April 17, 1997

MEMORANDUM TO: L.B. Marsh, Chief
Plant Systems Branch
Office of Nuclear Reactor Regulation

FROM: K. Steven West, Chief
Fire Protection Engineering Section
Plant Systems Branch
Office of Nuclear Reactor Regulation

SUBJECT: MEETING WITH ENTERGY OPERATIONS, INCORPORTATED, AND TRANSCO PRODUCTS, INCORPORATED TO DISCUSS VERSAWRAP FIRE BARRIER SYSTEM (TAC NO. M82809)

On April 7, 1997, K.S. West, Chief, Fire Protection Engineering Section (FPES), and M.H. Salley, Fire Protection Engineer, FPES, Office of Nuclear Reactor Regulation (NRR), met with W. Walker, Fire Protection Engineer, Entergy Operations, Incorporated (Entergy), the licensee for Arkansas Nuclear 1 (ANO); and K. Hawks, Manager, Fire Protection Services, Transco Products, Incorporated (Transco). The purpose of the meeting was to discuss Versawrap, a new electrical raceway firewrap system. Transco is developing Versawrap as a possible stand-alone fire barrier or as an upgrade for such existing barriers as Thermo-Lag 330-1.

In general, Versawrap fire barriers are installed (from the raceway out) as individual layers of foil, water filled mylar tubes, fiber blankets, foil, and intumescent-coated fiberglass cloth. The numbers and arrangements of the specific barrier components are dependent on the type of raceway and the desired fire rating. Attachment 1 describes the components of a typical Versawrap barrier and their general arrangements. According to Mr. Walker, Entergy is considering installing 1- and 3-hour fire-rated stand-alone Versawrap barriers at ANO. According to Mr. Hawks, Northern States Power Company is considering installing a 1-hour fire-rated stand-alone Versawrap barrier at Prairie Island Nuclear Generating Plant.

A full-scale fire endurance test at Underwriters Laboratories, Incorporated, Northbrook, Illinois, is scheduled for April 10, 1997. Attachment 2 is Transco Products, Inc., Test Procedure TR-228, "Three Hour Fire Test of One and Three Hour VERSAWRAP Raceway Fire Barrier Systems for Conduits and Cable Trays," Revision 2, February 7, 1997.

Mr. Walker and Mr. Hawks stated that the attachments do not contain proprietary information.

Docket Nos.: 50-313, 50-282, and 50-306

Attachments: As stated

CONTACT: S. West, NRR
301-415-1220

DISTRIBUTION (w/atts):

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Document Name: G:\SECTIONC\WEST\VWRAPMTG.DOC

SC:SPLB:NRR
SWest
04/17/97

ATTACHMENT 1

TRANSCO, PRODUCTS INC.
EXECUTIVE OFFICES
Fifty Five East Jackson Boulevard
Suite 2100
Chicago, Illinois 60604-4166
312-427-2818
Facsimile 312-427-4975

Kevin J. Hawks
Manager, Fire Protection Services

Celebrating our 61st year (1936-1997)

March 24, 1997

Subject: VERSAWRAP
Raceway Firewrap replacement or upgrade to Thermo-Lag

Dear Sir,

Transco Products Inc. would like to introduce VERSAWRAP (patent applied for), a raceway firewrap system, as a possible solution to your current raceway fire barriers. This is a totally new concept in fire protection systems. This extremely versatile product is able to be installed as a stand-alone or upgrade, over existing raceway firewrap, system.

VERSAWRAP is the solution to all of your raceway barrier needs. It is far superior to existing systems for the following reasons:

a) **Economical** VERSAWRAP is the least costly system available as a GL 86-10 qualified firewrap for large and small conduits, free air cable drops, trays from 2" to 30" wide, aluminum or steel, and junction boxes both wall mounted and free air as a upgrade or stand-alone.

b) **Installation** This product is easily installed. Transco will offer the option to provide this as a totally complete "turn key" installation, train and certify your own site personnel for installation and inspection or any combination of this. The key advantage to the VERSAWRAP system is it's simplicity, using the same basic installation techniques for all types of applications.

c) **Light weight** It is lighter than any current raceway barrier systems. If you require a seismically qualified installation this product, due to it's light weight, will easily meet your site requirements.

d) **Deration** Very low ampacity deration factor due to the fact that it derives very little of it's performance from insulating materials there will be only a very slight increase in the current cable deration.

e) **Easy access** The VERSAWRAP system can be installed as a totally dry system with a minimal amount of attachment allowing ready access to the protected equipment without destroying the installed materials.

f) **Simple** Fast and easy surveillance requirements, this simple, sturdy installation will not become damaged by normal plant activities.

g) **Unlimited** The shelf-life for these materials are unlimited, as long as properly stored, allowing sites to maintain a readily available stock of materials.

h) **Local** All products used in this system are made in the USA. This reduces time required for deliveries and reduces cost by eliminating expensive overseas shipment cost and import duties.

i) **Safe** Recently, there has been some concerns raised about the use of ceramic fibers, due to their potential health hazards. Transco has selected material which pose a significantly less health risk there by eliminating some possible restrictions during installation.

The VERSAWRAP system has already demonstrated, through numerous fire tests, that it can provide protection to raceway for as long as 6 hours. The 1 and 3 hour systems currently demonstrate a large margin of safety which will provide additional conservatism to your plant fire protection program.

Transco has currently scheduled an extensive test program in support of upcoming installations at Entergy (Arkansas Nuclear One) and Northern States Power (Prairie Island), to be performed at Underwriters Laboratories in North Brook, Illinois, on April 10, 1997. You are cordially invited to attend and witness the installation of materials or the fire test to see first hand the performance of the system. We have attached a schedule calling out some of the key dates for your information and a list of hotels located close to the test laboratory.

We have also attached some general information which describes the VERSAWRAP's general arrangement, weight and products involved. A demonstration and additional information about the VERSAWRAP system can be provided at your site at your convenience.

Please review the above and feel free to contact us should you have any concerns or require further information.

Sincerely,
TRANSCO PRODUCTS INC.

Kevin J. Hawks
writers' extension 113
w/attachments

Gregory J. Jarosz
Product Manager
extension 136

March 1997

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

April 1997
VERSAWRAP FIRE TEST

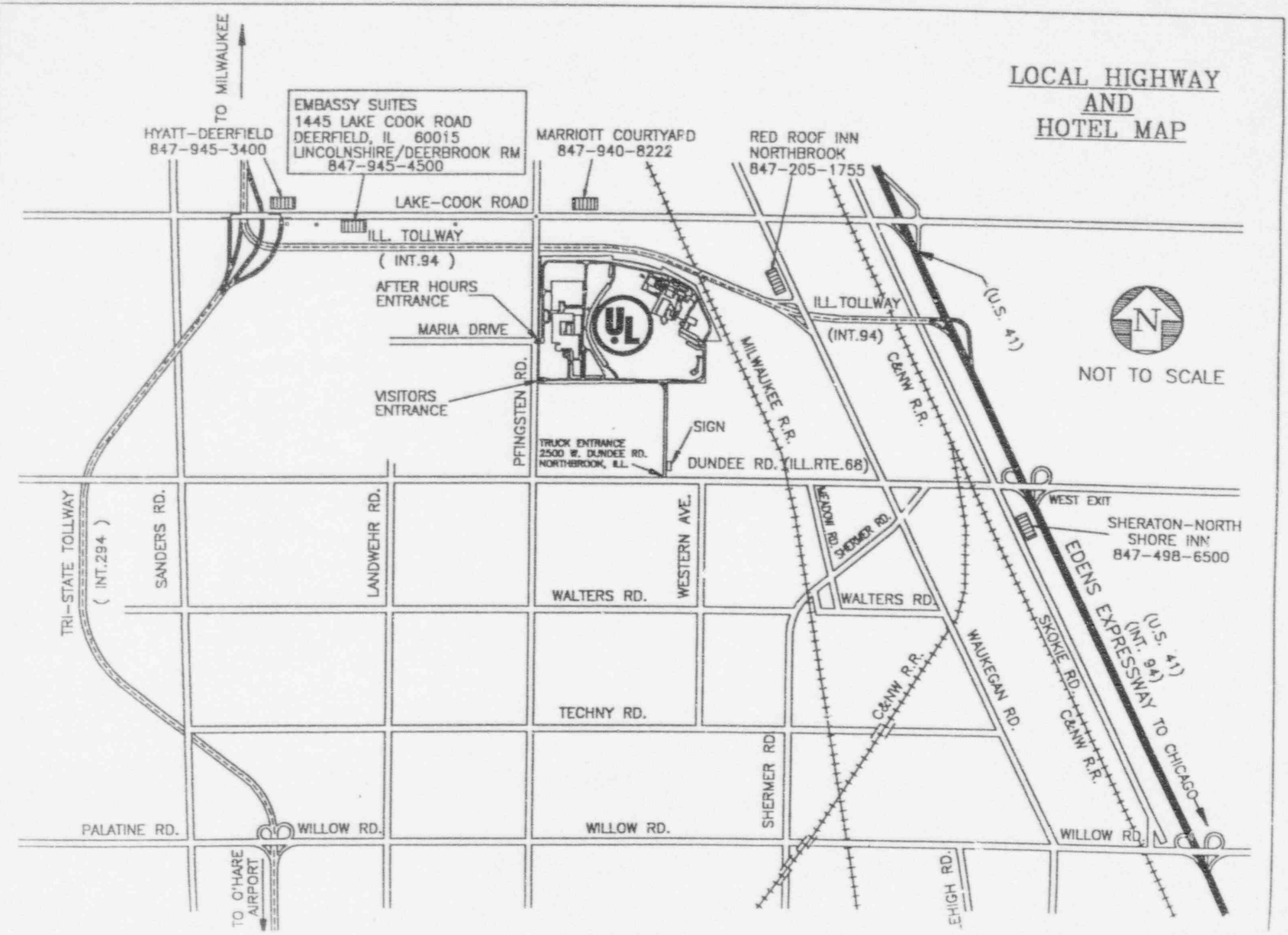
May 1997

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 April Fool's Day	2 [3:00p]Complete installation of Versawrap	3	4	5
6	7 [9:00a]Meet with NRC Fire Protection	8 [9:00a]Make adjustments to rig if required	9	10 [3:00p]Start 3 hour fire test	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25 [9:00a]Issue test report	26
27	28	29	30 [9:00a]Return report w/comments			

4/3/97

LOCAL HIGHWAY AND HOTEL MAP



CLIENT MAP OF UL FACILITY

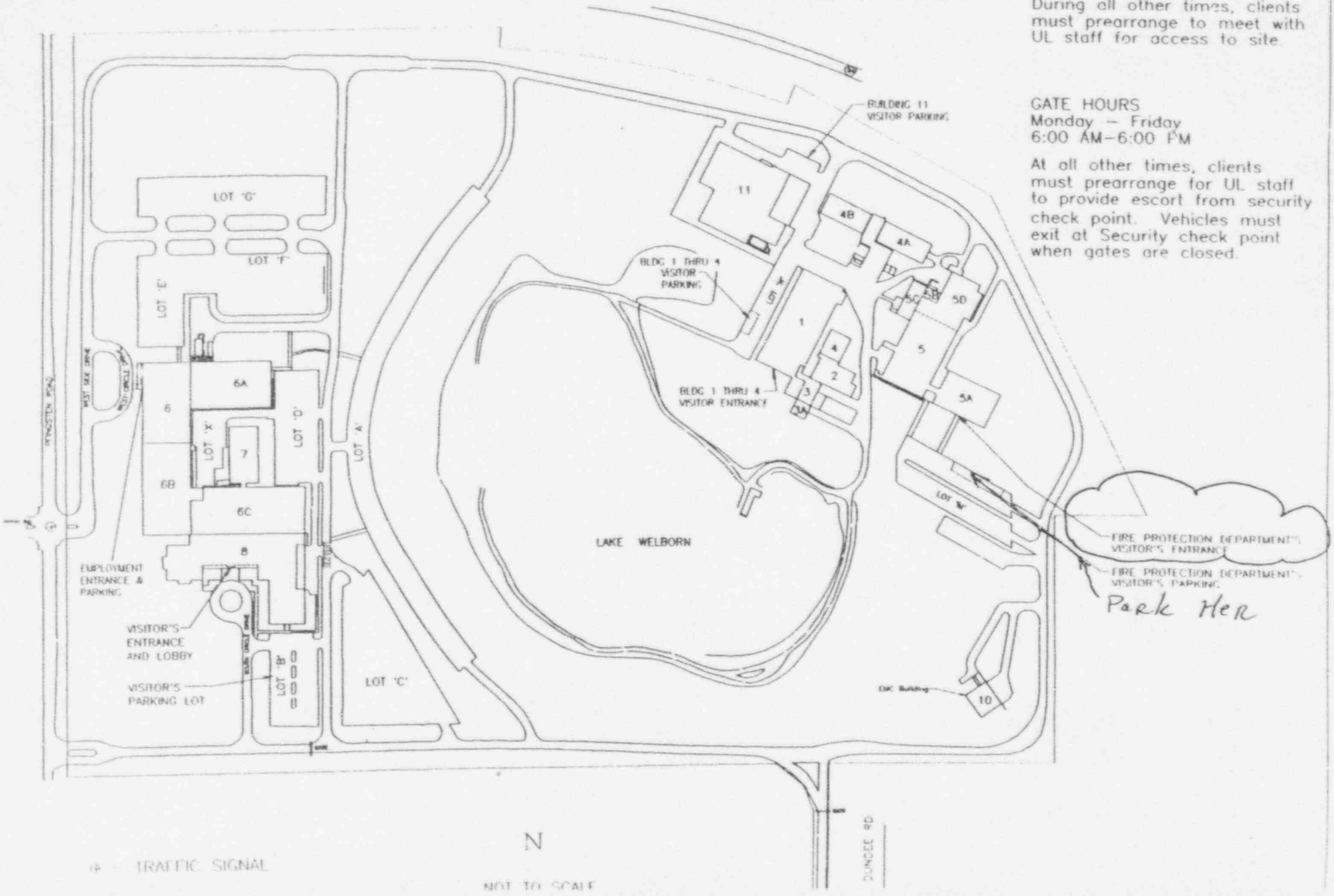
UNDERWRITERS LABORATORIES
333 PFINGSTEN ROAD
NORTHBROOK, IL 60062

VISITORS ENTRANCE HOURS
Monday – Friday
7:00a.m.–4:30p.m.

During all other times, clients must prearrange to meet with UL staff for access to site.

GATE HOURS
Monday – Friday
6:00 AM–6:00 PM

At all other times, clients must prearrange for UL staff to provide escort from security check point. Vehicles must exit at Security check point when gates are closed.



Hotels in the Area

Marriot Court Yard *Closest to Lab*
800 Lake Cook Road
Deerfield, IL
847-940-8222 UL rate $72 - $81

Embassy Suites
1445 Lake Cook Road
Deerfield, IL
847-945-4500 UL rate $99

Hyatt
1750 Lake Cook Road
Deerfield, IL
847-945-3400 UL rate $105

Red Roof Inn
340 Waukegan
North Brook, IL
847-205-1755 UL rate $38 - $49

Transco Products Inc. #TCO-700

VERSAWRAP ELECTRICAL RACEWAY FIRE BARRIER SYSTEM

Transco Products Inc.'s VERSAWRAP is a economical, easy-to-install, passive system for protecting electrical raceways for both one and three hour fire ratings in accordance with the requirements of the USNRC's Generic Letter 86-10, Supplement 1. Depending on the end-user's needs, VERSAWRAP can be used either as a stand-alone system or as an upgrade overlay to cover existing barrier materials to bring them into full compliance.

Both one and three hour systems consist of an innovative arrangement of heat absorbing water modules, fiber blanket, and stainless steel foil covered with an outer intumescent ceramic wrap. The ceramic intumescent activates and expands upon exposure to high temperature or fire and thus provides superior protection to the raceway and cables within, as well as any other substrate materials. The use of the intumescent wrap allows for a significant reduction in the design thickness of the fiber blanket portion of the barrier. This considerable reduction in the reliance on the fiber blanket results in a system that is both thinner and lighter that will contribute to a more favorable ampacity derating factor. As a thin and lightweight system, VERSAWRAP is a designer and installer friendly system. The compartmentalized water modules act to absorb heat during a fire as thermal mass. When exposed to higher temperatures, the modules are designed to melt to let steam escape into the surrounding blanket to further cool the assembly.

As its name implies, VERSAWRAP is a versatile, flexible, temperature resistant system that is adaptable to just about all field configurations including those where tight spaces make other systems difficult or impossible to install. VERSAWRAP utilizes a simple *cut-and-tie* installation. The vast majority of installations can be performed as completely dry work. However, wet lay-ups of the outer intumescent wrap are allowable as needed.

Typically, VERSAWRAP is installed as individual layers of water modules, fiber blanket, foil, and intumescent outer wraps. The water modules are supplied as flat sheets of interconnected sealed tubes of water that are wrapped around the raceway. These sheets are supplied in three different lengths to suit field installation needs. The number of tubes installed around the raceway reflect the one and three hour systems as tested. Each layer of the system is generally held in place using 18 gauge stainless steel wire that is "twist-tied" at its ends. In certain instances, installations can be supplemented with lightweight, metal frames to support the wrap where there is no suitable underlying substrate to suspend the flexible system. Being flexible, VERSAWRAP can be bent or squeezed into spaces that are less than the wrap's normal, uncompressed thicknesses (as tested). Other forms of attachment to and/or over the raceway are acceptable such as the use of concrete expansion anchors to secure the wrap to walls and ceilings where the raceway is in close proximity to the architectural barrier.

Installation procedures show that layers are placed utilizing both overlapping and butt joints at longitudinal and axially seams. It is recommended that the joints of subsequent layers be staggered to optimize the overall structural integrity of the completed installation. Because of the geometry of certain field raceway configurations, it is acceptable that not all joints be staggered (i.e., some conduit bends) as identified in the installation procedures in order to reflect tested conditions.

Transco Products Inc. #TCO-700

VERSAWRAP ELECTRICAL RACEWAY FIRE BARRIER SYSTEM

Typical Properties:

Outer Wrap Information:

- Color of Ceramic Coating: ..... White
- Flame Spread of Ceramic Coating: ..... 0 (*)
- Fuel Contribution of Ceramic Coating: ..... 0 (*)
- Smoke Generation of Ceramic Coating: ..... 0 (*)
- PH of Ceramic Coating (wet): 7.5
- Flash Point of Ceramic Coating (wet): ..... None
- Cure Time of Ceramic Coating: ..... 4 days
- Environmental/Health Information for Ceramic Coating (wet):
  - HMIS
  - Health: 1
  - Flammability: 0
  - Reactivity: 0
  - Personal Protection: ..... B
- Weight of Uncoated Fabric Reinforcement (*oz./sq. yd*): ..... 60 (x 2)

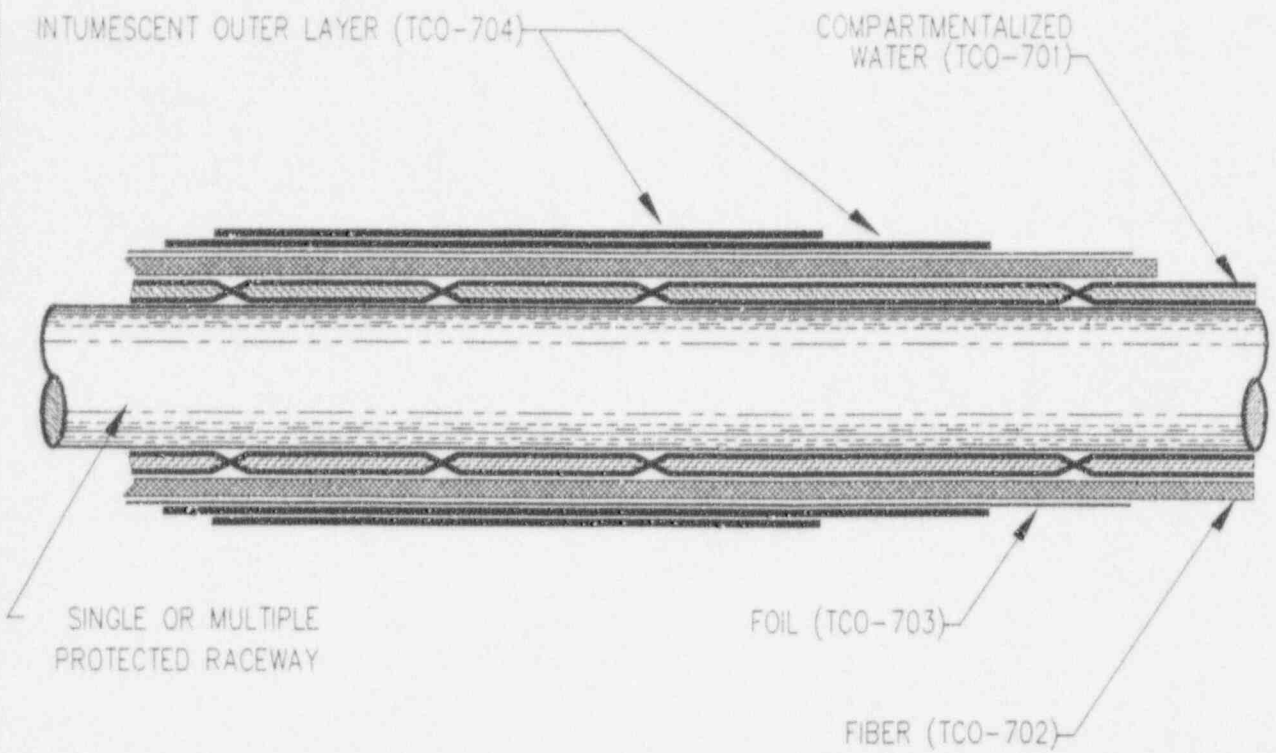
(*): Based on 100 for untreated red oak

Tie Wire: ..... 18 gauge s.s.
Banding (if used): ..... ½" wide s.s.

Fiber Blanket Information:

- Thickness Each Layer: ..... As Required by Test
- General Composition: ..... Ceramic
- Manufactured Density: ..... Nominal 8 lb.
- Nominal Specific Gravity: 2.65
- Nominal Percent of Linear Shrinkage at 1,800°F: 1.6
- Health/Safety Information: ..... Material should be treated as a ceramic blanket material (see attached data sheet)
- Foil Information: ..... 20 mil s.s.

NOTE: SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.



TPI GENERAL ARRANGEMENT 1 HOUR VERSAWRAP

1 HOUR RACEWAY PROTECTION FOR CONDUIT

AUTOCAD REF. DWG. No.: FWV001A.DWG

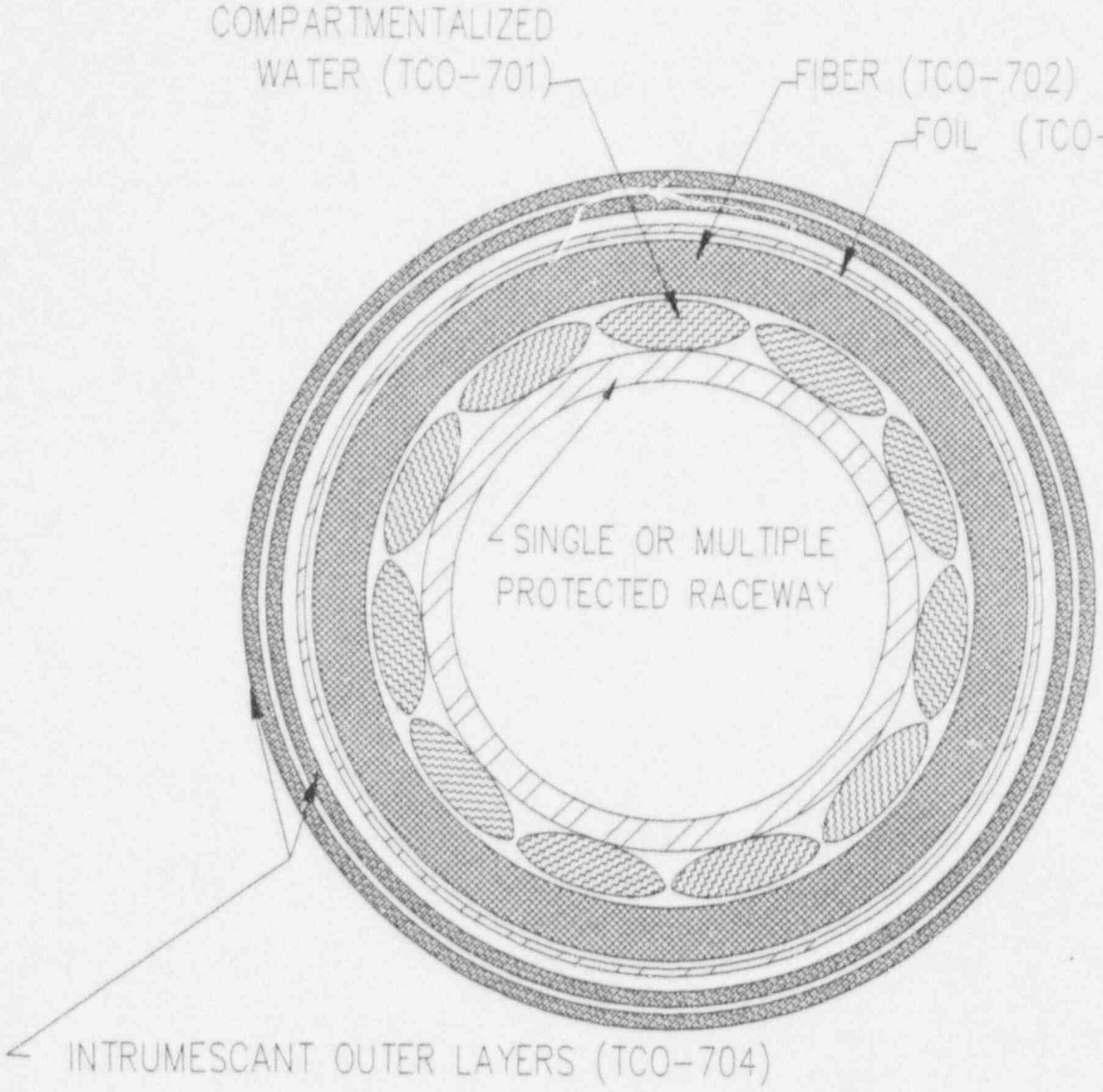
TRANSCO PRODUCTS INC.
55 E. JACKSON BLVD. CHICAGO, IL 60604 TEL. (312)427-2818

TPI GENERAL ARRANGEMENT: "FWV-001"
VERSAWRAP RACEWAY PROTECTION SYSTEM

NO.	REVISION	BY	DATE	APP'D	DATE
0	APPROVAL	K.J.H.	02/19/97	G.J.J.	02/19/97

DRAWN K.J.H. DATE 02/19/97
APPROVED G.J.J. DATE 02/19/97
SCALE N. T. S. --PLOT @ 9.9=110

DWG NO. FWV-001-A REV. 0



TPI TYPICAL DETAIL 1 HOUR VERSAWRAP

1 HOUR RACEWAY PROTECTION FOR CONDUIT

AUTOCAD REF. DWG. No.: FWV0018.DWG

TRANSCO PRODUCTS INC.
55 E. JACKSON BLVD. CHICAGO, IL 60604 TEL. (312)427-2818

TPI TYPICAL DETAIL "FWV-001"
VERSAWRAP RACEWAY PROTECTION SYSTEM
1 HOUR SYSTEM

NO.	REVISION	BY	DATE	APPD	DATE
0	APPROVAL	K.J.H.	02/19/97	G.J.J.	02/19/97

DRAWN	K.J.H.	DATE	02/19/97
APPROVED	G.J.J.	DATE	02/19/97
SCALE	N. T. S. -PLOT @ 9.9=110		

DWG. NO.: FWV-001-B

REV.: 0

CONDUIT SIZE NOM. BORE	CONDUIT SIZE ACTUAL	INSTALLED SYSTEM WEIGHT PER LINEAR FOOT (INCLUDING ATTACHMENT)			
		UPGRADE		STAND ALONE	
		1 HOUR	3 HOUR	1 HOUR	3 HOUR
0.75	1.25	2.55	6.38	2.55	6.38
1	1.5	2.69	6.58	2.69	6.58
1.5	2	2.97	6.99	2.97	6.99
2	2.5	3.25	7.41	3.25	7.41
2.5	3	3.53	7.90	3.53	7.90
3	3.5	3.82	8.52	3.82	8.52
4	4.5	4.59	9.96	4.59	9.96
6	6.5	6.12	12.83	6.12	12.83
8	8.5	7.65	15.70	7.65	15.70
WEIGHT PER SQ / FT		3.25	7.41	3.25	7.41

ALL WEIGHTS REPRESENT THE MAXIMUM TOLERANCE WITH AN ADDITIONAL 10% ADDED SAFETY MARGIN

A. OLSZEWSKI

Insulfrax
Specialty Glass Fiber

TO: ID-8

December 29, 1993

FROM: M. A. Rhoa

CC: G. W. Deren
W. Bishara
A. E.'s
P. J. Viola

RE: THERMAL STABILITY
INSULFRAX™ 1800 BLANKET

Since the introduction of Insulfrax™ products at the 1993 sales meeting, questions have been raised regarding the thermal stability of Insulfrax™ 1800 Blanket, and the margin of safety inherent with the product.

During the sales meeting, the thermal shrinkage performance of Insulfrax™ 1800 Blanket was compared to Durablanket-S®. On the attached chart, the shrinkage comparison is extended to Durablanket® 2600. Based on an average of all thermal shrinkage data generated to date, Insulfrax™ 1800 Blanket is the most stable blanket product available at temperatures up to 1800°F!

Typically, Fiberwall™ linings are designed to compensate for shrinkage up to 3%. In critical applications up to 1800°F where minor shrinkage cannot be tolerated, Insulfrax™ 1800 Blanket exhibits less than half the shrinkage of a Durablanket-S® or Durablanket® 2600 lining!

The chart below compares the continuous use limit, recommended use temperature and failure temperature for a range of fiber products:

Product	Design Temperature Limit (°F)	Recommended Use Temperature (°F)	Failure Point (°F)	Margin of Safe °F	% T
✓ Insulfrax 1800 Blanket	1800	1800	2200	400	22
Durablanket-S®	2300	2100	2600	500	24
Durablanket-2600®	2600	2450	2700	250	10
Fibermax® Mat	3000	2800	3100	300	11

As the comparison presented above points out, the "margin of safety" for Insulfrax™ 1800 blanket is extremely conservative and consistent with that of existing products.

FAVORABLE PROPERTIES OF HIGH TEMPERATURE GLASS FIBER INSULATING MATERIAL BY IMPROVED CHEMISTRY

By Gary Deren
Market Development Manager
and Mark A. Rhoa, Product Manager
Fibers Division
The Carborundum Co.
Niagara Falls, NY

An evolutionary breakthrough in insulating materials entails the combining of a completely new fiber chemistry with proprietary fiber spinning technology to create a specialty high temperature glass fiber with superior thermal and mechanical properties. The new class of product was developed by Carborundum Co. from a calcium, magnesium, silicate chemistry, Table I, with limiting temperature of 1000°C (1832°F). Tensile strength of this product family (Insulfrax®) is enhanced by the spinning technology. In addition to good strength, the products are light weight, flexible, possess excellent acoustical properties and exhibit excellent thermal characteristics.

Product Development

Since the invention of ceramic fiber by J. C. "Charlie" McMullen, a Carborundum research scientist, in 1942, The Carborundum Company's ceramic fiber products (Fiberfrax®) have been the source of innovative insulating solutions, providing energy savings, for a broad range of industries. Now the company, with extensive research and development activities, produces ceramic fiber (Fiberfrax) in nine separate manufacturing facilities in six countries.

Development of the high temperature fiber of new chemistry (Insulfrax) is the direct result of Carborundum's on-going commitment to a product stewardship program. This program is structured to reduce the potential handling hazards associated with all types of fine fibers generated during handling of ceramic fiber products, by decreasing the dose of airborne fibers generated during handling of ceramic fiber products, creating fibers that will dissolve more readily in body fluids, and increasing fiber dimensions to prevent fibers from becoming airborne. From 1990 to 1993, over 150 new fiber chemistries have been developed and tested (see Figs. 1 and 1A). The development of the calcium, magnesium, silicate fiber (Insulfrax) is an early end-product of this work (see Figs. 2-4).

Product Forms and General Properties

Currently, the new product is made in a variety of forms — bulk fiber, needled blanket, Anchor-Loc® modules and bonded modules — for applications that include refractory linings, thermal insulation, fire protection and metals transfer. The various product forms, Fig. 5, demonstrate excellent thermal stability at temperatures up to 1000°F (1832°F) after exposure to water immersion or high humidity. The material also provides outstanding wetting resistance to molten aluminum alloys. Testing with corrosive aluminum alloys at elevated temperatures has proven these fibers to be superior to traditional alumina/silica refractory ceramic fibers (see Fig. 6).

Table I Chemical Analysis of New Glass Fiber Material

Chemical Analysis Insulfrax Spun Bulk 3010 Insulfrax 1800 Blanket	
Typical Chemical Analysis:	%
SiO_2	55
CaO	34
MgO	2

Fig. 1 Tensile strength of CaO-MgO-SiO_2 blanket (Insulfrax® 1800) is monitored hourly during the manufacturing process.

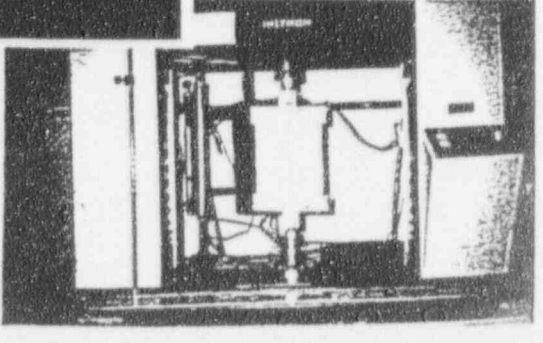


Fig. 1A Close-up of tensile test apparatus for CaO-MgO-SiO_2 blanket. Blanket products meet or exceed minimum tensile strengths for fibrous insulating material per ASTM E-892.

Reprinted from INDUSTRIAL HEATING November 1993

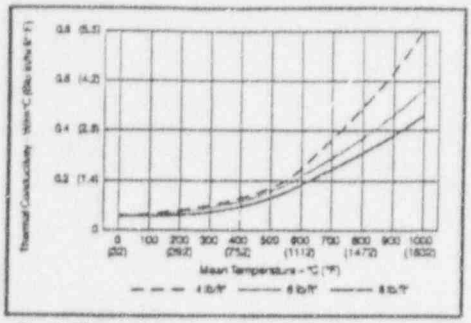


Fig. 7 Thermal conductivity of CaO-MgO-SiO_2 blanket as a function of mean temperature and density.

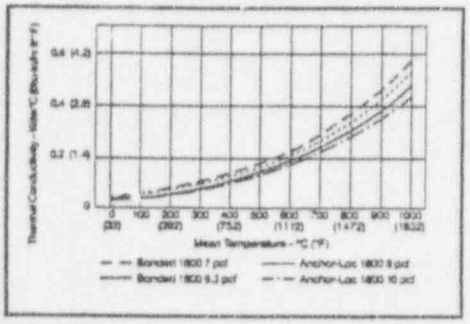


Fig. 8 Thermal conductivity of CaO-MgO-SiO_2 modules as function of mean temperature and module type.

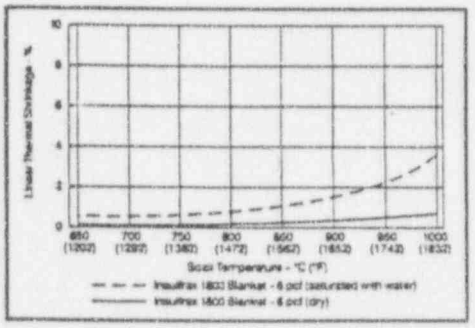


Fig. 9 Thermal shrinkage of CaO-MgO-SiO_2 blanket in conditions shown as a function of temperature.

Typical physical properties of spun bulk fiber and blanket products are listed in Table II. Thermal conductivity and shrinkage data are shown in Figs. 7-9.

Bulk Fiber

Spun bulk fiber (3010) enhanced tensile strength provides increased resistance to vibration and mechanical stress during service. Its high fiber index (low percentage of unfiberized particles) contributes to the excellent thermal performance. This bulk fiber is the feedstock for the product line and is easily converted to board, paper and vacuum cast shapes. Typical applications for the fiber form include those listed in Table III.

Blanket

Blanket (1800) is produced from the bulk fiber. Mechanical needling of the spun fibers eliminate the need for binders in the product manufacture and produces a high tensile strength product. The blanket is completely inorganic and thus exhibits no smoke generation or outgassing in service. Applicability of the material in this form is broad, as shown in Table IV.

Modules

Eight folds of one inch blanket is combined with Anchor-Loc hardware in fabrication of the module block which is produced in densities of 128 kg/m^3 (8 lb/ft^3) and 160 kg/m^3 (10 lb/ft^3) and in a range or sizes. The folded blanket layers are secured to the metallic module anchor with several alloy support tubes (see Fig. 10). Flanges on the tube ends effectively lock the position of the tubes relative to the anchor at the time of the installation. Four attachment systems, Fig. 11, are provided with the selection dependent upon the needs of the specific application.

Bonded Modules

Bonded modules, based on Insulfrax 1800 blanket, comprise folded blanket, tightly compressed and banded (see Fig. 5). They can be installed as a hot face veneer over existing refractory or with hardware (HeftyLock™) as a full thickness lining (see Fig. 12 and Table VI).

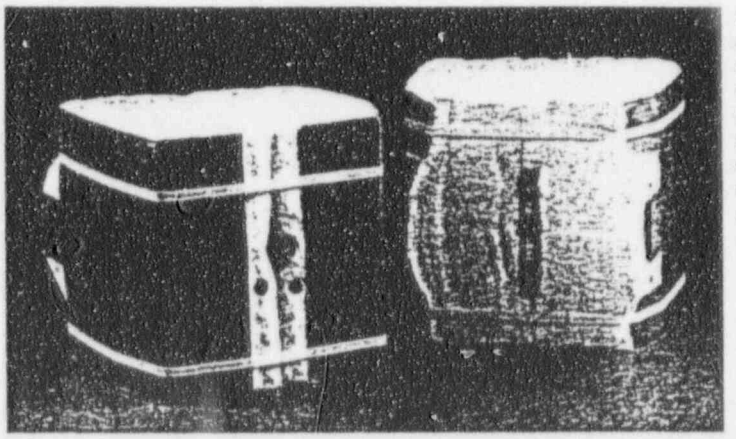


Fig. 10 CaO-MgO-SiO_2 modules are fabricated from folded blanket layers secured to the metallic module anchor with several alloy support tubes.

Table III Typical Applications of CaO-MgO-SiO_2 Bulk Fiber

- ▼ Expansion joint packing - refractory construction
- ▼ Fire protection or penetration seals
- ▼ Conversion to vacuum cast tap out cones, precast molten metal distribution shapes
- ▼ Tube seal packing
- ▼ Burner block gaskets
- ▼ Manufacture of blanket, moldables and coatings

Table IV Typical Applications of CaO-MgO-SiO_2 Blanket

Primary Metals
- Expansion joint seals
- Aluminum homogenizing furnace linings
- Aluminum transfer ladle covers
- Backup insulation for dense refractory linings
- Backup insulation for refractory ceramic fiber linings
- Maintenance blanket
- Heatshields

Petrochemical/Power
- Crude heater linings
- Convection box, stack linings
- Cogeneration duct linings
- Reusable insulating pads
- External boiler and duct insulation
- Acoustical insulation
- Field steam generator linings

Metals Processing
- Annealing furnace linings
- Stress relieving blankets
- Seals and gaskets
- Investment casting mold wrap
- Heat treating furnace linings

Ceramic and Glass
- Glass tank crown insulation
- Glass feeder linings
- Expansion joints
- Carbon baking furnace linings

Fire Protection
- Shroud blanket
- Tank car blanket
- Chimney liner insulation
- Ceiling tiles
- Curtain wall

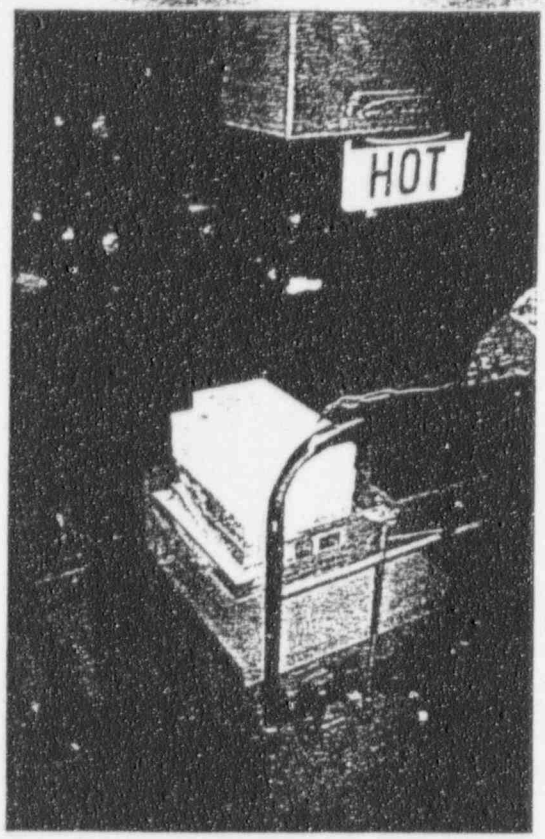


Fig. 2 $CaO-MgO-SiO_2$ blanket sample is being placed in the kiln for testing material shrinkage. Typical shrinkage of blanket is less than 1% after thermal soaking at 1800°F for 24 hours.

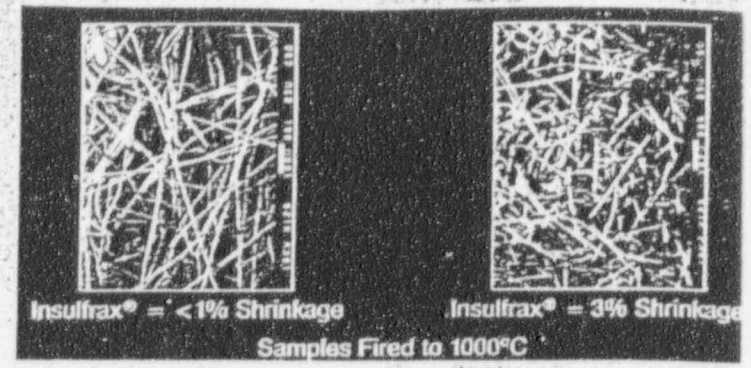


Fig. 3 Photomicrographs show the effect of water saturation on the thermal stability of new $CaO-MgO-SiO_2$ material. Note at right that exposure to high humidity or complete saturation in water will increase product shrinkage at the maximum use temperature to 3%, well within accepted design limits.

Fig. 4 Photomicrograph shows the effect of water saturation on shrinkage of a typical soluble amorphous fiber product. Note that exposure to water increases shrinkage at maximum use temperature up to 18%, limiting the safe working limit for this product to 1400°F.

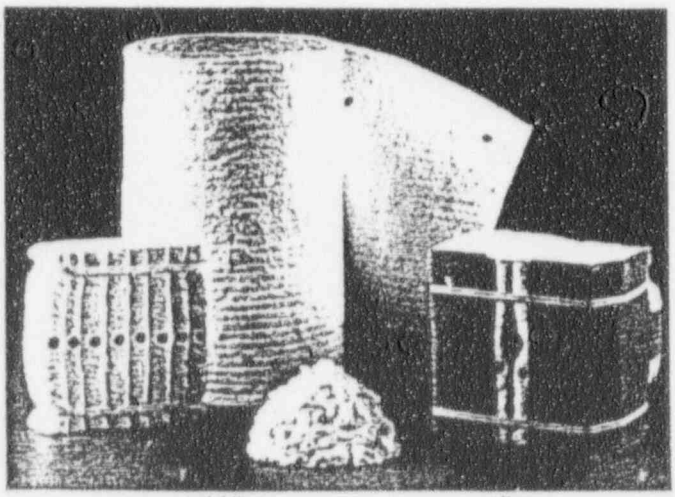


Fig. 5 Glass fiber ($CaO-MgO-SiO_2$) products made in several forms including (left to right): bonded modules, blanket, spun bulk fiber and Anchor-Loc® 1800 modules.

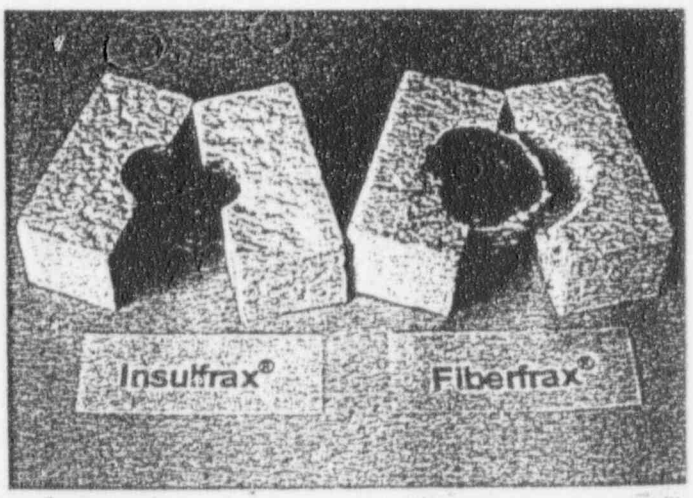


Fig. 6 New glass fiber chemistry exhibits superior resistance to aluminum wetting. Standard cup tests with aluminum alloy shows new material (Insulfrax®) resistance to aluminum superior to that of high purity refractory ceramic fiber (Fiberfrax®).

Table II Typical Physical Properties of $CaO-MgO-SiO_2$ Fiber and Blanket Products

Insulfrax Product Form	Color	Continuous Use Limit	Melting Point	Fiber Length	Fiber Diameter	Specific Heat	Specific Gravity	Average Tensile Strength	Fiber Index
Spun Bulk 3010	Bluish White	1000°C 1832°F	1260°C °F	Up to 6 inches	4.6 m (mean)	1000j/kgk (1000°C)	2.67	—	62%
Insulfrax 1800 Blanket	Bluish White	1000°C 1832°F	1260°C °F	—	4.6m (mean)	1000j/kgk (1000°C)	2.67	4.0 psi/4 PCF 6.0 psi/6 PCF 8.0 psi/8 PCF	—

Modules Applications and Advantages

Typical application for modules are listed in Table V. Advantages in use of insulating modules are fast furnace cycling, resistance to thermal shock, low heat storage and minimum of heat loss (Table VI), energy savings low installed cost, rapid and easy lining repairs, low sound absorption and increased furnace productivity.

Conclusion

Evolved from considerable research and development work is a new family of glass fiber products with good combination of properties for advantageous service in numerous thermal applications.▼

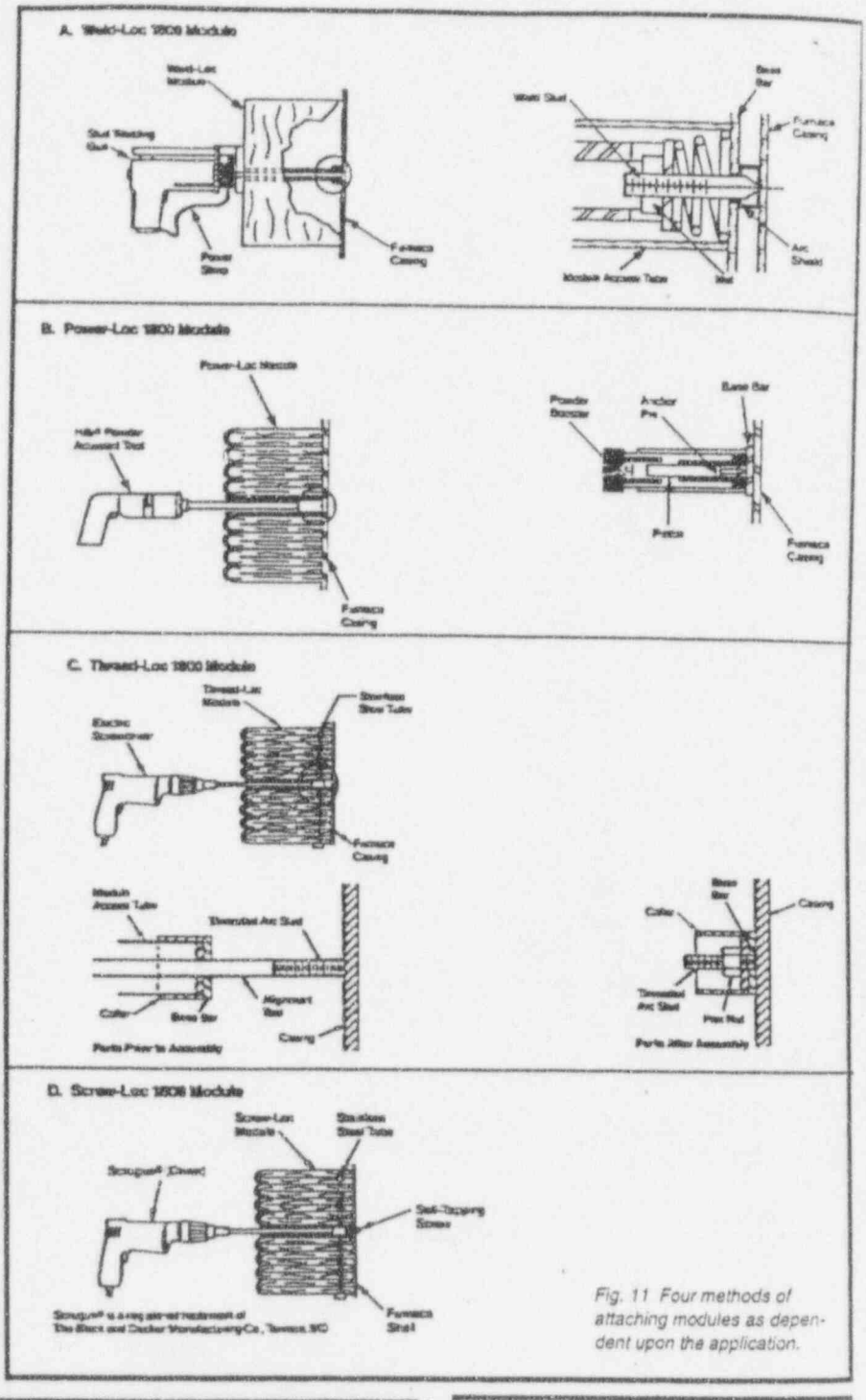


Fig. 11 Four methods of attaching modules as dependent upon the application.

Table V Typical Application of $CaO-MgO-SiO_2$ Modules Utilizing Special Anchoring System

- ▼ Annealing furnaces
- ▼ Aluminum homogenizing furnaces and soaking pits
- ▼ Process heaters
- ▼ Stacks, ducts and flue linings
- ▼ Heat treating furnace linings
- ▼ Fume incinerators
- ▼ Field steam generators
- ▼ Slow cool covers for slabs and ingots
- ▼ Aluminum ladle covers
- ▼ Personnel heat shields
- ▼ Flue stack and duct linings

Table VI Hot and Cold Wall Temperatures for $CaO-MgO-SiO_2$ Bonded Modules as Insulating Lining or Special Construction

Bonded 1800/Hefty Lock® Lining

Fiberwall Bonded 1800		Folded Modules 112 kg/m³ (7 lb/ft³)			
Hot Face		Cold Face Temperature °C (°F)			
°C (°F)	Insulation Thickness-mm (In)	102 (4)	156 (6)	203 (8)	254 (10)
600 (1112)		79 (176)	65 (150)	54 (130)	52 (127)
800 (1472)		112 (235)	90 (195)	77 (172)	69 (157)
1000 (1832)		153 (310)	122 (254)	104 (222)	92 (200)

Fiberwall Bonded 1800		Folded Modules 149 kg/m³ (9.3 lb/ft³)			
Hot Face		Cold Face Temperature °C (°F)			
°C (°F)	Insulation Thickness-mm (In)	102 (4)	152 (6)	203 (8)	254 (10)
600 (1112)		77 (172)	63 (147)	56 (113)	51 (124)
800 (1472)		106 (225)	82 (187)	74 (166)	66 (152)
1000 (1832)		143 (292)	114 (239)	97 (209)	86 (189)

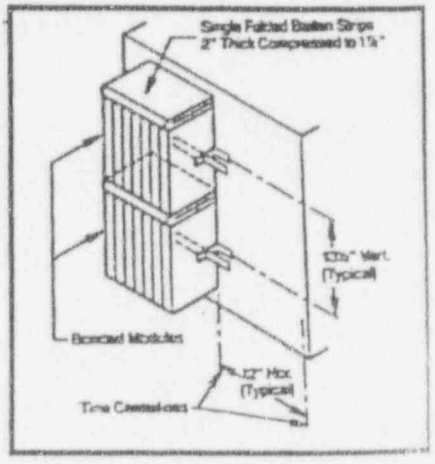


Fig. 12 Bonded module installation by means of alloy steel hardware (Hefty Lock).

A. OLSZEWSKI

Insulfrax®
Specialty Glass Fiber

To: ID-8

December 16, 1994

From: M. A. Rhoa

Mark A Rhoa

cc: A. Banks-Rainford
K. Cheeseman-Paris
G. W. Deren
A. P. Norris
J. R. Olson
L. A. Peekstok
P. J. Viola
D. Yardley-Rainford

Subject: INSULFRAX® PRODUCTS
CUSTOMERS' QUESTIONS

When Insulfrax® specialty glass products were commercialized, health and safe handling guidelines were published to introduce the product. Over the past two years, customers have raised additional questions related to classification, labelling and advantages of Insulfrax fiber products.

Several questions frequently asked by customers are answered below:

1) Is Insulfrax fiber RCF free? If so, why is this fact not stated in the Material Safety Data Sheet?

Answer

Yes, Insulfrax fiber is a high temperature glass, not a ceramic fiber product. The chemistry of Insulfrax fiber (65% silica, 31% calcia, 3% magnesia) falls outside EPA's definition of RCF products:

> "An amorphous man-made fiber produced from the melting and "blowing" or "spinning" of calcined kaolin clay or a combination of alumina (Al_2O_3) and silica (SiO_2). Oxides such as zirconia, ferric oxide, titanium oxide, magnesium oxide, calcium oxide, and alkalies may also be added. Approximate percentages (by weight) of components may vary as follows: Alumina, 20 to 80 percent; silica, 20 to 80 percent; and other oxides in lesser amounts, approximately 1 to 5 percent (CAS number 142844-00-6)."

Although Insulfrax fibers were developed for increased solubilization and leaching of components in simulated body fluid, we do not have absolute scientific proof that Insulfrax® fibers are safe.

Carborundum avoids using statements like "contains no RCF" or "asbestos free" on our products since the connotation associated with this labelling is that the product is inherently safer than RCF or asbestos.

2) **Is Insulfrax fiber classified as a Group 2B agent (possible human carcinogen)?**

In 1987, the International Agency for Research on Cancer (IARC) reviewed relevant health and experimental data on man-made vitreous fibers. Based on this review, IARC classified all man-made vitreous fibers as a 2B "possible human carcinogen." Insulfrax, like Fiberfrax® RCF, Fiberglass and Mineral Wool falls into the classification of man-made vitreous fibers as defined by TIMA (Thermal Insulation Manufacturers Association).

3) **Since the handling practices in the Material Safety Data Sheets are the same, how are Insulfrax products different from Fiberfrax RCF products?**

Insulfrax glass fiber and Fiberfrax ceramic fibers are produced in the same process furnaces, therefore, there are similarities in fiber appearance and geometry. Due to the fiber chemistry, discussed earlier, thermal and physical properties of the products are different.

Carborundum's recommendation to handle Insulfrax fiber in the same manner as Fiberfrax RCF products is based on two factors:

a) The absence of absolute scientific evidence proving that Insulfrax is safer than Fiberfrax ceramic fiber.

b) Consistency with the best industrial hygiene practices which seek to reduce worker exposure while continuing to decrease the potential hazards associated with the product.

4) **What are the advantages of Insulfrax in comparison to Fiberfrax fibers?**

a) Increased Fiber Solubility

In a recent monograph, IARC stated that fiber dose, dimension and durability in the body were key factors in determining a fiber's carcinogenicity.

On the attached chart (Attachment A), the solubility of Insulfrax fiber is compared to other natural and man-made industrial fibers. Note that this testing, conducted with simulated lung fluids in the lab, is not conclusive scientific proof of the material's safety, however, it does provide a "signal" to researchers as to the potential hazards associated with inhaled fibers.

4) b) Regulation/Reporting

Since Insulfrax products fall outside the CAS (and EPA) definition of refractory ceramic fiber, they are not subject to the same reporting and approval regulations as Fiberfrax RCF products. As a result of being classified as specialty glass fiber, Insulfrax is not subject to the EPA's Significant New Use Rule (SNUR) or the TSCA export reporting requirements which regulate Fiberfrax ceramic fiber sales.

c) Thermal Stability (Shrinkage Resistance)

Based on thermal shrinkage tests performed on blanket samples, Insulfrax fibers shrink less than RCF fiber chemistries at temperatures up to 2200°F (see Attachment B).

d) Molten Metal Penetration Resistance

Due to the calcia/silica chemistry, vacuum cast shapes, boards and gaskets made from Insulfrax resist penetration of aluminum better than Fiberfrax RCF products.

Results of molten metal penetration tests are attached (Attachment C).

If your customers have additional questions about Insulfrax products or if you would like to discuss product performance or properties in greater detail, please contact this office, 716/278-2019.

Note that this mailing will be sent to distributors and vacuum casters in your sales territory within the next two weeks.

MAR:lc
Attachments

Insulfrax®
Specialty Glass Fiber

To: A. OLSZEWSKI

September 14, 1994

From: G. W. Deren

cc: P. J. Viola
Insulfrax™ Team

Subject: INSULFRAX™ PRODUCTS
DISSOLUTION IN SIMULATED LUNG FLUID

A key element of Carborundum's Product Stewardship Program is dedicated to developing systems and products which effectively reduce the risk associated with industrial fibers. Insulfrax™ products, an early end product of this effort, were designed to dissolve readily in simulated lung fluids.

In order to compare the solubility of Insulfrax fiber with that of other common industrial fibers, Dr. Bruce Zoitos prepared the attached explanation and graph for Carborundum's in vitro tests.

Based on laboratory tests with simulated lung fluid, Insulfrax fiber with a one micron diameter dissolves in 3 weeks. This compared favorably with other industrial fibers like E-Glass (+1 year) and RCF (approximately 2 years).

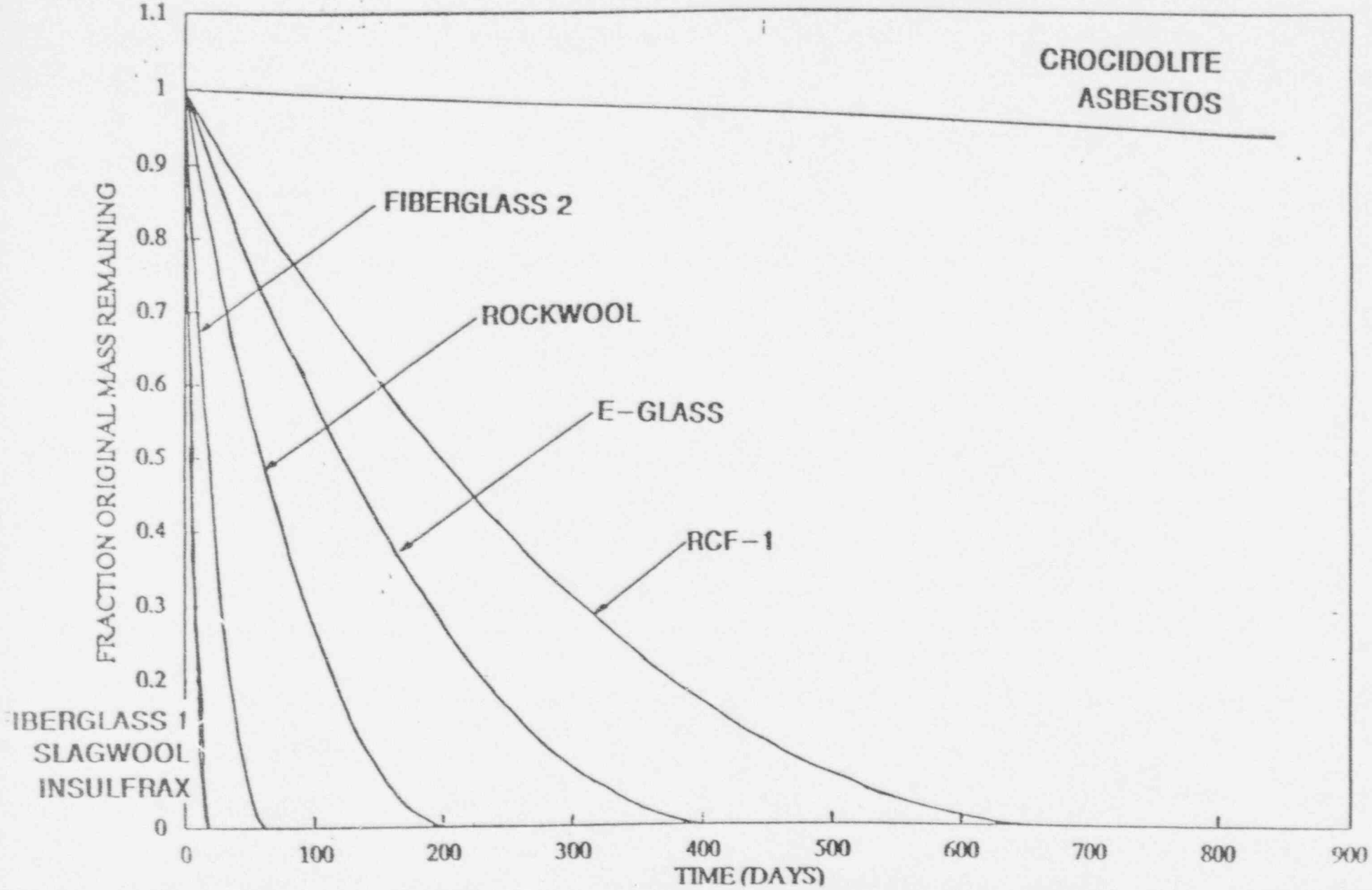
Please note in your discussions with customers that this testing, conducted with simulated lung fluids in the lab, is not conclusive scientific proof of the material's safety. The results do provide a "signal" to researchers as to the potential hazards associated with inhaling the product.

If your review of the attached graph raises additional questions, please contact this office, 716/278-6163.

GWD:lc
Attachment

DISSOLUTION OF 1 MICRON FIBER

BASED ON CARBORUNDUM IN VITRO TEST



One key product feature of Insulfrax Specialty Glass Products, which was discussed at the time of introduction, is the fiber's increased solubility in simulated lung fluid.

To measure the dissolution rate of fibers in simulated lung fluid, a 28-day corrosion test is conducted in which SLF is pumped over the fibers at 98.6°F. Glass corrosion products are then measured in the solution and used to calculate the rate at which the fiber dissolves.

Using this method, dissolution rates were measured for various fibers. Based on this dissolution rate, the time required for a 1 micron fiber to dissolve in SLF was calculated. These values are shown in the following table and graph.

FIBER	DISSOLUTION RATE	TIME TO DISSOLVE 1 MICRON FIBER
SLAGWOOL	296 ng/cm²·hr	2.5 weeks
FIBERGLASS 1	292	2.5
INSULFRAX™	255	3.0
FIBERGLASS 2	81	9.6
ROCKWOOL	26	30
E-GLASS	13	60
RCF-1	8.0	97
CROCIDOLITE ASBESTOS	0.2	3869

This shows that, based on in vitro laboratory measurements, a 1 micron Insulfrax™ fiber dissolves in about 3 weeks. This may be compared to RCF which dissolves in two years and asbestos which would require approximately 74 years to dissolve.

Biological durability is considered to be one of the key factors, along with fiber dimension and amount of fiber inhaled (dose), in determining potential human health effects. To date no animal or human health data is available for Insulfrax™ products.

Health & Safe Handling Information on Insulfrax® Specialty Glass Fiber

Questions and Answers

1. **What is Insulfrax® fiber?**
   Insulfrax fibers are made from a vitreous inorganic composition of conventional glass making oxides. This composition renders Insulfrax fibers more subject to leaching and solubilization of components in simulated body fluid tests than many other manmade vitreous fibers (MMVFs), such as refractory ceramic fibers, mineral wool and many types of fibrous glass. Typical uses for Insulfrax fibers include thermal insulation (with a normal use limit of 1000°C), acoustical insulation and mechanical reinforcement.

2. **How is the solubility of fibers generally evaluated?**
   The Carborundum Company evaluates the solubility of fibers using a continuous flow leaching test simulating lung fluids. The fibers are exposed to a constant flow of fluid for a specified period (usually 28 or 120 days). After exposure, the fibers are analyzed to determine the amount of dissolved material. Solubility is expressed as the mass of all dissolved components per surface area of the sample per day.

   Solubility is considered to be one of the key factors, along with size and the amount of fiber inhaled, in determining potential human health effects. To date no animal or human health data is available for Insulfrax products. Please consult the Material Safety Data Sheet for safe handling recommendations and details of health related effects for Insulfrax products.

3. **How was Insulfrax fiber developed?**
   The Fibers Division of The Carborundum Company has been a leader in the development of high temperature fibers for many years. For the past several years, Carborundum has dedicated substantial resources to developing fibers that are more prone to solubilization and leaching of components in simulated body fluid testing. The development of Insulfrax fibers is an early end product of this work.

4. **How is Insulfrax fiber classified relative to traditional insulating fibers, fibrous glass, mineral wool and refractory ceramic fibers (RCFs)?**
   Insulfrax fibers are classified as manmade vitreous fibers together with discontinuous fibrous glass, mineral wool and refractory ceramic fibers (RCFs). Insulfrax fibers are classified with other alkaline silicates as a specialty glass fiber.

5. **How do Insulfrax fibers compare to asbestos fibers?**
   Asbestos is a naturally occurring crystalline mineral which is readily separated into long, thin, flexible fibers during processing. Since the fibers are of small diameter (generally less than one micron), they tend to readily become and remain airborne. Further, asbestos fibers tend to split longitudinally into finer fibrils when handled. In contrast, most manmade vitreous fibers, including Insulfrax fibers, break transversely into shorter lengths due to their glass structure.

6. **Have Insulfrax fibers been evaluated for potential human health effects?**
   No. Recently, state-of-the-art animal inhalation studies were completed on fibers whose solubility and chemistry are similar to that of Insulfrax products. These tests showed no harmful effects in laboratory animals. Results for Insulfrax fibers will be presented when available.

7. **Are there any human health risks associated with Insulfrax fibers?**
   Yes. Most fibers by their very nature tend to be irritating to the eyes, skin and respiratory system. Animal studies demonstrate that very high exposures to any type of respirable fiber can provoke an inflammatory reaction in the lung. Long-term exposure should be avoided. We strongly recommend that airborne levels be maintained as low as practicable, and that engineered controls along with protective clothing and properly fitted HEPA-filtered respirators be used.

8. **Is Insulfrax fiber insulation safe to use?**
   We firmly believe that Insulfrax fiber materials can be used safely when workers follow recommended safe handling practices. By following the recommended work practices described in the Material Safety Data Sheets (MSDSs), worker exposures can be kept at a minimum. Please review the MSDS carefully prior to working with Insulfrax fiber materials.

9. **How does the International Agency for Research on Cancer (IARC) classify Insulfrax fibers?**

IARC, a branch of the World Health Organization has developed a classification system designed to indicate the potential human health effects of various substances. Their determinations are based on a careful review of available scientific data derived from both animal and human epidemiology studies.

Insulfrax fibers have not been reviewed by IARC. However, in 1987, the IARC reviewed all available information on other manmade vitreous fibers and classified discontinuous fibrous glass, mineral wool and refractory ceramic fibers (RCFs) as "2B – possibly carcinogenic to humans."

10. **Are Insulfrax fibers regulated by any federal or state agencies?**

Currently, no manmade vitreous fibers are regulated by any federal agency. However, OSHA has proposed a permissible exposure level of 1 fiber/cubic centimeter (1 f/cc) 8 hr. TWA for discontinuous fibrous glass, mineral wool and refractory ceramic fibers (RCFs). This proposal will be subjected to public review and comment in the future. California's Proposition 65 currently requires specific labeling of most manmade vitreous fibers.

11. **What is The Carborundum Company's recommended exposure guideline (REG) for Insulfrax fibers?**

Carborundum recommends a maximum exposure of 1 fiber/cubic centimeter (1 f/cc) 8 hr. TWA. This guideline is consistent with the recommendations of the manmade vitreous fibers producers for fibrous glass, mineral wool and RCFs. As with all potentially dusty materials, personal exposures should be minimized through prudent handling practices and appropriate engineered controls. Please consult the product Material Safety Data Sheet (MSDS) prior to working with Insulfrax fibers.

12. **What personal protection measures does Carborundum recommend when handling Insulfrax fibers?**

Properly designed and operated engineered controls should be used whenever feasible to control potential dust exposure. If workplace monitoring indicates personal exposure potential in excess of the recommended exposure guideline (REG), properly fitted respiratory protection should be used. In addition, proper respirators should be worn by workers who experience throat irritation.

Safety glasses or goggles, work gloves, head covering and full body clothing will minimize the potential for eye and skin irritation. Disposable coveralls should be disposed of properly and launderable clothing should be laundered separate from other clothing.

13. **What levels of airborne Insulfrax fibers are typically seen in the workplace?**

The fiber size and geometry of Insulfrax fibers are similar to many other glass and mineral fibers. Based on workplace monitoring of various manmade vitreous fibers, the potential exists in certain handling operations for dust levels in excess of the recommended exposure guideline (REG). It is important to first determine the actual workplace exposures and then develop appropriate controls and safety practices to minimize worker exposure. In all cases where the airborne exposure potential is unknown, proper respiratory protection must be used.

14. **Is cristobalite formed when Insulfrax fibers are exposed to elevated temperatures?**

Insulfrax fibers do not form cristobalite (a form of crystalline silica) when exposed to temperatures up to their recommended use limit of 1000°C. Chemical transformation in normal use results only in the formation of crystalline forms of calcium silicate. Over firing (temperature exposure exceeding 1000°C) can result in a partial transformation to cristobalite if partial melting of the product occurs.

15. **What procedures are recommended for clean-up of scrap and "after service" Insulfrax fibers?**

HEPA-filtered vacuums or wet handling procedures have been found most effective in minimizing the potential for airborne dust during clean-up operations. All scrap materials should be placed in a covered "dumpster" or in heavy plastic bags before transport to a landfill.