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XII. USES AND REQUIREMENTS OF USE

Textile Products

General features

Asbestos has a great variety of uses. For some of them the requirements are quite exacting. For others fibers of varying quality and character may be used, and grades are interchangeable to some extent, depending upon price and availability. The longer fibers (such as Canadian groups, 1, 2 and 3; Rhodesian C. & G. 1, C. & G. 2, and to some extent C. & G. 3 and VRA2; Swaziland SVL1 and SVL2; the longer African and Australian blue fibers; and Russian C-1, C-2 and I-2) are adaptable for making textile products (such as cloth, yarn, tape, rovings, etc.). The asbestos is spun and woven in much the same way as cotton, silk, or wool.

An outstanding characteristic of asbestos fabrics is their fireproof quality. Also they have superior heat-insulating properties but lower tensile strength than products made from other fibers. The low tensile strength is not due to lack of strength of the individual fibers, which in many instances are as strong as or stronger than silk; it is due to their shortness, because fiber lengths generally range from 1/4 to 3/4 inch. Because of the shortness and smoothness of the fibers, it is difficult to make a 100-percent asbestos cloth, and only small quantities, applied to specialized uses, as in electrolytic cells, are now manufactured.

To give adequate strength to asbestos fabrics, cotton, rayon, or other organic fibers are blended with the asbestos in varying proportions. As the organic fiber content is increased the strength increases, but the resistance to heat decreases. Accordingly, the proportion of organic fiber is adjusted to suit the conditions of end use. The higher the asbestos content, the more difficult are the manufacturing processes, but these difficulties may be overcome to some extent by making a heavier cloth. Table 27 presents the standard code under which asbestos fabrics are classified and the heat resistance of each grade. 1/

Asbestos fabrics are used extensively for lagging cloth, brakeband linings, clutch facings, safety clothing, curtains, packings, gaskets, and various other applications.

1/ Tucker, [illegible]. Blending Fibers for Fabrication of Asbestos Textiles. Asbestos, Vol. 32, No. 12, June 1951, pp. 4-11.

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TABLE 27.--Asbestos content and heat resistance of Asbestos Fabrics

Grade	Asbestos content, percent	Maximum temperature for end use, degrees Fahrenheit
Commercial	75 to, but not including 80	350 - 400
Underwriters'	80 to, but not including 85	400 - 450
A	85 to, but not including 90	450 - 550
AA	90 to, but not including 95	550 - 600
AAA	95 to, but not including 99	600 - 750
AAAA	99 to, and including 100	750 - 900

Spinning-grade fibers are used also for certain nonspinning uses, such as compressed sheet packings and gaskets. Another important non-textile use is the manufacture of low-iron spinning-grade fibers into strong asbestos paper known as "Pyrotex". When used in tape form for wrapping electric wires, it is said to make a covering superior to that obtained by wrapping the wire with asbestos roving. 2/ Because of their superior electrical resistance, Rhodesian C. & G. 1 and C. & G. 2 are used for electric cable coverings and for primary electrical insulating on magnet wire.

For the purpose of this report, emphasis is placed on the uses of the strategic grades. The longer Canadian fibers, groups 1, 2 and 3, are used extensively for making woven fabrics, which are in turn manufactured into fire-proof clothing, gloves for handling hot metals, mechanical packings and gaskets, and lagging cloth used in large quantities by the Navy. Long fiber in the form of rovings is used as cable filler (material used to fill in spaces in groups of insulated cables on shipboard). Long fibers are also used in making compressed sheet packings of high strength for the high steam pressures now in general use.

Friction Materials

A very important use of asbestos fabrics is for the manufacture of friction materials. Such materials are brought into contact with moving members (brake drums, fly wheels, or other rotating equipment) in such a manner as to retard the free motion of the rotating part. The effect of the friction is to convert the kinetic energy of the moving member into heat. The best braking materials are those that convert the kinetic energy into heat the most rapidly and then dissipate the heat as quickly as possible. The friction material must also be

2/ Data from Jesse E. Weaver, March 1951.

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heat-resistant and nonflammable. Asbestos is regarded as indispensable in most types of friction materials.

Brake linings are of three principal types. In early days virtually all brake bands were of woven asbestos fabrics, but at the close of World War I the molded type was invented and is now used extensively. Molded linings are of several types, but all consist primarily of asbestos fibers bonded with an organic matrix. Metallic reinforcing, such as brass, zinc, or lead, is commonly added, and the shaped products are thoroughly cured. The asbestos required is chrysotile ranging in length from fibers just under spinning grades to those as short as 7-F in the Canadian classification. A preponderance of the shorter fibers is used because of the price advantage.

A second type of friction materials is the rubberized fabric lining. It consists of multilayer woven structures held together with wire-inserted asbestos yarn. The asbestos used is of spinning grades.

The third type is the woven brake lining made in roll form in a variety of widths and thicknesses. It permits a wide range of service with a relatively small inventory. Its general utility popularizes it, particularly in the industrial field. As such linings are woven fabrics, chrysotile of spinning grades is required.

The evolution of friction materials from the all-woven to a wide use of molded types has had a profound effect on the asbestos industry in that it has permitted a wide substitution of shorter fibers for the spinning grades. This is a fortunate circumstance because spinning fibers constitute a relatively small proportion of the asbestos recovered.

Friction materials are of primary strategic importance because they are essential to all types of mobile military equipment, as well as many kinds of industrial and oil-well machinery.

Miscellaneous Nontextile Uses

Fibers that are somewhat shorter, such as Canadian group 4, (to some extent groups 5 and 6), and Grade 3S of Cape Blue, are used widely for asbestos-cement products. These consist of about 80 percent portland cement and 20 percent asbestos fiber. Roofing shingles, flat and corrugated siding, and asbestos-cement water, gas, oil, or sewer pipe are also well-known products.

Canadian groups 4 and 5 and African amosite are used extensively in making 85-percent magnesia block and pipe insulation. These products consist of about 85 percent basic magnesium carbonate, and about 15 percent asbestos.

Canadian group 5 is suitable for asbestos paper and millboard manufacture. Such products are made on standard papermaking machines.

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important use of asbestos paper is for making the so-called air-cell pipe covering.

The shortest fibers are used for boiler and roofing cements and as filler in asphalt floor tile and various other products.

Interchangeability of grades

As pointed out elsewhere in this report, the asbestos miner has virtually no control over the percentage of the various grades produced. He must mine the rock as he finds it and extract from it all grades present, the proportions of which are fixed in nature. It is inevitable that some grades are more in demand than others, and the most desirable grades may be those that are in short supply. Thus shortages may develop for the preferred grades; and, at times, accumulation of stocks of the less valuable fibers. Currently, however, all grades are in demand.

To meet this condition, a great deal of research has been devoted to substitution of the more abundant grades for those that are less plentiful but more in demand. For instance, much work has been done on adapting Canadian group 6 fibers for use in asbestos-cement products for which groups 4 or 5 are preferred. It was found that a thorough fiberization permitting intimate contact between cement and fiber made it possible to use the group 6 short fibers successfully. Similar problems are under investigation constantly.

Uses of amosite

The uses of amosite, in order of importance, are:

(1) Lagging in felted form for high-temperature insulation up to 900°F. It is commonly used as a protective covering over 85-percent magnesia or other kinds.

(2) Felted, loosely compacted covering for marine turbines, jet engines, and similar applications. It is especially well-adapted for this use because it does not pack under vibration, and if it becomes wet it dries without detriment to the product. Amosite insulation mattresses weigh only 9½ pounds per cubic foot; if made of chrysotile they would weigh 50 percent more and therefore would not conform with Navy specification.

(3) As a constituent of 85-percent magnesia. Some manufacturers of magnesia insulation use 40 to 60 percent amosite and the remainder of Canadian groups 4 or 5. When fibers of fair length are used, the proportion of fiber may be reduced, possibly as low as 11 percent. If shorter fibers are used, the percentage must be increased, possibly to 15 percent or more. The shorter the fibers that are used, the greater

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is the breakage loss in the finished product. Amosite furnishes long fibers at lower cost than those obtained by employing Canadian chrysotile. One product, "Unibestos", consists almost entirely of amosite. The 85-percent magnesia is used for temperatures up to about 550°F. above which the magnesia disintegrates. Unibestos is used for temperatures of 550° to 900°F. Another high-temperature insulating material named "Calsilite" consists of amosite, Canadian 3Z, and a siliceous binder. It is said to withstand temperatures up to 1,200°F.

An important special use for B-1 amosite is for insulating underground steam pipes. Its quality of moisture resistance prevents or reduces corrosion and electrolytic reaction detrimental to the pipes.

Another special use for amosite is for making a lightweight, fireproof wallboard (Marinite board) used for partitions on ships. The weight per cubic foot would be increased considerably if other fibers were substituted for amosite.

Uses of Crocidolite

Crocidolite (blue asbestos) is characterized by high tensile strength, acid resistance, and harshness in wet mix. The longer fibers are used for spinning and weaving. It is reported that during World War II the American Asbestos Co., Norristown, Pa., manufactured yarn from crocidolite in a small way, and Green Tweed & Co., North Wales, Pa., wove it into fabrics for chemically-resistant packing. According to current information, no spinning or weaving of blue fiber is carried on in the United States at present; these processes are conducted only in the United Kingdom. J. W. Roberts, Ltd., at Armley, Leeds, a subsidiary of Turner & Newall, specializes in woven products of blue fiber, particularly mattresses for locomotive-boiler lagging. Blue-asbestos fabrics for acid-resistant packings or for other uses in the United States are now imported. Canadian fiber cannot be substituted for blue asbestos in such packings. The shorter blue fibers are used extensively in the manufacture of asbestos-cement pipe, as both the high tensile stength and the harshness in wet mix adapt it well for such use. It was presumed during World War II that Canadian asbestos could be substituted for blue in an emergency but that methods of manufacturing asbestos-cement conduits, pressure pipe, and flue pipe would require many modifications, with probable changes in existing machinery. It was further presumed that much costly experimentation would be required and that the end product at its best might not be of a quality that would meet Underwriters' requirements or Government specifications, also that the modified methods and equipment would probably be obsolete when blue fiber again became available.

Recent developments have changed this situation considerably. Some of the harsh chrysotile mined in Quebec is substituted for blue fiber in asbestos-cement pipe manufacture with fair success. The new Munro mine in Ontario furnishes a harsh type of chrysotile that may,

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ter further experimentation, replace blue fiber entirely. According-
crocidolite is not as essential as was formerly supposed.

Long blue fibers are exceptionally well adapted for gas filters. Bolivian blue is preferred for this use. This is the only type of blue fiber that is regarded as strategic at this time.

Distribution of Asbestos According to Use

Much has been written on the multitudinous uses of asbestos, but little information is available on the quantities or proportions that are applied to the several uses. The classification by use, such as spinning fibers, cement stock, paper stock, and magnesia and compressed sheet fibers would seem to indicate distribution by use, but mixed grades are used so extensively that such a classification affords no criterion of the actual quantities applied to each use. Data on the grades, qualities, and quantities of fiber used, for instance, in asbestos-cement pipe, 85 percent magnesia, or brake-band linings are not easily available.

For the purpose of this report the distribution according to use of the strategic grades is of paramount importance. Fortunately a record of allocations by end use of strategic asbestos during World War II was made by the War Production Board, and these records furnish a basis for tables 28 and 29.

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TABLE 28.--Allocation of strategic grades of asbestos in 1944, by end use 1/ - Asbestos textiles

Product	Textiles from Canadian fiber, short tons	Textiles from Rhodesian C. & G. Nos. 1 & 2, short tons
Mechanical packings and gaskets	4,300	
Asbestos safety clothing	920	
Woven brake linings and clutch facings	6,700	
Navy lagging cloth	3,000	
Navy cable filler and conductor insulation 2/	4,000	4,000
Aircraft	675	
Navy and aircraft hose	135	
Laminated plastics		630
Electrical equipment, new and maintenance		1,500
Maintenance and repair other than electrical	1,000	
Asbestos yarn in flexible metal tubing	220	
Miscellaneous textile uses	1,600	
Total textiles	22,450	6,130
Asbestos content of textiles 3/	19,000	5,900
Deduct C. & G. 3 substituted for Canadian 4/	3,200	
Net allocation of Canadian	15,500	

1/ Compiled from records of WPB.

2/ The filler was probably Canadian fiber; the conductor insulation C. & G. Nos. 1 and 2; hence one-half of total is arbitrarily assigned to each.

3/ Assuming that 95% of textiles consists of asbestos fibers.

4/ WPB Conservation Order M-79 as amended October 1943 required 1 ton of Rhodesian C. & G. No. 3 be used with every 5 tons of Canadian AR used in textile manufacture.

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Table 29.--Allocation of strategic grades of asbestos in 1944 by end use nontextile uses 1/

Product	Canadian spinning grades, short tons	African amosite, short tons
Compressed sheet packing	3R & 3T 3,000 2/	
Molded amosite insulation		5500
85% magnesia and other high-temperature insulation		4800
Navy felt insulation (lightweight blankets)		9700
Marine insulating board		2400
Sprayed insulation 3/		700
Total	3,000	22,100

1/ Compiled from records of WPB.
2/ Omitting 650 tons 3Z.
3/ Sprayed insulation also required 500 tons of Rhodesian C. & G. No. 3.

Total allocations indicated in tables 28 and 29 may be summarized as follows:

Canadian chrysotile spinning fibers, textile uses	15,800
Canadian chrysotile spinning fibers, nontextile uses	3,000
Total Canadian spinning fibers	18,800
Rhodesian chrysotile C. & G. Nos. 1 and 2	5,800
Amosite	22,100
Total strategic grades	46,700

In table 30, the allocations according to end use are compared with actual end use during 1944, also compiled by the WPB.

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30.--Correlation of allocations and actual use of strategic grades of asbestos during 1944

Kind of asbestos	Allocations, short tons	Actual consumption, short tons
Canadian Groups 1, 2 and 3	19,900	18,122 1/
Rhodesian C. & G. Nos. 1 and 2	5,900	6,646
Amosite	22,100	15,698

1/ Canadian groups 1, 2 and 3, except 3.

From this table it appears that there is a fair correlation, except for amosite, where actual use fell considerably below the allocations. However, the proportional distribution by use is probably fairly accurate.

On the basis of WPB figures as given in tables 28 and 29, the strategic grades of asbestos were distributed by use in 1944 approximately as indicated in table 31.

TABLE 31.--Allocation of asbestos by end use in 1944

Canadian spinning fibers

	Percent
Woven brake linings and clutch facings	30
Mechanical packings and gaskets	19
Navy cable filler	15
Navy lagging cloth	13
Maintenance and repair other than electrical	4
Asbestos safety clothing	4
Aircraft	3
Asbestos yarn in flexible metal tubing	1
Miscellaneous textile uses	1
	100

Rhodesian C. & G. Nos. 1 and 2

Navy cable insulation	65
Electrical equipment new and maintenance	25
Laminated plastics	10
	100

African amosite

Navy felt insulation (lightweight blankets)	39
Molded amosite insulation	25
85% magnesia and other high-temp. insulation	22
Marine insulating board	11
Sprayed insulation	3
	100

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These proportions are to be regarded as approximations only. They ...t vary considerably from year to year depending upon circumstances, ...t at least they present a use pattern that existed under the war ...rgency. Under present conditions, the allocation by use for Cana... and Rhodesian spinning fibers would probably follow approximately ... same pattern as that given in the preceding table, but the amosite ...portions might change considerably. The manufacture of marine in...lating board, used extensively by the Maritime Commission but not by ... Navy, required about 2,400 tons o... amosite in 1944. Although ...osite makes a board of considerably lighter weight than one in which ...ysotile is used, it is probable that a heavier board could be used ... it became necessary to conserve amosite for more essential uses. ...rayed insulation is another product that might be eliminated from ... list of uses requiring amosite. Very little of this type of insu...tion is now used by the Navy; and, when used by either the Navy or ...aritime Commission, fiber glass may be employed in place of asbestos.

Directory of Asbestos Products Manufacturers

There are over 100 manufacturers of asbestos products in the ...ited States. The following lists include only the larger manufacturers ... products that may be regarded as of greatest strategic importance at ...esent.

Asbestos textile products

Company	Plant location
American Asbestos Textile Corp.	Norristown, Pa.
Asbestos Textile Co., Inc.	N. Brookfield, Mass.
Asten Hill Mfg. Co.	Philadelphia, Pa.
Carolina Asbestos Co.	Davidson, N. C.
Garlock Packing Co.	Palmyra, N. Y.
Johns-Manville Sales Corp.	Manville, N. J.
Keasbey and Mattison Co.	Ambler, Pa.
Raybestos-Manhattan, Inc.	Manheim, Pa.
	N. Charleston, S. C.
Russell Manufacturing Co.	Middletown, Conn.
Southern Asbestos Co.	Charlotte, N. C.
Standco Brake Lining Co.	Houston, Tex.
Tallman-McCluskey Fabrics Co.	Kirkwood, Mo.
Union Asbestos & Rubber Co.	Marshville, N. C.
U. S. Rubber Co.	Hogansville, Ga.

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