UCC-0127 #

PLAINTIFF'S EXHIBIT

UC-2419

UNION CARBIDE

UNION CARBIDE CORPORATION
SPECIALTY PRODUCTS GROUP

P.O. BOX 94637, CLEVELAND, OHIO 44101
PHONE: (216) 529-3900
(800) 822-4322

February 3, 1987

J.C. Arnold (CPD-Danbury)
Dr. L.M. Baker (UCC-Danbury)
R.M. Berzok (UCC-Danbury)
S. Brier (UCC-Danbury)
W.J. Burroughs
Dr. P.D. Coulter
T.D. Finigan (UCC-Washington)
J.C. Howell (CPD-Danbury)
C.F. O'Brien (UCC Law-Danbury)
J.D. Griffith
R.M. Ross
C.H. Pelanne
R. Wishart (UCC-Danbury)

Alternate Materials
Institute (AMI)

Gentlemen:

Minutes for the subject non-asbestos coalition's meetings of December 4, and 18, are enclosed. A historical background and executive summary of these two meetings follows:

Historical Background:

The Goal of the AMI is to accelerate changeover from asbestos to non-asbestos products. A final regulation on banning asbestos products is scheduled to be promulgated by the EPA the end of 1987. Organization of the AMI was driven by DuPont's KEVLAR® Friction Products Group. They have provided seed funding and continue heavy resource support. Norm Griffiths, their legal counsel, has attended all meetings.

UCC's involvement through the GRAFOIL® Group was solicited by DuPont via our joint involvement in the Fluid Sealing Association (FSA), a trade group of suppliers of fluid sealing (packings, gaskets, etc.) products. We are charter members and sit on the board of directors. Current involvement consists of Tom Finigan and myself.

Currently, the membership is small, five companies, and membership efforts have been encumbered by the need for immediate focus on EPA issues rather than by-laws and membership fees. The latter issues have been resolved and active recruitment is underway. The AMI is still in its formulative stages and ultimate viability still a major concern.

Our involvement is consistent with EM & TS Division's Program, chaired by Clyde Neely, to stop purchase of asbestos packing and gasketing products for the C & P Business Groups Plants by end of 1988. The consequent replacement of asbestos-based materials with

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 1 of 24 asbestosclaims.law/library/17398/1

GRAFOIL®, recognized as a more effective fluid sealing product, also further demonstrates our commitment to the Air Toxic Control Policy.

Executive Summary

Under highly qualified guidance by E. Bruce Harrison, this is a very professional effort that justifies continued and expanded support, not only because of "what's in it" for the GRAFOIL® Products Group, but other potential CPD and Corporate interests. Some selected product possibilities in this category include:

CPD
- Boron Nitride - Friction Products
- Graphite Powders - Friction Products

UCC
- Silane Coupling Agents?
- Urathanes?
- Polyolefins?
- Others?

There are undoubtedly other primary chemicals whose expanded use is related to displacement of asbestos fibers. Appendix I shows information gaps in ICF's (EPA's Contractor charged with determination of the economic impact of the change over to non-asbestos) list of material substitutes "known to them". Whether a primary substitute such as GRAFOIL® or a secondary material used as part of the substitution composition or technology full benefits to UCC need to be established to get maximum benefits from involvement and "bang for our buck".

Direction and guidance relative to other UCC products that might benefit from involvement is requested from Dr. Baker.

The sooner the ban on asbestos is implemented the greater the opportunity for existing viable substitutes, such as GRAFOIL®, to capitalize on the market opportunity. New technology substitutes will diminish the opportunity with time.

The December 4, Meeting with IFC|EPA and the December 18, meeting with ICF were timely and brought an immediate opportunity to correct|enlighten this regulatory agency on packing and gasket products with focus on flexible graphite within the AMI (A direct Union Carbide response will focus on GRAFOIL® Brand Flexible Graphite.) An example of misinformation obtained by ICF, which would have been submitted to EPA is "Garlock Blue Guard® is the only effective non-asbestos gasket material for high temperature". This statement is false and this KELVAR® based product has been a failure. Not only does this type of misinformation distort current

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 2 of 24 asbestosclaims.law/library/17398/2

"state-of-the-art" knowledge but when reported in serves to erode EPA's credibility and further the case for the asbestos lobby via the Asbestos Information Association (AIA). Their current focus is challenging the cost of EPA's proposed ban on asbestos as well as potential health implications of the substitutes. The AIA, of course, is counter proposing close regulation and continued use of asbestos. UCC, a member of AIA before our sale of the CALIDRIA Operation, is no longer on the membership list.

The ICF computer model for establishing cost of replacement is grossly inadequate and will lead to erroneous conclusions relative to the "cost per life saved" EPA criterion (See Appendix V). EPA considers < $2.0MM|life as justified. Comments on these inadequacies will be part of our direct response to the EPA.

The immediate and positive response by the EPA to formation of the AMI is displayed in their press release, Appendix VII.

Outside legal counsel has now been appointed because of DuPont's concern about potential conflict of interest (and cost).

Minutes of the January 13th meeting are forthcoming.

Very truly yours,

P.S. Petrunich

PSP|kkf
Enclosure

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 3 of 24 **asbestosclaims.law/library/17398/3**

Battelle Memorial Institute has a subcontract to study the efficacy, etc., of substitute materials in automotive brakes. There is a first draft which is undergoing peer review by the American Society of Mechanical Engineers. A draft should be available in March 1987.

Friction Products

Using a table of data gaps that was prepared by ICF, Mr. Bansal reviewed questions listed under the friction products category.

In each of the areas discussed below, ICF needs more information on the aftermarket for brake components. How long will it actually take to accomplish a switch to non-asbestos products? Do they just have to pass the 105 standard and be dimensionally the same with the same coefficient of friction?

Drum Brake Linings

Mr. Bansal told AMI members that the consensus is that semi-metallics will take over the drum brake lining market. However, most AMI members present disagreed, stating that non-asbestos organics (NAOs) will probably take most of the market.

Carbon fibers are also potential substitutes for asbestos in drum brake linings, but were not listed as substitutes known by ICF. Ashland will provide supplementary sustantiation to ICF directly.

Rich Gould (DuPont) asked if AMI can provide EPA with information that discusses the varying roles asbestos plays in brake components -- as a filler and insulator as well as a friction component. Asbestos and the substitutes are both used with different ingredients in a wide range of formulas. ICF welcomed any information that will improve their analyses.

Brake Blocks, Clutch Facings and Friction Materials

Several AMI members noted that ceramic fibers, carbon fibers and graphite (synthetic/particulate) should also be listed as ingredients in the NAOs for brake blocks, clutch facings and other friction materials.

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 4 of 24 asbestosclaims.law/library/17398/4

Each said that exact make-up, that is, percentage of materials used, of these NAOs is not known, but clearly these substitutes are being used in these applications as NAO ingredients. Information on the substitute products used in NAOs will be supplied to ICF by the member companies directly.

Disc Brake Pads

Mr. Boyer noted that a carbon-carbon complex is being used in aircraft and some semi-metallic brakes are used for small aircraft.

Mr. Boyer also said that the racing industry has developed some new carbon-carbon brakes but they must have a rotor of carbon to be technically feasible. Ashland will provide information to ICF on this application.

Gaskets and Packings

Mr. Petrunich reviewed the conventional types of packing materials: braided fibers/yarns made of aramids, PTFE, carbon, and graphite; and expanded PTFE, ceramic fibers, glass, and PBI. Non-conventional substitutes for packing materials include PTFE and flexible graphite

Some conventional substitutes known for gaskets are aramid fibers, micas, mica/graphite, glass, carbon fibers, and cellulose. Non-conventional substitutes include PTFE, (solid & filled glass and graphite), flexible graphite and expanded PTFE.

Processes used to manufacture gaskets, both the "beater add" and compressed types, were discussed.

With regard to ICF's table, Mr. Petrunich noted that ICF's information on high temperature gasketing material on the market is incomplete. He will attempt to provide supplementary data and information on the temperature ranges of gaskets.

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M...
Published by AsbestosClaims.Law
ACL Doc 17398 · Page 5 of 24
asbestosclaims.law/library/17398/5

Other Miscellaneous Uses

Mr. Gould will provide more information on use of Kevlar in missile liners.

Mr. Boyer will provide information on carbon fibers used in flooring felt, missile liners, and textiles.

Followup Submissions

AMI members agreed to try to provide the information ICF and EPA need in mid-January 1987.

The information AMI members agreed to gather and submit will not be shared among the companies. It will be sent directly to ICF/EPA and AMI, which will protect the confidentiality of the detailed data and develop generic submissions for the Institute itself.

Submissions to EPA containing confidential business information should be sent to the Document Control Officer, return receipt requested (e.g., registered mail or Federal Express). The materials themselves should be contained in an inner envelope addressed to Tony Bansal at ICF marked as follows: "CONTAINS CBI. TO BE OPENED ONLY BY ADDRESSEE."

AMI020LQP

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 6 of 24 **asbestosclaims.law/library/17398/6**

ALTERNATIVE MATERIALS INSTITUTE

MEETING WTH EPA AND ICF RE: ASBESTOS SUBSTITUTES

December 18, 1986

ATTENDANCE LIST

NAME	COMPANY
Wilfred Kenan	Asbury Graphite
D. Chris Boyer	Ashland
Richard Krock	Ashland
John Newman	Ashland
Glen Wrap	Carborundum (Standard Oil)
Richard Gould	DuPont
Tony Bansal	ICF, Inc.
Pete Petrunich	Union Carbide
Tom Finnigan	Union Carbide
Cheryl Morton	AMI (E. Bruce Harrison Co.)
Ernie Rosenberg	AMI (E. Bruce Harrison Co.)
Christine Augustyniak	USEPA OTS/ETD

Public Affairs

ARM027.LQP

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 7 of 24 asbestosclaims.law/library/17398/7

APPENDIX II

ALTERNATIVE MATERIALS INSTITUTE

AMERICAN SUPPLIERS OF NON-ASBESTOS PRODUCTS

GENERAL BUSINESS MEETING SUMMARY

ATTENDANCE: List Attached

DATE;TIME;PLACE: December 4, 1986; 10:00 AM;
Standard Oil Company
1001 22nd Street NW
Washington, DC 20037

Purpose of Meeting

As agreed at the October 31 meeting, members of the Alternative Materials Institute met to discuss efforts of Phase I of the project and other business matters related to the establishment of the coalition.

Name of Coalition

After brief opening comments by Tom O'Brien (DuPont), Jeff Conley (E. Bruce Harrison Company) presented the name created for the coalition, the "Alternative Materials Institute" with the tag line: "American Suppliers of Asbestos-Free Products." Jeff explained the basis for the selection and then showed the art work done. It was decided by the members present that the term "asbestos-free" would be replaced with "non-asbestos" as the former may imply that not even trace amounts of asbestos would be present in products manufactured by member companies. It was also decided that the color of the letterhead would be changed to blue.

Update on Activities

Ernie Rosenberg (E. Bruce Harrison Company) gave an update on the rulemaking. EPA had expected AIA to petition for additional cross-examination but instead EPA has received an AIA request to withdraw the entire rule and go back to start. (The AIA letter was distributed to those present). EPA is expected to deny the request. After that, EPA will either close the hearings phase of the rulemaking and ask for final written comments or it will allow AIA time for additional cross-examination of EPA's contractors. In any event, EPA will re-open the entire record for comment before ending the opportunities for formal comment.

605 Fourteenth Street, NW, Suite 900, Washington, DC 20005 • Telephone 202 737-1419

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 8 of 24 asbestosclaims.law/library/17398/8

The final comment period is expected to be open during the first quarter of 1987. During that period the coalition should plan to submit its initial, formal comments with data that affects how substitutes are characterized.

EPA is engaged in several efforts to obtain additional information on asbestos substitutes before issuing a final rule. Ernie reviewed several ongoing projects on non-asbestos materials, their scope of work and deadlines, (as presented in the summary table prepared by EBH Co).

ICF has an EPA contract to conduct a comprehensive review of asbestos substitutes. The American Society for Mechanical Engineers (ASME) has a subcontract reviewing feasibility of substitution in asbestos brake applications. Battelle Columbus Laboratories is, in turn, ASME's subcontractor. It has done the basic research and drafting. ASME is providing peer review, already under way. (A list of peer review panel members was provided to AMI members.)

With regard to the ASME/Battelle contract, it was agreed that certain members of AMI would contact peer review members that they know personally to get more information on the draft report's contents and to determine what the general consensus is among panel members.

In connection with another effort to collect data on durable fibers, the EPA Health and Environmental Review Division (HERD) has prepared a document on the biological testing of durable fibers (of which some data on substitutes is going to be extracted). HERD is also drafting a hazard assessment for fibers. ICF also has a contract in connection with this proceeding to do an exposure assessment on all durable fibers.

These ongoing projects will probably reveal new information that will affect how substitutes are characterized in the docket and present a new, separate area of effort for the coalition. We have established contacts with ICF and several EPA staffers and we expect information-sharing forums to evolve.

To prepare for these forums, Ernie briefly reviewed a guideline that he prepared on dealing with EPA contractors.

EPA Contractors

Bob Dresser, Vice President, and Tony Bansal, Project Manager, from ICF, joined the group for lunch along with Bruce Sidwell from EPA's Chemical Evaluation Branch. Mr. Sidwell gave a brief overview of the rulemaking, in particular, the efforts to collect information on substitutes and the Agency's general interest in durable fibers. His discussion led into the ICF's contract work.

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with M... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 9 of 24 asbestosclaims.law/library/17398/9

Mr. Dresser described the scope of work of the ICF contracts and explained how ICF's work fits into the overall framework of the Regulatory Impact Analysis that his company will assist EPA in developing.

Tony Bansal, who actually manages the project (on substitutes, their performance and availability), discussed specific data gaps that his group has encountered during the course of their work. Tony also described the methodology used for identifying and collecting data on asbestos substitutes.

The gaps in ICF's data were surprisingly large. For the most part, ICF has used questionaires directed to the fabricators of products using asbestos or substitutes and has not had prior contact with the materials producers. Generally speaking, ICF needs data on costs, useful life, and projections of the future market share that substitutes would take as ICF's goal is to project use of substitutes for each application.

It was apparent after this discussion that AMI member companies have critical information, without which the final ICF report would be deficient in its findings on the availability of substitutes and the costs of asbestos replacement. The members agreed that the coalition and ICF would conduct several information sharing sessions (by application) possibly the week of December 15, providing that EPA approves of these meetings.

Bylaws

Ernie and Jeff reviewed the bylaws that were developed for the coalition. It was agreed that although membership by companies strongly tied to asbestos and AIA members might present tactical and public affairs problems, AMI will have to accept any company that meets its membership criteria. Norm Griffiths (DuPont) agreed to examine the question of whether active opponents of AMI's goals and purposes can be legally excluded.

With regard to legal counsel for AMI, Ernie told the group that we had been informed by our current legal counsel that they can no longer represent AMI due to an apparent conflict of interest. Norm also agreed to work on obtaining legal counsel along with David Litvin (Standard Oil) and another person to be nominated by Chris Boyer (Ashland).

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with… Published by AsbestosClaims.Law
ACL Doc 17398 · Page 10 of 24 **asbestosclaims.law/library/17398/10**

Membership and Dues

Ernie discussed our membership development efforts to date. So far, five companies have either committed or given a strong indication that they will do so. In addition to Ashland, who confirmed its membership at the meeting, these companies include DuPont, Carborundum, Rhodes-American, and Union Carbide. Engelhard and NYCO and a number of potential associate members are still prospects. A more intense effort may be required to get such companies to join -- possibly an AMI newsletter, minutes from this meeting or an invitation to the upcoming meetings with EPA contractors.

With regard to new prospects, we still are recommending that initial contacts come from member companies, rather than coalition staff.

Also discussed were some of the specific legal concerns of the companies like Owens-Corning Fiberglas, who are involved in asbestos ligitation and fear involvement with AMI. AMI's firm commitment not to attack asbestos or to address the risks presented by asbestos has not been enough to allay these companies' legal staffs. Ernie suggested that lawyers from AMI member companies contact those companies with legal concerns.

Further, it was agreed that the appropriate marketing person may have to be contacted at Celanese, Bethlehem Steel, Monsanto, Amoco and PPG, as it appears that in these cases we may not yet have been in contact with the right people. Other companies that members agreed to make initial contacts with include Allied, Pyron Corporation, W.L. Gore, and W.R. Grace.

Pete Petrunich (Union Carbide) agreed to forward the Fluid Sealants Association's member list to be used for membership development.

Technical Committee

Persons nominated to serve on AMI's technical committee included Bill Breitsman (Carborundum), Ted Merr (DuPont), Pete Petrunich (Union Carbide) and on a tentative basis, Chris Boyer (Ashland).

Technical committee members will be responsible for forwarding to AMI rebuttals to information in the docket by the week of December 15 as well as preparing for the upcoming meeting with ICF and EPA.

Next Meeting

It was agreed that the next general meeting of the Institute will be on January 6, 1987. If the agenda is full, members should plan to arrive in town the night before the meeting and start the meeting at 8:30 AM. (The meeting date was subsequently slipped to January 13.)

ami013.lqp

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 11 of 24 asbestosclaims.law/library/17398/11

ALTERNATIVE MATERIALS INSTITUTE
December 4, 1986

ATTENDANCE LIST

NAME	COMPANY
D. Chris Boyer	Ashland
Bill Hettinger	Ashland
John Newman	Ashland
Bill Breitsman	Carborundum
Buzz Peters	Carborundum
David Litvin	Carborundum (Standard Oil)
Richard Gould	DuPont
Tom O'Brien	DuPont
John Roberts	DuPont
Norman Griffiths	DuPont
Norm Soep	Rhodes-American
Pete Petrunich	Union Carbide
Tom Finnigan	Union Carbide
Jeff Conley	E. Bruce Harrison Co.
Cheryl Morton	E. Bruce Harrison Co.
Ernie Rosenberg	E. Bruce Harrison Co.

ARM027.LQP

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with… Published by AsbestosClaims.Law
ACL Doc 17398 · Page 12 of 24 asbestosclaims.law/library/17398/12

APPENDIX III

AMI

ALTERNATIVE MATERIALS INSTITUTE

AMERICAN SUPPLIERS OF NON-ASBESTOS PRODUCTS

MEETING SUMMARY

ATTENDANCE:	U.S. Environmental Protection Agency, ICF and Alternative Materials Institute (List Attached)
DATE;TIME;PLACE:	December 18, 1986; 10:00 AM; Standard Oil Company 1001 22nd Street NW Washington, DC 20037

Purpose of Meeting

As agreed at the December 4 meeting, members of the Alternative Materials Institute (AMI) met with Christine Augustyniak (USEPA) and Tony Bansal (ICF, Inc.). ICF is an EPA contractor conducting a review of the cost, efficacy and availability of materials which could substitute for asbestos in the applications under review by EPA. The agenda for this meeting was to discuss just two of those applications: friction products and gaskets and packings.

(Note that after introductions, Ernie Rosenberg (AMI) read and provided each person attending with a statement cautioning against discussion of issues which might raise antitrust questions such as prices, projected market shares, and costs.)

The Rulemaking-Cost Model Data

Before addressing the product categories, a general discussion was held of the computer model that EPA and ICF are using to estimate the costs of replacing asbestos and the model's specific assumptions. In her summary of the rulemaking, Ms. Augustyniak stressed the fact that the cost model does not fully account for life-cycle costs and that it is conservative -- it will tend to overstate replacement cost.

Mr. Bansal said that he could provide a list of data inputs for the cost model, but cautioned AMI members that the basis of any data submitted to ICF and/or the Agency should be included.

605 Fourteenth Street, NW. Suite 900, Washington, DC 20005 • Telephone 202 737-1419

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with… Published by AsbestosClaims.Law
ACL Doc 17398 · Page 13 of 24 asbestosclaims.law/library/17398/13

SCIENCE

VOLUME 234
NUMBER 4779

Letters

Risk from Exposure to Asbestos

In the light of the Environmental Protection Agency's proposed ban on the remaining uses of asbestos, it should be of interest to *Science* readers that there is a significant error in certain risk estimates of low-level asbestos exposure.

We report a mistake we discovered in the mesothelioma risk assessment portion of the National Research Council (NRC) report *Asbestiform Fibers: Nonoccupational Health Risks* (*1*). The report's authors proposed, on the basis of the analysis of Peto, Seidman, and Selikoff (*2*), a cumulative incidence function, $I(t,d) = cd(t - t_0)^k$, for equation 7 (p. 209) of the report, where t is age; $t - t_0$ is the time since first exposure at age t_0; cd is b, a constant depending on the type of asbestos exposure for workers exposed at dose level d; and k is a constant.

The values of the constants k and b (and hence c) were intended to be chosen from those calculated by Peto *et al.* by using maximum likelihood fitting to several data sets, including Selikoff's 1979 data (*3*) on insulation workers.

Unfortunately, the analysis of Peto *et al.* seems to have been misread, and as a consequence the lifetime risk of mesothelioma has been consistently underestimated by a factor approaching 20. Peto *et al.* fit observed death rates to the function $b(t - t_0)^k$ and found, for example, that when k is 3.2 and b is 4.37×10^{-8}, the Selikoff data are represented. The NRC chose these values of k and b for direct insertion in equation 7 to illustrate the cumulative incidence function, despite the fact that the Peto *et al.* death rate is the time derivative of the function $I(t,d)$. If the values of b and k are as determined by Peto *et al.*, then the resulting cumulative incidence function (cumulative death rate in the absence of competing causes) becomes $I(t,d)$, which is equal to $(t - t_0)^{k+1}\, cd/(k + 1)$ or $(t - t_0)^{k+1}\, b/(k + 1)$, rather than equation 7.

To grasp the magnitude of this correction, we observe that lifetime risk of mesothelioma, calculated (presumably incorrectly) on page 221 of (*1*) for an admittedly hazardous exposure profile, is as follows: school risk, 21×10^{-6}; background risk, 46×10^{-6}; and total risk, 67×10^{-6}. These become, after correction, school risk, 399×10^{-6}; background risk, 800×10^{-6}; and total risk, 1199×10^{-6}.

A major implication of this correction is that estimated lifetime mesothelioma risks are nearly 20 times larger than those shown in the NRC report. Therefore, mesothelioma risks would appear to dominate those of lung cancer for the exposure profiles illustrated in chapter 7.

JERRY AROESTY
KATHLEEN WOLF
Engineering and Applied Sciences Department, Rand Corporation, Santa Monica, CA 90406-2138

REFERENCES

1. Board on Toxicology and Environmental Health Hazards, National Research Council, *Asbestiform Fibers: Nonoccupational Health Risks* (National Academy Press, Washington, DC, 1984).
2. V. Peto, H. Seidman, I. Selikoff, *Br. J. Cancer* **45**, 124 (1982).
3. I. J. Selikoff, E. C. Hammond, H. Seidman, *Ann. N.Y. Acad. Sci.* **330**, 91 (1979).

Table 7.2 Estimated individual lifetime risks from a continuous exposure to asbestos at 0.0004 fiber/cm³ (a median dose) or 0.002 fiber/cm³ (a high dose).

Disease	Exposure group	Estimated individual lifetime risk ($\times 10^6$)	
		Median exposure (0.0004 fiber/cm³)	High exposure (0.002 fiber/cm³)
Lung cancer	Male smoker	292	1459
Lung cancer	Female smoker	105	524
Lung cancer	Male nonsmoker	27	132
Lung cancer	Female nonsmoker	14	68
Mesothelioma	All groups	156	780

Response: Aroesty and Wolf are correct in pointing out an error in the calculation of mesothelioma risk due to asbestos exposures in the National Research Council (NRC) report *Asbestiform Fibers: Nonoccupational Health Risks* (*1*). The error was in using the simple (annual) incidence function for risk rather than the cumulative incidence function. As a result, equation 11 on page 216 of the NRC report should have read:

$$L = c(0.004)\,(73)^{k+1}/(k + 1)$$

rather than

$$L = c(0.0004)\,(73)^k$$

Using the correct function increases the estimated lifetime risks for mesothelioma by a factor of 17.4. Aroesty and Wolf mention that the corrected mesothelioma risks would now dominate those of lung cancer in the environmental estimates made in the NRC report (table 7.2). This, however, is not the case because the published lung cancer risks were also understated. A multiplier of 4.56 was used to adjust risks for mesothelioma arising from occupational exposures of 1920 hours per year to risks from general environmental exposures of 8760 hours per year. This was not done for lung cancer. Using this same multiplier to estimate lifetime risks for lung cancer resulting from asbestos exposure increases the estimated projections by a factor of 4.5.

Incorporating these corrections increases the estimated risks of both lung cancer and mesothelioma (*2*). The table above is a correction for table 7.2 in the NRC report.

It should also be pointed out that when values of k and c are used which reflect the correlation between their measures, the range of risk estimates in table 7.2 of the NRC report is greatly reduced.

The NRC regrets these errors and urges persons working with the risk estimates to note the new values in the table above. We thank Aroesty and Wolf for calling attention to this matter.

LESTER BRESLOW
STEVEN BROWN
JOHN VAN RYZIN
Committee on Nonoccupational Health Risks of Asbestiform Fibers, Board on Environmental Studies and Toxicology, National Academy of Sciences–National Research Council, Washington, DC 20418

REFERENCES

1. Board on Toxicology and Environmental Health Hazards, National Research Council, *Asbestiform Fibers: Nonoccupational Health Risks* (National Academy Press, Washington, DC, 1984).
2. *Airborne Asbestos Health Assessment Update* (EPA/600/8-84/003F, Environmental Protection Agency, Washington, DC, June 1986).

UCC 015747

Published by AsbestosClaims.Law
asbestosclaims.law/library/17398/14

APPENDIX V

DATA REQUIREMENTS FOR THE ASBESTOS REGULATORY COST MODEL

1. Year of data
2. Price per ton of asbestos fiber

For each asbestos product market:

3. Product Asbestos Coefficient, i.e., tons of asbestos used per unit of output.
4. Price of the asbestos product. (Total price including purchase and installation costs. If O & M costs are available, please note separately.)
5. Quantity of product produced domestically.
6. Life of the asbestos product.
7. Quasi-rents per unit of output. (This is the difference in the selling price and the average variable cost.)
8. Life of the quasi-rents.
9. Consumption-Production Ratio, i.e., the ratio of domestic consumption to domestic production of the asbestos product. Alternatively, quantity of product consumed domestically is sufficient.

For each substitute product:

10. Price of the substitute product. (Total price including purchase and installation costs. If O & M costs are available, please note separately.)
11. Life of the asbestos product.
12. Market share of each substitute product. This refers to the share of the existing market that will switch to the substitute, given the non-availability of the asbestos product.

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with… Published by AsbestosClaims.Law
ACL Doc 17398 · Page 15 of 24 asbestosclaims.law/library/17398/15

APPENDIX VI

December 12, 1986

TENTATIVE LIST OF CATEGORIES OF ASBESTOS PRODUCTS

1. Friction Products
   - Disc Brakes (LM)
   - Disc Brakes (H)
   - Drum Brakes
   - Brake Blocks
   - Automatic Transmission Components
   - Clutch Facings
   - Friction Materials

2. Gaskets and Packings
   - Beater-add gaskets
   - Sheet gaskets
   - Packings

3. Coatings and Compounds
   - Roof Coatings and Cements
   - Non-Roofing Adhesives, Sealants, and Coatings

4. Asbestos-Cement Products
   - A/C Pipe
   - A/C Sheet, Flat
   - A/C Sheet, Corrugated*
   - A/C Shingle

5. Paper and Felt Products
   - Millboard
   - Pipeline Wrap
   - Roofing Felt
   - Electrical Paper
   - Flooring Felt*
   - Specialty Paper*
   - Commercial Paper*
   - Rollboard*

6. Textile Products
   - Cloth
   - Thread, Yarn and Lap

7. Other Products
   - Reinforced Plastics
   - Missile Liner
   - Sealant Tape
   - Diaphragms
   - Acetylene Cylinders
   - Fuel Cells
   - V/A Floor Tile*
   - Repackaged Fiber*

* No longer being produced or sold in the U.S.

3040D

UCC 015749

APPENDIX VII

Inside E.P.A. Weekly report

An Inside Washington Publication

An exclusive report on the U.S. Environmental Protection Agency

Vol. 8 No. 2 January 9, 1987

INDUSTRIES PRODUCING ASBESTOS SUBSTITUTES HAVE BANDED TOGETHER TO PROMOTE their products and to counter what they consider "erroneous" information about the safety and availability of asbestos alternatives. EPA last January proposed to ban five major asbestos consumer products and phase out remaining uses over a 10-year period (Inside EPA, Jan. 31, p10). The agency is required to show when substitutes will become available in order to ban specific products, and the new Alternative Materials Institute seeks to provide EPA, as well as industry and consumers, with the most accurate and current information.

A spokesman for AMI this week said the need for such a group became evident last fall when EPA records released for cross-examination hearings (Inside EPA, Oct. 10, p5) revealed "a lot of erroneous information" about the risks, costs and availability of asbestos substitutes. The source said that while AMI "is not in this to make the case against asbestos," the group does seek to promote its products during the transition period as public awareness increases about asbestos-linked health risks.

Initial members of the group are Du Pont, Standard Oil, Rhodes-American, Ashland Oil and Union Carbide. They represent manufacturers of asbestos substitutes that include aramid fibers, ceramic fibers, carbon fibers, flexible graphite and steel fibers used in automotive brakes and transmissions; gaskets and packings; and adhesives and sealants.

UCC 015750

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with… Published by AsbestosClaims.Law
ACL Doc 17398 · Page 17 of 24 asbestosclaims.law/library/17398/17

UNION CARBIDE CORPORATION
SPECIALTY PRODUCTS GROUP

P.O. BOX 94637, CLEVELAND, OHIO 44101, U.S.A.
TELEX # 810-421-0047
ANSWER BACK — UC ELECT UD
PHONE: (216) 529-3900

March 4, 1987

Document Control Officer
ICF, Inc.
1850 K Street NW
Washington, DC 20037

Attention: Tony Bansal
Project Manager

RE: Asbestos Substitute
Packings and Gaskets -
Flexible Graphite

Dear Tony:

This letter's purpose is to address the subject issues, more specifically to provide information relevant to Union Carbide's GRAFOIL® Brand Flexible Graphite, which is a functional substitute for asbestos based packing and gasketing materials. Packings are generally used to seal various fluids when some movement (dynamic) occurs between members of a fluid containing device. Examples include valves and pumps employed in the electric power, petroleum refinery, petrochemical, chemical, pulp and paper industries. Gaskets are cut and fabricated from gasketing materials and are generally used to effect a static seal, for example between pipe flanges, vessels, or within a valve design (body to bonnet) used in these industries. Gaskets and other semi-static seals, such as those in an exhaust gas recirculating valve (EGR) and transverse engine flexible exhaust connection, also are employed extensively to seal fluids in internal combustion engines. Example include head gaskets and exhaust manifold gaskets used in automobiles, trucks, auxiliary electrical power systems, lawn mowers, and other internal combustion engines.

This memorandum will focus on gaskets.

Gasketing Material

The majority of gaskets are either non-metallic sealing material alone or a non-metallic reinforced with a metal component. Conventional non-metallic, asbestos based gasketing is elastomerically bonded and processed via two major methods; the "Compressed" and "Beater Add". The Fluid Sealing Association (FSA), a trade association which includes manufacturers of packing and gasketing materials defines the two in their Non-Metallic Gasketing Handbook, currently being revised, as:

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with...
ACL Doc 17398 · Page 18 of 24
Published by AsbestosClaims.Law
asbestosclaims.law/library/17398/18

Beater Add:

A manufacturing process for making non-metallic sheet employing a paper making process, using fourdriner or cylindrical paper machines.

Compressed:

....manufactured on a special calender, known as a "sheeter" in such a manner that the compound is "built up" under high load, on one roll of the "sheeter" to a specific thickness.

With either process, asbestos fibers, the principal reinforcing fiber, are incorporated within various elastomeric binders and other fillers to form the material. Compressed products have been more extensively used in high performance (temperature and pressure) industrial (power, petroleum refining, etc.) service because they inherently contain more asbestos. "Beater Add" generally have been used more extensively for internal combustion applications such as head gaskets. This class of material also is used as the sealing component in spiral wound gaskets, which are employed extensively in high temperature|pressure industrial applications. Appendix I describes the basic design of a spiral wound gasket.

Flexible graphite is a solid, non-fibrous material that can functionally replace the above elastomeric bonded asbestos products. Appendixes II and III overview process and property differences between flexible graphite and the conventional asbestos-based, elastomerically bonded gasketing. Flexible graphite generally has been accepted as the only proven functional replacement for asbestos based gasketing for essentially all applications and services. GRAFOIL® Flexible Graphite also has been proven to provide value benefits to the user which represent advantages over the asbestos based products. These will be quantified later. The FSA service temperature limits for asbestos and non-asbestos gasketing are shown in Table I. Note the superiority of flexible graphite over the conventional asbestos and non-asbestos based elastomeric bonded products. The latter are processed with various fiber replacements for asbestos and fillers. Also, as noted in Appendix II and III fluid temperature limits for flexible graphite are independent of gasket compressive load, and thereby, fluid pressure, whereas all "Compressed" and "Beater Add" gaskets are temperature and pressure dependent. As temperature increases their pressure capability decreases. Principal fiber reinforcements for the compressed non-asbestos gasketing are aramids and glass. Compositional differences for these products are discussed in Appendix IV.

Usefull temperature and pressure ranges for asbestos based and non-asbestos gasketing materials are shown in Table 2. Note that flexible graphite covers the entire range and is the only non-asbestos material that is suitable for the high temperature range. Note also that compressed asbestos is manufactured in several quality|price ranges.

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 19 of 24 **asbestosclaims.law/library/17398/19**

Economic Impact

Current prices for flexible graphite gasketing material range from 2.0 - 3.0 times, on weight basis, that of premium compressed asbestos (CA) for the same gasket thickness. Typically a CA sheet contains 80% asbestos by weight. Density of the flexible graphite is approximately 60% that of CA and in many applications a thinner (than CA) flexible graphite gasket can be used because of its superior sealability e.g. reduced leakage. Examples of this improvement in leak tightness are shown in Appendix II and V. On the same thickness basis typically 0.7 weight units of flexible graphite are needed to replace 1.0 weight units of CA. For the same thickness price difference on equivalent weight basis, would be 1.4 - 2.1 times that of CA. Flexible graphite gaskets generally are supplied with a metal insert to improve handleability. Since reduced thickness, e.g. one-half that of CA with a metal insert will produce equivalent performance in many cases, even "first cost" can be comparable with that of CA.

A major value benefit from use of flexible graphite is reduced emissions. Industries are moving to this product because of this and many other economic value benefits. These include inherent fire safety, greater than double life improvement over asbestos, reduced energy losses, greater tolerance to changes in flange load, and unlimited shelf life. Flexible graphite is, therefore, not just a replacement for asbestos-based gasketing but the only material proven via industry experience to have superior, long term sealing characteristics. An example of industry acceptance is the American Petroleum Institute, Refinery Division, Technical Subcommittee proposal to include flexible graphite as the only listed non-asbestos gasket material in their gate valve standards API-603 and API-604, which currently list only CA as gasket material.

Based on the previously cited factors and in spite of the "first cost" difference between flexible graphite and CA, on the same thickness basis, a conservative value pay back of less than one year is estimated for the industrial market segment above 750°F. In the case of internal combustion applications this pay back is immediate in some cases because flexible graphite is the only non-asbestos material that satisfies engine design requirements e.g. exhaust systems, manifold gaskets, EGR seals, head gaskets, etc. Value benefits are demonstrated through reduced machining of flanges, reduced engine wear, improved emission control, and greater reliability e.g. reduction in "recalls". Maximum penetration is expected for these applications with some into the 250-750°F range. Recent examples of this latter case is use of GRAFOIL® Head Gaskets by General Motors, Buick Division.

Best estimates indicate that current penetration of flexible graphite into the total asbestos-based gasket market, excluding internal combustion applications e.g. automotive, truck, tractor, etc., is in the order of 1%. This is projected to grow to 20% within five years assuming a ban on asbestos. This penetration will be complemented by displacement of asbestos gasketing with other materials principally Polytetrafluroethylene (PTFE), "compressed" and "beater add"

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with… Published by AsbestosClaims.Law
ACL Doc 17398 · Page 20 of 24 asbestosclaims.law/library/17398/20

non-asbestos for temperatures under 500°F. For internal combustion applications estimated current penetration is 15%. This is projected to grow to 50% within five years. Other non-asbestos gasket material principally "beater-add" and PTFE, will displace asbestos based products at the lower pressure|temperature operating range. Incremental capacity for GRAFOIL® is being added by Union Carbide to accommodate this scenario. The same applies to the other products which are made by other AMI Members. Therefore, the replacement of asbestos gasketing by flexible graphite will not be capacity limited.

This assessment addressed only the asbestos gasketing material issue since packings represent a different technology. A more detailed assessment of the important roll GRAFOIL® flexible graphite is and will serve as a replacement for asbestos based packing products is forthcoming in a separate memorandum.

Very truly yours,

P.S. Petrunich
Customer Service Manager

PSP|kkf
Enclosures

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with… Published by AsbestosClaims.Law
ACL Doc 17398 · Page 21 of 24 **asbestosclaims.law/library/17398/21**

TABLE I
GASKETING MATERIALS CHARACTERIZATION

Material	Maximum Temperature*		Rank in Order of Torque Retention
Flexible Graphite	5400°F	(3000°C)**	1
Compressed Asbestos	650|1000°F	(340|550°C)	1
Compressed Non-Asbestos	600|750°F	(320|400°C)	3
Asbestos Beater Add	450|650°F	(230|340°C)	4
Non-Asbestos Beater Add	350|750°F	(180|400°C)	3-4
Expanded PTFE	500°F	(260°C)	3
Vegetable Fiber	250°F	(120°C)	4
Rubber (Chloroprene|SBR)	212|250°F	(100|120°C)	5
Cork-Rubber	250°F	(120°C)	6
Cork Composition	250°F	(120°C)	7

* NOTE: For specific service temperatures consult the manufacturer.

** Non-Oxidizing environment
Numerically rated from 1 to 10 indicating comparative torque retention e.g. "1" is best, "10 is worst.

From: FSA Non-Metallic Gasketing Handbook - In Print

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with... Published by AsbestosClaims.Law
ACL Doc 17398 · Page 22 of 24 asbestosclaims.law/library/17398/22

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with...
ACL Doc 17398 · Page 23 of 24

TABLE 2

USEFUL FLUID TEMPERATURE AND PRESSURE RANGES NON-METALLIC GASKETING MATERIAL

	High Pressure	Medium Pressure	Low	Vacuum
	>1000 psi - 1500 psi	>300 - 1000 psi	Atmos. - <200 psi	<Atmos. - 0.01 micr
High Temperature	Premium CA	Premium CA	Premium CA	Premium CA
>750 - 1000°F	Flexible Graphite	Flexible Graphite	Flexible Graphite	Flexible Graphite
Medium Temperature	Service CA	Service CA	Service CA	Service CA
>250 - 750°F	Flexible Graphite	Flexible Graphite	Flexible Graphite	Flexible Graphite
	Compressed Aramid|Glass	Compressed Aramid|Glass	Compressed Aramid|Glass	Compressed Aramid|Gl
		Asbestos Beater Add	Asbestos Beater Add	Asbestos Beater Add
		Aramid Beater Add	Aramid Beater Add	Aramid Beater Add
Low Temperature	Ecomomy CA	Economy CA	Economy CA	
-70 - 250°F	Flexible Graphite	Flexible Graphite	Flexible Graphite	Cellulose Beater Adc
	Compressed Aramid|Glass	Compressed Aramid|Glass	Compressed Aramid|Glass	Cork Beater Add
	PTFE (Reinforced)	PTFE	PTFE	

UCC 015756

Published by AsbestosClaims.Law
asbestosclaims.law/library/17398/23

Note: Trade Names Include: GRAFOIL® - Union Carbide (Flexible Graphite)

TEFLON® - Dupont (PTFE)

BLUEGUARD® - Garlock (Compressed Aramid)

NOBESTOS® - Lydall (Aramid Beater Add)

SYNTHESEAL® - Armstrong (Proprietary Beater Add)

CA = Compressed Asbestos

Temperatures & pressures based on presuming compatibility with fluid

UCC 015757

Union Carbide trial exhibit UC-2419: P. S. Petrunich Cover Memo on Alternative Materials Institute Meetings, with...
ACL Doc 17398 · Page 24 of 24
Published by AsbestosClaims.Law
asbestosclaims.law/library/17398/24