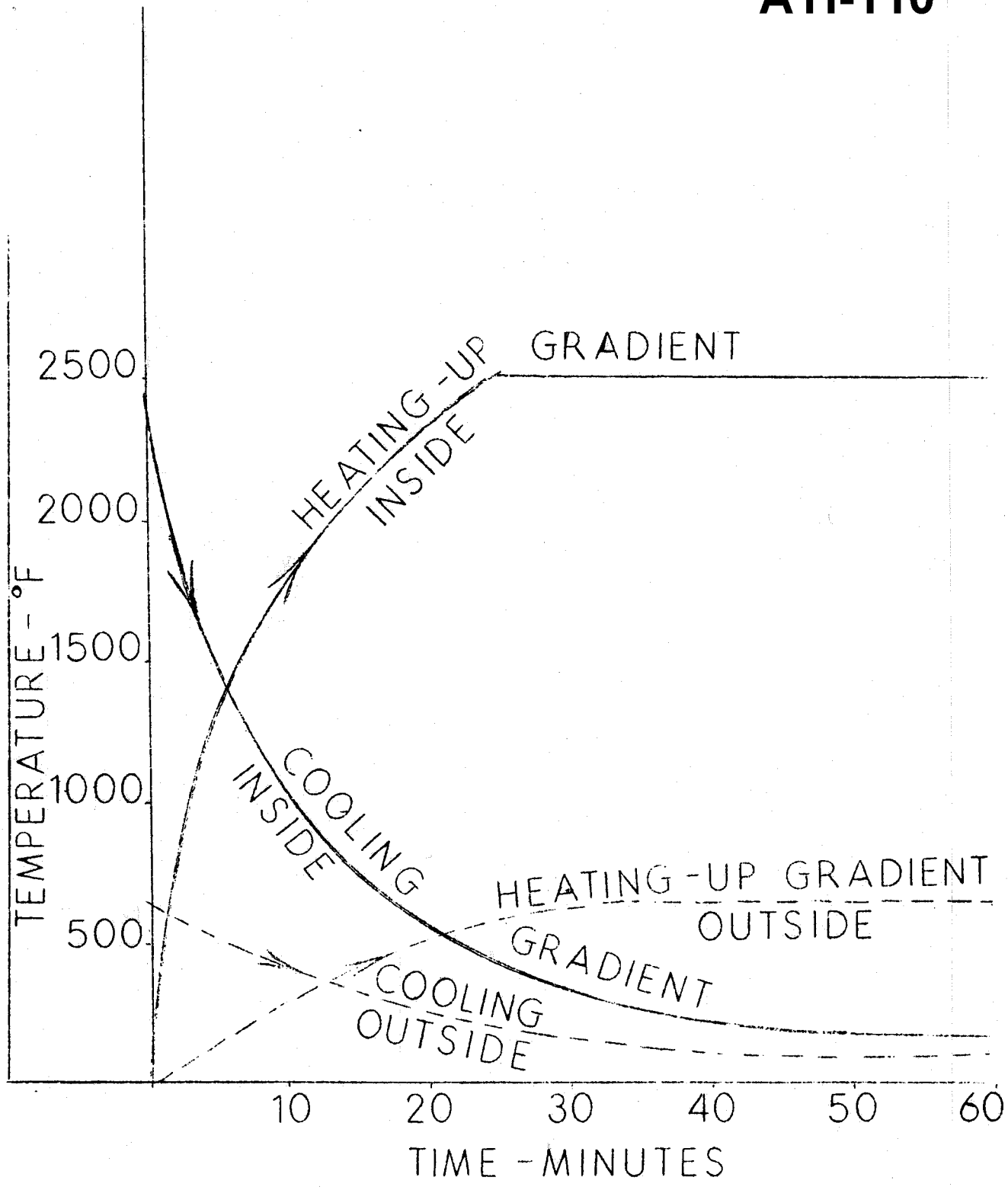

FIGURE 1

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The practical applications for materials so fabricated would seem to be numerous in present day rocket and jet constructions and in services where materials in a liquid state at extremely high temperatures are to be transferred.

It is our intention to continue this work adapting much thinner and therefore lighter weight tubing with "Cerbestos" compositions that will provide the maximum in refractoriness and insulation properties.

We are also interested in glazing certain "Cerbestos" compositions to affect improved strength and to provide a material with very low or zero porosity.

CONCLUSIONS

(1) Our work as it has been concerned with proposed Federal Specification revisions has, we trust, been executed to the satisfaction of all parties concerned. We have, on occasion, taken issue with certain suggested revisions when we felt that an opportunity for misunderstanding was being written into the specification. However, our final position, in the case of the Bureau of Ships specification, SS-C-466b, was truly a composite of the suggestions by our membership with all views, as expressed, being submitted for consideration.

We do feel that as the four specifications as they are currently being revised are made effective they will provide much clearer and more meaningful specifications than have been heretofore available.

(2) With respect to the research work being conducted on "Cerbestos", we still seek guidance and suggestions as to how far and in what direction we should proceed. We know that certain member companies are exploring the possibilities and capabilities of these materials and we are providing assistance as it is requested.

We feel certain that the capabilities of these materials are unlimited and feel further that as they are properly adapted and applied they will provide some of the important refractory materials that the rocket and jet engine fabricators today so desperately seek.

The samples we have on display here today are markedly superior to those exhibited just a year ago when we first introduced this material, but even so, they provide only a very rough idea of what the final or ultimate "Cerbestos" material will be like as improved materials and fabrication techniques are evolved through the research program we now have under way.

FELLOWSHIP REPORT

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REPORT #51

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Introduction

During recent months the Fellow has directed attention primarily to three major considerations, namely, 1) Federal Specification Revisions, 2) Asbestos tape applications as duct tape and 3) Cerbestos. In addition, the semi-annual meetings of the American Society for Testing Materials were attended and problems related to 1) the method for the determination of thickness of asbestos textiles and 2) the method for the determination of the asbestos content of asbestos textiles which contain glass, were considered.

Project Reports

Federal Specification Revisions:

The formally revised specifications being processed and issued by the Watertown Arsenal Agency, Specifically MIL-C-10316B and MIL-T-4117A, were forwarded to all interested parties in October, 1959 for review. Instructions were given by the Agency at that time that replies related to these specifications should be returned to them in early December, 1959.

The specifications as revised and issued for review are, for the most part, in general agreement with the recommendations that the industry has been making for the past several years and except for some minor changes appear to be generally acceptable.

Proposed revisions for Specification SS-C-466b and MIL-I-3053A, both of which are now being serviced by the Bureau of Ships are still being reviewed by that Agency. Action in regard to the revision of these latter specifications is anticipated in the near future.

Asbestos Duct Tape.

At the last meeting of the Asbestos Textile Institute it was pointed out that asbestos tape is rapidly being replaced in hot-air heating system duct work in new home construction by certain less thermally-stable tapes as joint sealing materials. The safety feature and the life expectancy of organic tapes for such service is understandably considerably less than would be expected from asbestos tape. Since it was felt that the volume of tape that would be required to satisfy this market would be quite large, it was recommended that an effort be exerted by the Institute to reclaim this market. It was suggested that since the Federal Housing Authority, in its specification for Property Standards had dropped all references covering this subject, it might be advisable to confer initially with F.H.A. in this regard.

A conference with the specification engineers in the Washington, D. C. offices of FHA, revealed that in the publication by this agency titled "Minimum Property Standards" FHA #300, the specifications and standards applicable in the construction of living units such as those with which we are here concerned are, for the most part carried and detailed in published standards and technical data handbooks as furnished by some 170 industry associations, national code organizations, etc. The organizations referred to as those specifically interested in the subject of concern to us at this time, namely, hot air heating systems and the duct work connected herewith were: 1) American Society of Heating and Air Conditioning Engineers, New York, 2)

National Board of Fire Underwriters, New York, and 3) National Warm Air Heating and Air Conditioning Association, Dleveland, Ohio.

In pursuing this matter, each of the above associations was contacted and the published standards and technical data issued by each obtained. The American Society of Heating and Air Conditioning Engineers in a volume of compiled test data and installation recommendations makes no reference to the use of asbestos tape in duct work. As a matter of fact, great detail is given to air duct design but in this presentation the only reference to duct connectors is set forth as follows:

"Heavy canvas connections are recommended on both the inlet and outlet to all fans. Self-vulcanizing adhesive tapes are available for this purpose and for sealing joints in duct-work. Where a fire hazard exists, the material used must satisfy the requirements of any codes or authorities having jurisdiction."

In a letter received from Mr. H. T. Gilkey, Director of Technical Services for the National Warm Air Heating and Air Conditioning Association, in regard to this subject, he says in part:

"All recommendations on duct construction and duct materials which are contained in the manuals of the National Warm Air Heating and Air Conditioning Association are based upon the standards of the National Fire Protection Association and the National Board of Fire Underwriters. These requirements are specifically stated in NFPA No. 90 B "Standards for the Installation of Residence-Type Warm Air Heating and Air Conditioning Systems". The standard is published in identical text and identified by the same number as publication of The National Board of Fire Underwriters. We also recommend that vibration isolation connectors be used in duct systems. Pamphlet 90B specifies that such connectors shall be made of woven asbestos or approved flameproofed fabric or shall consist of sleeve joints with packing of rope asbestos or other approved non-combustible materials. The term "approved flameproofed fabric" refers to material which meets the requirements of NFPA, NBFU, No. 701 "Flame-proofed Textiles"."

In pursuing this search further the National Board of Fire Underwriters, New York, was contacted and from them was obtained the most recent publications related to the subject of concern. Standard NFBU 90A covers "Air Conditioning and Ventilating Systems of Other than Residence Type", and in paragraph 117 states: "Ducts shall be made reasonably tight throughout and shall have no openings other than those required for the proper operation and maintenance of the system. Tape may be used for sealing joints but where exposed to the air in the duct, it shall be not more combustible than approved flameproof fabric". The term flameproof here refers to a fabric that is carried on the Fire Protection Equipment List published by the Underwriters Laboratories, Inc. Standard NFBU 90B covers "Residence Type Warm Air Heating and Air Conditioning Systems" and in this publication reference is again made only to the use of approved "flameproof fabrics".

As a result of this survey it is obviously clear that little or no thought has been given the desireability or the necessity of using an elevated temperature-stable and serviceable material rather than the organic, low-temperature serviceable material that may have perhaps been flameproofed.

The flameproofing while reducing the flaming or burning hazard contributes little if anything to the elevated temperature strength and structure properties.

Having been assured that a considerable volume of business might be realized if asbestos tape or some other asbestos textile materials were to be considered essential for this service, it appears logical that a program of research should be initiated to establish the necessity for specifying only asbestos textile for such applications. An investigation in pursuance of this end would include tests whereby serviceability degradation at those temperatures normally encountered in hot-air systems would be compared for a variety of material that would include all of those materials currently used in this service, such as cotton duck, asbestos and any other organic textile, flameproofed and not flameproofed. A thorough investigation properly executed and the results properly promoted would perhaps effectively serve in promoting the use of asbestos textiles in this field.

An opportunity to undertake such a program of study will be welcomed by the Fellow if it is the will of the membership and if this desire is reflected through action by the project committee, placing such a project on the current Fellowship project list.

In further consideration of this subject we have been advised regarding "Guide Specification for Military Construction, Heating System, Forced Warm Air; Gas-Fired Furnace, Spec. CE-301.12", wherein heating unit constructions for government installations are covered. In referring to flexible duct connections it reads, "Flexible connections of asbestos or glass fabric, to prevent transmission of vibration through the ducts to the rooms, shall be installed on both the supply and return sides of the heat exchange ..... . Cloth used for flexible connections shall be of proper weight and strength for the service required, and shall be properly filled to be rendered relatively air tight".

In this specification there is at least recognition of the fact that an inorganic type material is necessary. Our task in this case would be to endeavor to promote asbestos over glass. However, the problem that is most pressing at this time is not glass but rather the organic textiles and it would appear logical that our attention should be focused on that point.

Cerbestos

Investigations designed to further establish the properties and characteristics of "Cerbestos" materials have been continuing. Two member companies have been exerting a considerable amount of time and effort in promoting this unique material and in endeavoring to learn where it might serve in meeting the present day requirements for high temperature serviceable materials. There are service requirements today where moderately high temperatures, in the range of 1500°F to 2500°F, are encountered in combination with conditions of high oxidation or corrosive action. Under such conditions most metals do not provide the necessary serviceability and a new class of materials is being sought for this service. Reference to the Special Missle/Space Materials Issue of the Publication "Missles and Rockets", November 23, 1959, provides a challenging picture of the requirements for the new material necessary in order that progress may be realized.

We feel that Cerbestos materials may well serve as an answer to many of the problems currently being confronted and problems envisioned for the future. These materials in their present form and stage of development are undoubtedly quite different from that which might be required to meet a specific service, however, until some indication is given as to the specific properties and characteristics required, it will be difficult to fabricate a truly applicable and serviceable construction. We are gradually learning some of the basic requirements being sought such as size, shape and temperature range of serviceability for some special applications and are exerting our efforts to formulate materials to meet these requirements. It is hoped that through such developments further application of these materials may be promoted.

Conclusions

The results of the efforts of the Institute executed over the past ten years to clarify and unify specifications, Federal Specifications in particular, are finally bearing fruit as is evidenced by the remarks presented earlier in this report covering this subject. In addition to the Federal specification considerations reported, we have also met with the American Standards Association and will in the near future undoubtedly be called upon to assist that organization in bringing their specifications related to asbestos textiles up to date. Also, our participation in the work of the American Society for Testing Materials has served to clarify certain portions of these specifications.

Whether or not it is desirable to pursue this specification work further as it is related to duct tape is a subject for consideration and decision by the membership. It would seem that perhaps this is an area where sales promotion might well be served through such considerations.

The work represented and covered by this report has been such that the schedule of the Fellow has been fully occupied, however, it may well be that there are other problems or projects of interest to the members of the Institute which should take presidence over some of those currently being pursued. We will welcome suggestions from any of the members in this regard, however, it is our understanding that a meeting of a committee responsible for the establishment of a project list for the Fellowship work is to be held in the near future and any suggestions to be proposed should be cleared through this committee.