

Received 5/17/06
MSHA/OSRV

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May 17, 2006

Via Fax: 202 693 9441 and U.S. Mail
Via EM: zzMSHA-comments@dol.gov (RIN:1219-AB46)

US Department of Labor
MSHA
Office of Standards, Regulations, and Variances
1100 Wilson Blvd., Room 2350
Arlington, VA 22209-3939

**Re: Standards for Refuge Chambers, Rescue Shelters
and Safehouses - Portable**

We were grateful for the opportunity to comment personally at the May 9, 2006, meeting in Charleston, West Virginia, and are now grateful to provide the following comments on the above subject:

SCSR Storage (*Cache*); Portable Refuge Chambers, Rescue Shelters and Safehouses

The haunting words of Sago survivor Randy McCoy "we tried to ride out (ESCAPE-my words) but were blocked by bad air" serves as a reminder that all miners have as their primary priority to *escape* a mine emergency. Those who survive the initial emergency (explosion, fire, fall, flood) deserve to be kept safe until they can be rescued or walk out.

With that in mind, research was commenced to determine, from past emergencies, what levels of protection a structure must achieve to give the miners the opportunity they deserve.

History Examined in Determining Recommendations as to Standards for Storage *Caches*, Refuge Shelters, Refuge Chambers and Safehouses (*Portable*)

I. BACKGROUND

The following appeared in the Federal Register Volume 71 No. 46 for Thursday, March 9, 2006:

"MSHA's records show that 56 underground coal mine fires, with a duration greater than 30 minutes, and 5 explosions have been reported to MSHA during the 10-year period from February 1, 1996, to February 1, 2006. During that same period, explosions resulted in the deaths of 31 coal miners and fires resulted in two deaths. Although mine fires

"PROTECTING THE MINER UNDERGROUND"

AB46-COMM-11

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that last less than 30 minutes do not have to be reported to MSHA, the agency has anecdotal reports that such fires *commonly occur*. Mine fires, ignitions and explosions, regardless of duration, can present a grave potential hazard to underground coal miners due to the thick smoke, toxic atmosphere and limited visibility that often results from these events.

In addition to reportable coal mine fires, operators have reported numerous unplanned ignitions of methane. During the ten-year period from February 1, 1996 to February 1, 2006, the Coal Mining industry reported approximately 650 ignition. Each of these ignitions have the potential result of a mine fire or explosion which would release hazardous or life threatening contaminants into the mine atmosphere.

Potentially explosive methane is naturally present in *underground coal* and can ignite when an ignition source is present. Combustible dust, including material brought into a mine, can smolder and eventually catch fire when near a source of heat. There are numerous ignition sources present underground such as belt lines, trolley wires, roof falls, diesel powered equipment, battery operated equipment, charging stations and other forms of electrical equipment are prevalent and can provide a source of ignition. In addition, coal can undergo spontaneous combustion and burn.

Underground coal mine fires reach an intensity of 1000 to 1200 degrees F.”

II. FIRE and EXPLOSION Studies and Investigations

A. Industrial Safety Division Report - “Estimating Underground Coal Mine Fire Temperature Extremes” by Stephen J. Luzik revealed the following:

1. Underground coal fire can reach 1900 degrees F.
2. Diesel oil pan fire was studied in underground mines to be 1292 degrees F.
3. A 1952 degree F fire can cause timber burn through in 30 minutes 100 feet away and creates ignition with timbers at 755 degrees F.

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B. Anecdotal evidence: FIRES**1. BEATRICE -**

Found a 700 degree F to (1832 degree F) fire that burned for several hours and burned timbers in a mine that had to be sealed.

2. WILBERG -

Found that aluminum 160 feet downstream from the fire melted in 13 to 18 minutes. They found that at 600 degrees F the tensile strength had been reduced by 70% and by 700 degrees F it had been reduced by 90%.

Summary:

1. Fires in excess of 2000 degrees F are sometimes achieved in coal mine fires. Downstream temperatures measured at more than 1000 degrees F due to radiation and hot gas transportation.
2. Temperatures in a range of 700 to 1000 degrees F can be achieved in crosscuts or other areas of the mine remotely located from the fire.

C. Anecdotal Studies Concerning EXPLOSIONS

1. **McELROY** - An explosion with six miners working in the close vicinity of the explosion. Three were fatalities, and two were injured and one escaped with little harm. They found that the explosive force was of short duration and was 50 psi and 35 psi is a threshold pressure for fatality.

(MSHA Investigation Report January 22, 2003)

2. **JIM WALTER MINE NO. 5** September 23, 2001 - Two (2) separate explosions with 32 miners underground resulting in 13 fatalities.

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Note: At the point of the initial explosion, four miners were injured but three miners, including the Section Foreman, exited Section 4.

Second Explosion - Second Explosion at Entry No. 2 was ignited by a block light system and promulgated towards the faces of Section 4. The explosion strengthened when additional methane and coal dust became involved near the intersection of the last open crosscut in the No. 3 and 4 entries. The explosion, fueled primarily by coal dust, promulgated out by through No. 3 and 4 entries in the No. 4 east, the explosion continued into Section 6, Shaft 5-9 area and 3 East. The second explosion resulted in at least 12 fatalities and widespread destruction of ventilation controls throughout this area of the mine. **NINETEEN (19) MINERS EXITED THE MINE.**

Note: Explosions can only develop when proper quantities of oxygen, fuel and heat are available and when the fuel is suspended within the confined volume. The normal atmospheric concentration of oxygen occurred throughout the active mine workings and was about 20.9%. Methane only requires 12% or more oxygen to burn or ignite. Similarly, coal dust requires a minimum of 13% oxygen to burn or ignite.

3. **WILLOW CREEK MINE July 31, 2000**

A series of four explosions occurred. A roof fall in a worked-out area, a D-3 longwall panel, ignited methane resulting in the first explosion and fire. The second explosion occurred sometime thereafter and two closely spaced explosions occurred at 11:55 p.m. and 12:17 a.m. meaning that there was a primary, secondary, tertiary and even a fourth explosion. Two fatalities occurred as a result of the second and third explosion.

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4. **SAGO**

Seven miners were near the explosion site. One died, six walked out.

REASONABLE STANDARDS BASED UPON STUDIES AND INVESTIGATIONS OF PREVIOUS DISASTERS

I. STRUCTURE SURVIVABILITY - TEMPERATURE

Comment: Given the previous history of: (a) temperatures ranging to 1831 degrees F (BEATRICE); (b) down stream temperatures measures at more than a 1000 degrees F due to radiation and hot gas transportation; (c) temperatures as high as 1000 degrees F achieved in crosscuts or other areas of the mine remotely located from the fire itself; and (d) steel degrading at 850 degrees F and the elevated thermal conductivity of steel and aluminum; it appears reasonable that:

- A. The material for structures utilized in refuge chambers, rescue shelters, safehouses, and SCSR storage-*Caches* be made of material that can withstand heat without degrading the temperature of at least 1900 degrees F for a period of two hours without degrading or losing tensile strength. This material exists in the form of SAFETFOAM and is available at affordable prices.

II. THERMAL CONDUCTIVITY

The structure must be made of material which has little thermal conductivity in order that the heat from the exterior is not transferred to the interior creating a *crematorium* affect. For example, steel conducts heat at a rate of 420 times greater than GRAFOAM, SAFETFOAM utilized in the prototypes of the Safehouses which have been demonstrated to the Task Force and were on display at the International Symposium at Wheeling, West Virginia, April 20&21, 2006. (See attached literature)

GRAFOAM SAFETFOAM would meet these standards.

III. EXPLOSION

Comment: Given the studies of: (a) McELROY where the explosive force was measured at approximately 50 psi; and (b) the fact that underground disasters have often

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involved multiple explosions at varying points in time--i.e., JIM WALTER MINE NO. 5 (2 explosions); WILLOW CREEK MINE (4 explosions with each explosion many minutes apart with fatalities occurring as the result of the second and third explosions), it appears that the structure material be required to withstand 50 psi explosive force without damage to the structure. GRAFOAM SAFETFOAM has tested to 75 psi.

Mine Safehouse LLC embarked on a course to create a structure which would meet or exceed the known levels of fire and explosion from the previous studies. It did not intend to create a standard for any other purpose except to give miners a chance in the face of previous known and measured emergencies.

IV. BREATHABLE AIR

Given the experiences in terms of time to rescue trapped miners, it seems imperative that the rescue chamber, refuge shelter or safehouse:

1. Be portable - in order that the structure can move as the mining operations advance.
2. Have compressed air available.
3. Be able to provide breathable air for a period up to 72 hours and be able to supply full secondary power from batteries in the event mine power to the structure should be interrupted, and supplies by oxygen cylinder and/or oxygen candles.
4. Have CO and CO₂ scrubbers and/or self-contained units with scrubbing and oxygen generating capacity.
5. The maps be changed as the structures move so the location can be pinpointed at all times for rescue purposes.
6. Be equipped with additional SCSRs.
7. Be equipped with UPS Battery backup for scrubbing, lighting and cooling systems for 72 hours.

V. Supply of Water And Food For 72 Hours Minimum

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- VI. Methane, Heat, Co And Co₂ Monitors, Emergency Lighting, Warning Lights And Signage
- VII. Toilet, First Aid Supplies, Fire Extinguishers
- VIII. Positive Pressure, Sealings Doors And Escape Hatch
- IX. Equipped With Skids And Fork Lift Hooks For Movement
- X. **CACHE house (SCSR storage)** - Given the fact that SCSRs are life saving devices, it would be unthinkable for them to be stored in a structure which would not withstand the intensity of typically measured underground fires or explosions. Inasmuch as material that will withstand the highest measured underground fire temperature and/or explosion of the highest measured intensity can be used in an affordable fashion to create storage for SCSRs, it would be recommended that the same standards concerning fire, explosion and thermal conductivity which should apply to *portable* refuge chambers, shelters or safehouses be also applied to *cache* houses for storage of SCSRs.

FOR MINE SAFEHOUSE, LLC

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**Phone: 304 574 2800, Fax: 304 574 2801
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ELC/am

Enclosure

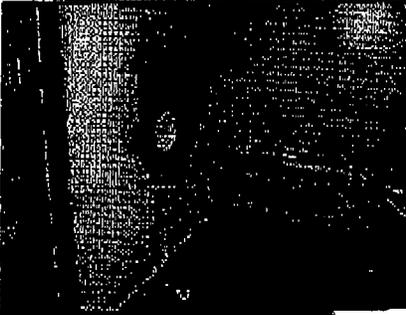
Mine Safehouse

SAFE/FOAM Panels

GRAFOAM™ Carbon Foam as Core Material

- Fire resistant
 - Outstanding fire rating
- Insulator
 - GRAFOAM™ maintains its thermal protection at elevated temperatures
 - Will not melt or ignite
- High strength and stiffness
 - No thermal creep
- Impact resistant
- Electromagnetic shielding
- Corrosion resistant

Fire Testing

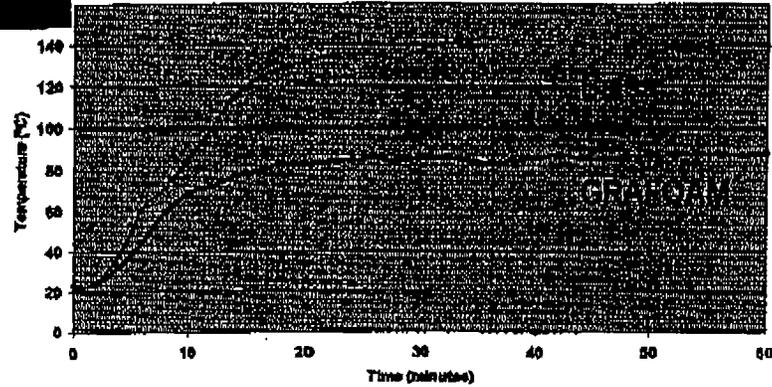


1000°C Flame

One Hour

- ✓ SAFETFOAM Panel will protect miners
- ✓ Maintains a safe environment inside
- ✓ Protects against heat transfer!!

Temperature on Backside of Panel



GRAFOAM 4

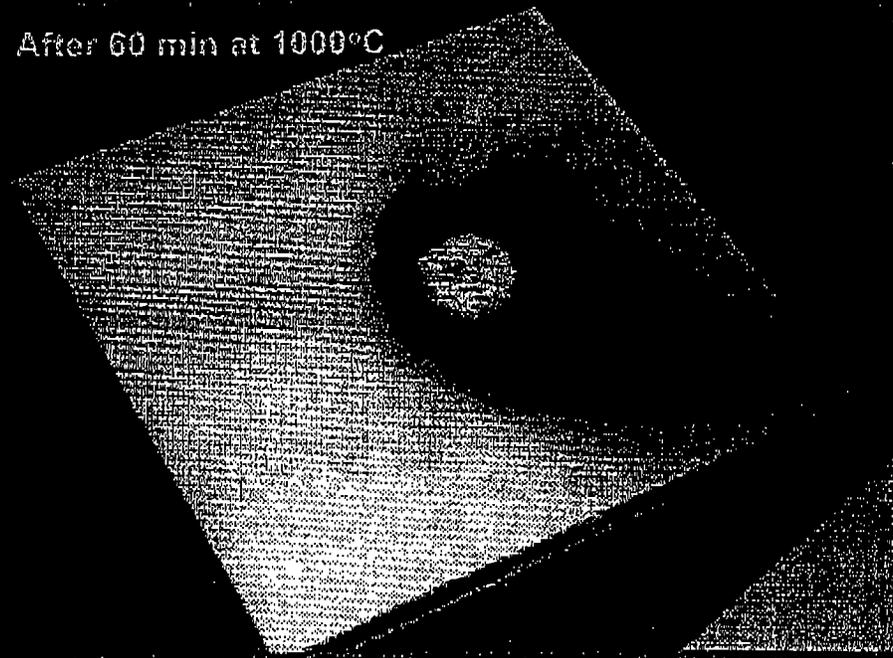
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SAFETFOAM

SAFETFOAM

Panel will Protect Miners

After 60 min at 1000°C



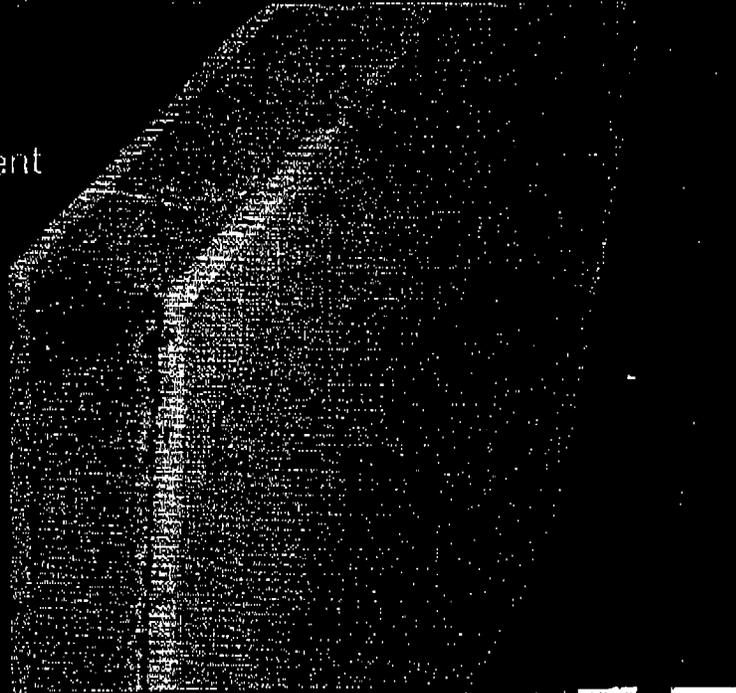
GRAFOAM 5

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SAFETFOAM

SAFE/FOAM Panel - Designed to Protect

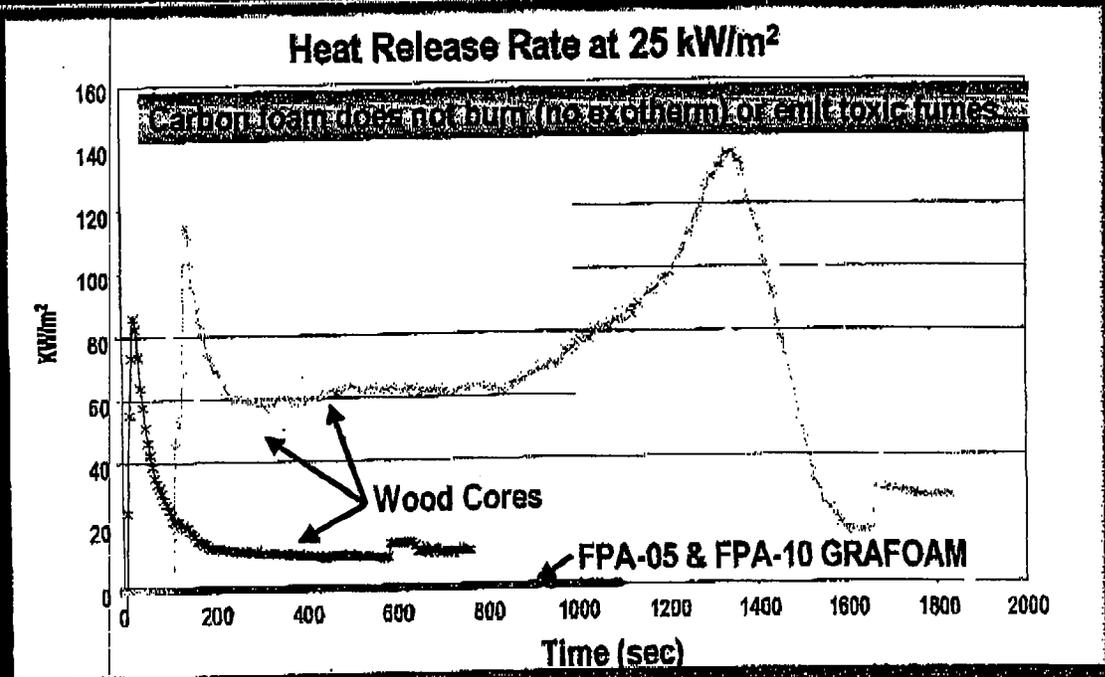
- GRAFOAM™ core
- Impact Resistant - strength enhancement ribs
- Insulates
- Fire Protection
- Corrosion Resistant



GRAFOAM 6

SAFE/FOAM

Outstanding Fire Resistance -- Cone Calorimeter Test



GRAFOAM 7

SAFE/FOAM

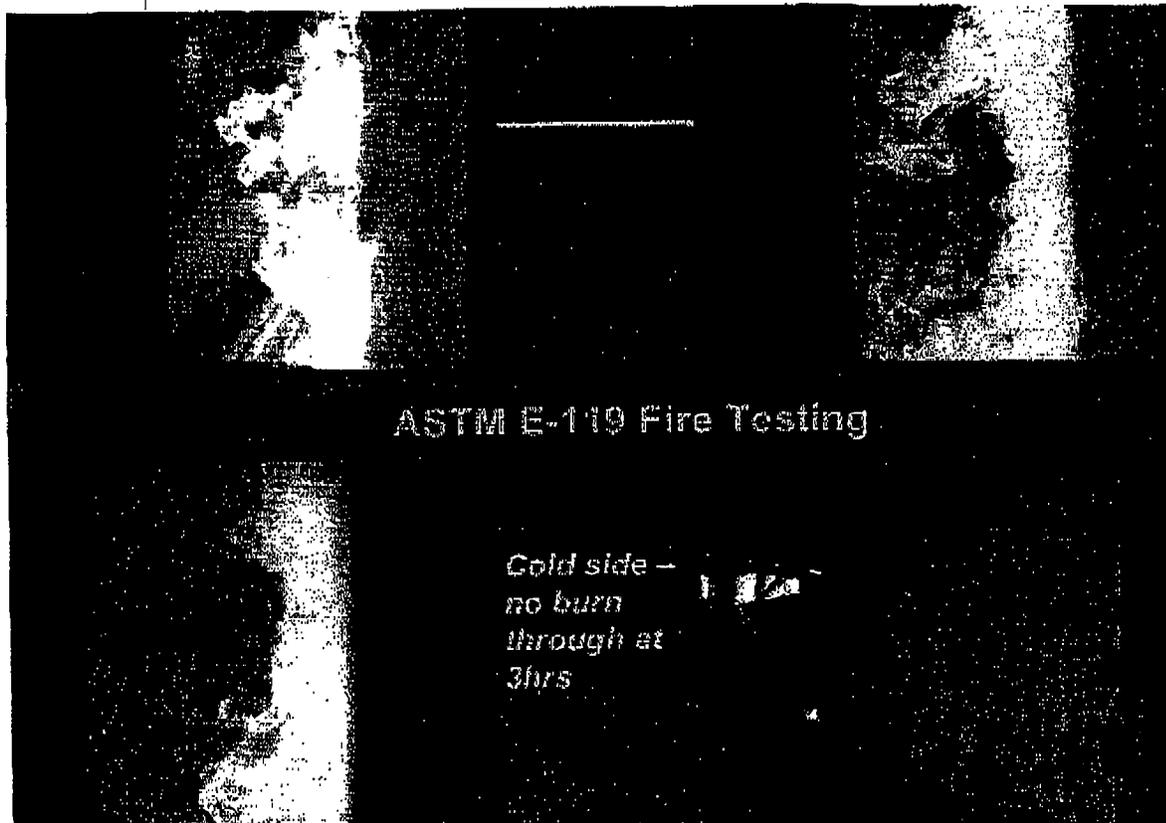
GRAFOAM™ Prevents Heat Transfer through Panel

Material	Thermal Conductivity (W/mK)	Magnitude higher than GRAFOAM™
GRAFOAM™	0.1	
Glass	1.1	11 X
Steel	46	460 X
Aluminum	250	2500 X

GRAFOAM 8

1.000.0001 1.000.002.000 4.0.000.4.000

GRAFOAM



GRAFOAM 9

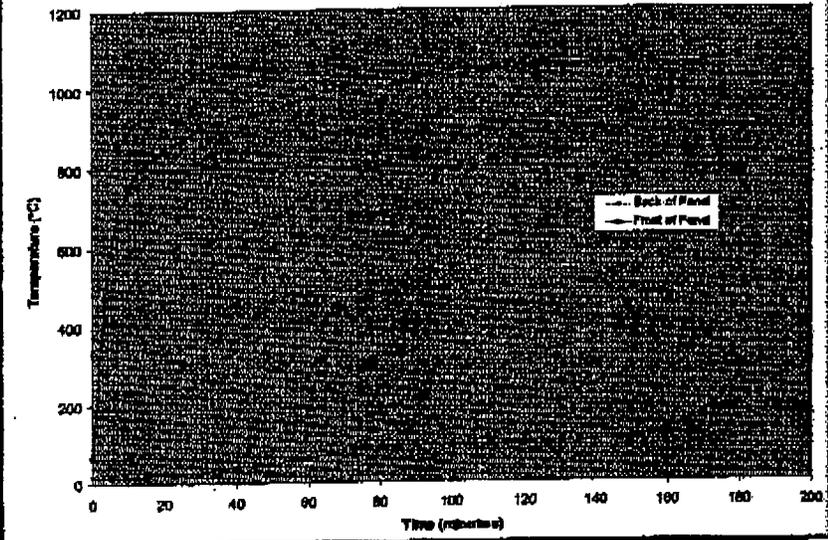
1.000.0001 1.000.002.000 4.0.000.4.000

GRAFOAM

GRAFOAM™ Lasts over 2 Hours in Grueling Test

ASTM E-119 Fire Testing

E-119 Time/Temperature Profile



GRAFOAM 10

GRAFOAM

Fire Wall Test (ASTM E-119) Infrared Image

- ✓ Wall only fails on steel fasteners
- ✓ Steel >140°C rise on cold side
- ✓ GRAFOAM 80°C colder and still protecting

Achieved 2 1/2 hour fire rating



GRAFOAM 11

GRAFOAM

Impact Test - GRAFOAM™ Resists Impacts



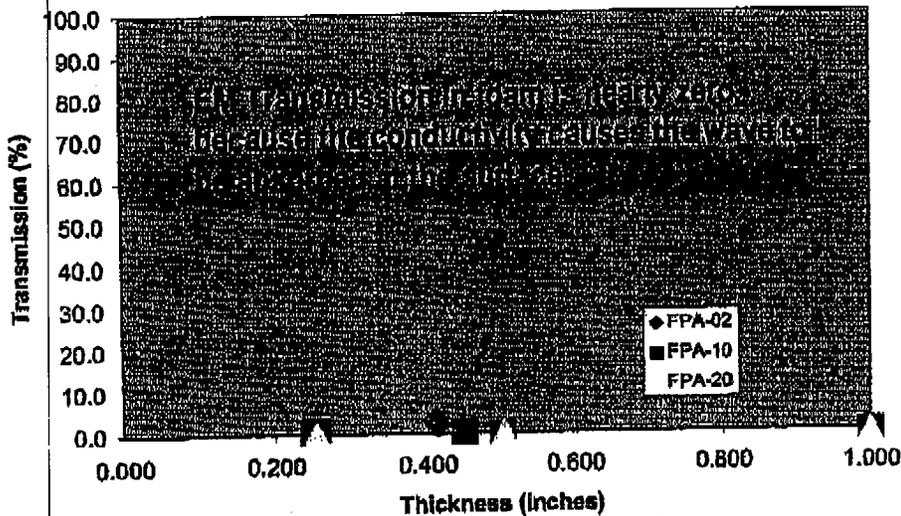
GRAFOAM™ panel withstands debris impact test under hurricane conditions

GRAFOAM™ panel will withstand 75 psi blast impact

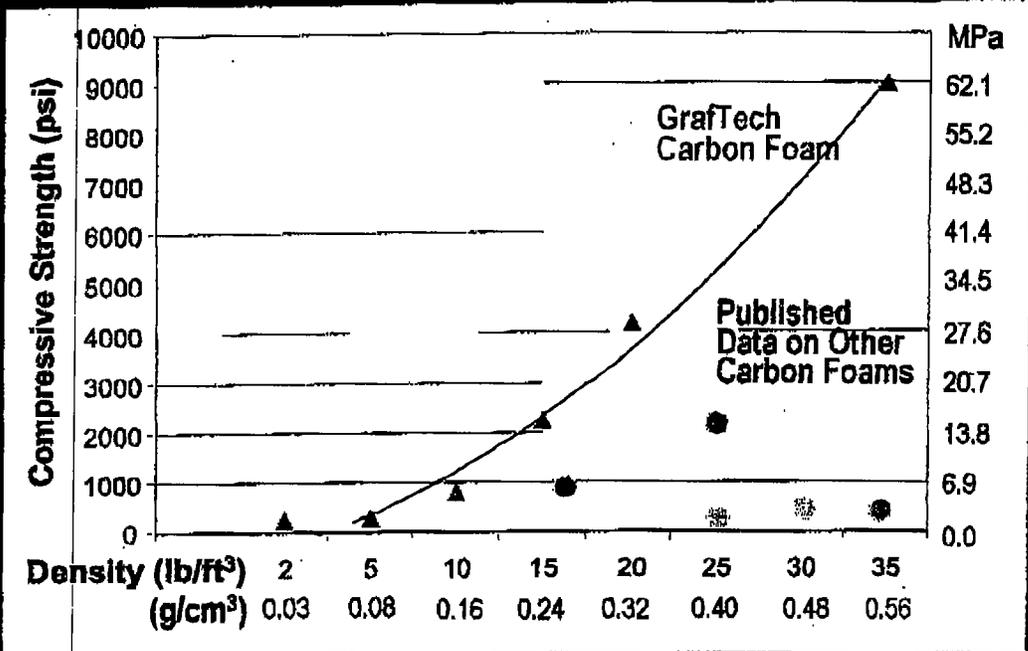


Electromagnetic Shielding (100-3000 MHz)

EM Transmission vs Foam Thickness



Compressive Strength

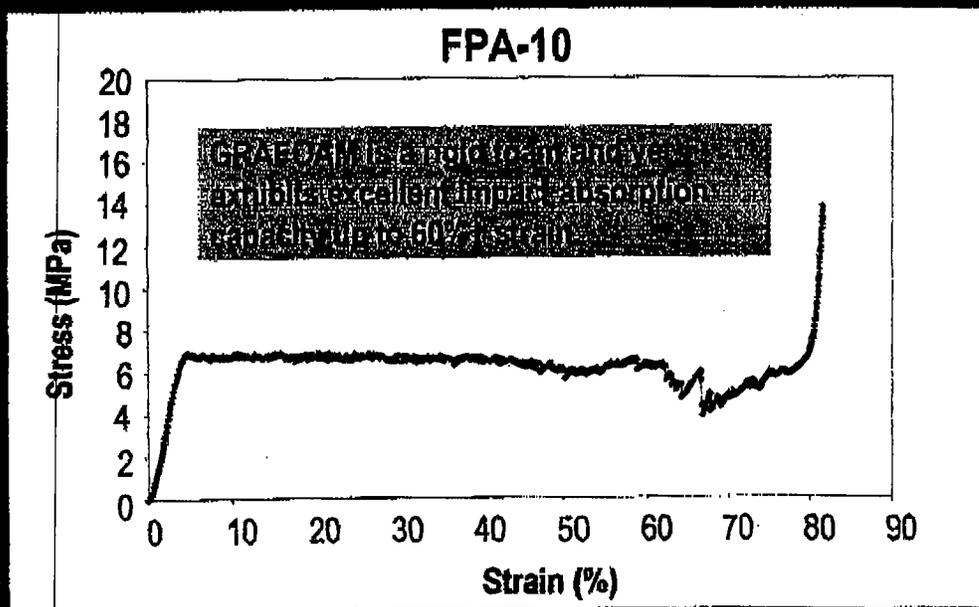


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Compressive Stress-Strain Curve



GRA/FOAM 17

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GrafTech Carbon Foam – GRAFOAM™

• Largest Block Size

- Nominal block size:
1.8m long
0.45 – 0.9m wide
0.15m thick



• Large Capacity



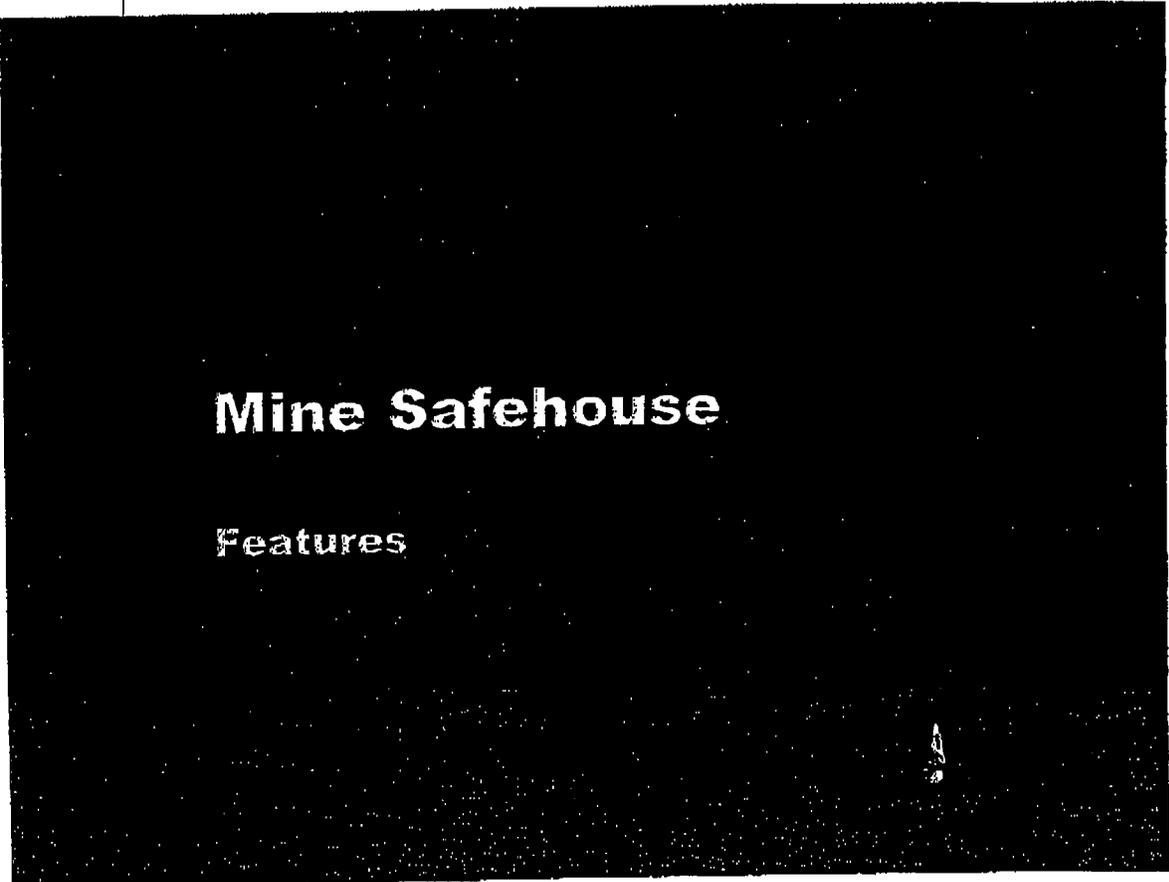
GRAFOAM 18

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GRAFOAM

Mine Safeshouse

Features



Mine Safehouse Design Parameters

Functional Requirements

- Designed to accommodate 16 miners
- Provide 72 hours of breathable air
- Provision for
 - ✓ Food/Water
 - ✓ Toilet
 - ✓ Lighting
 - ✓ Medical Kit
 - ✓ Air conditioning
- Communication equipment

Mine Safehouse Design Parameters

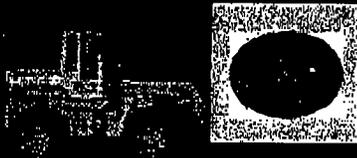
Functional Requirements

- Air Tight to prevent ingress of toxic gases
- Waterproof
- Methane and temperature monitoring
- Additional breathable air units
- Lights signaling when to use the safehouse due to unsafe air conditions

Mine Safehouse Design Parameters

Functional Requirements

- Mobile design
- Survive repeated handling
- Puncture resistant
- Blast protection to 75 psi

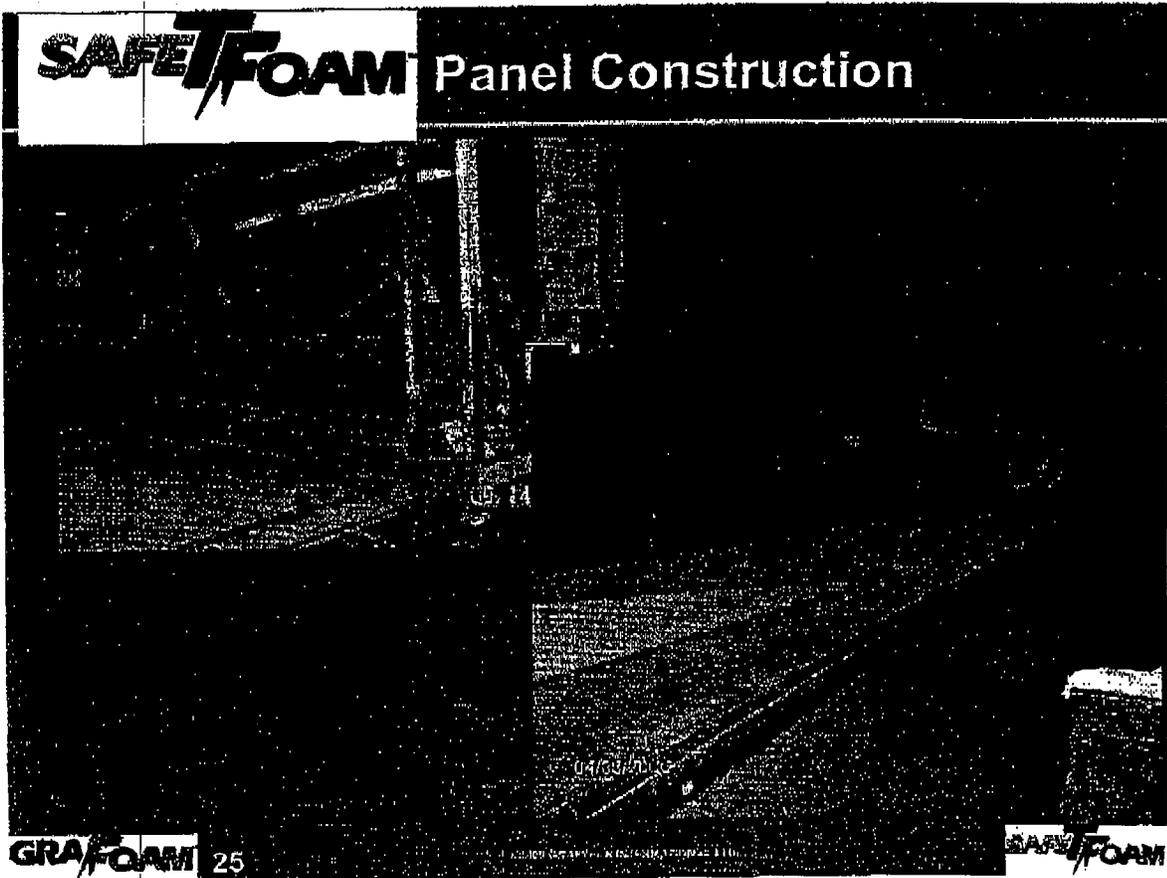
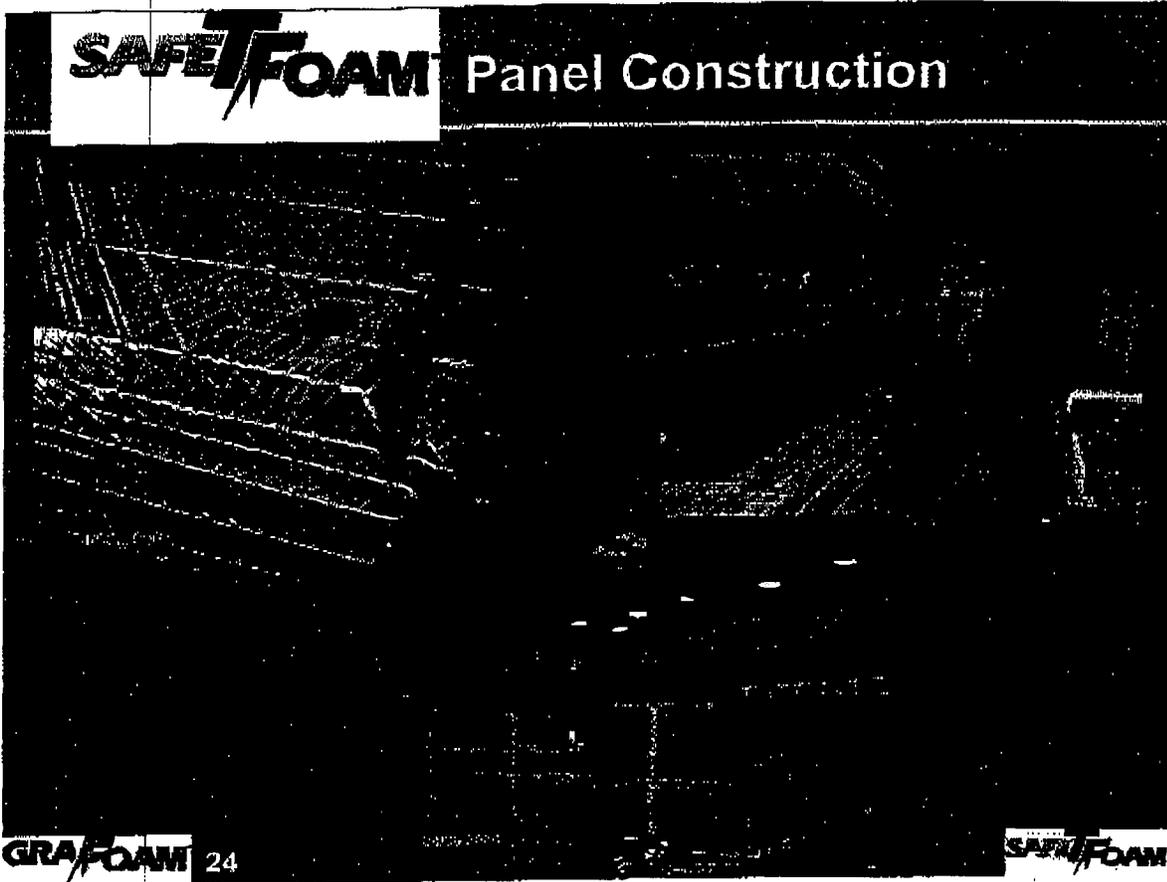


GRAFOAM 22

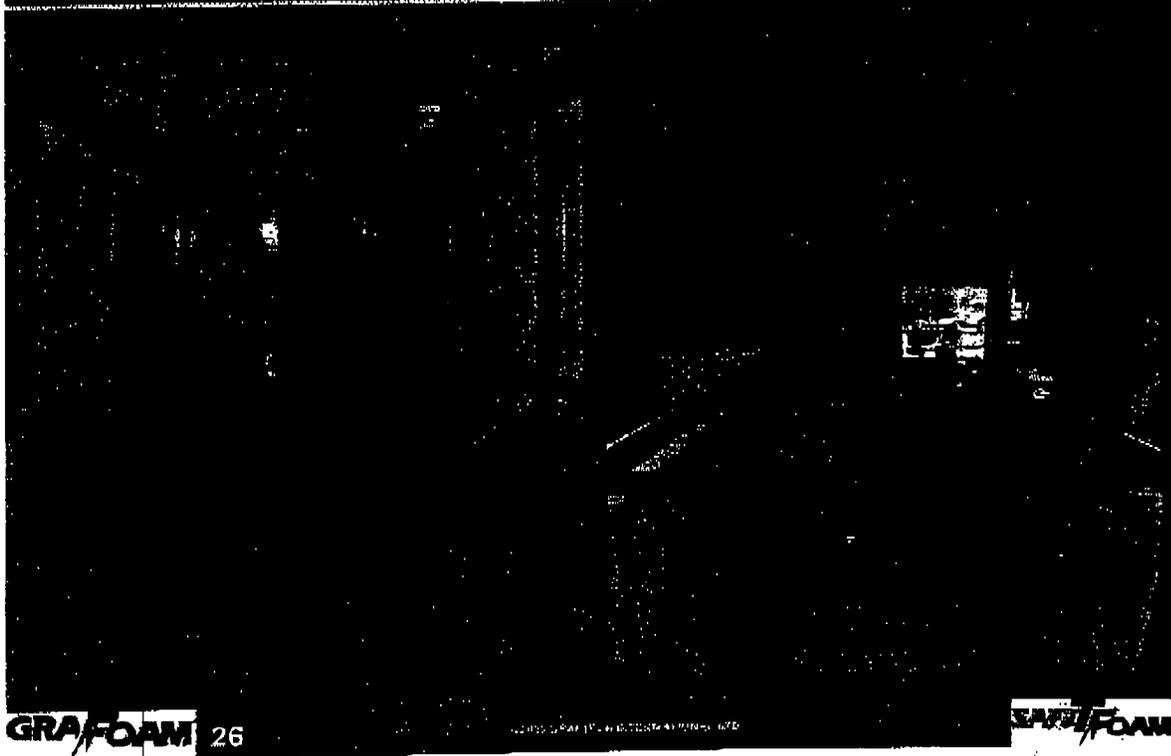
SAFEFOAM

Mine Safehouse

Construction



Safehouse Construction

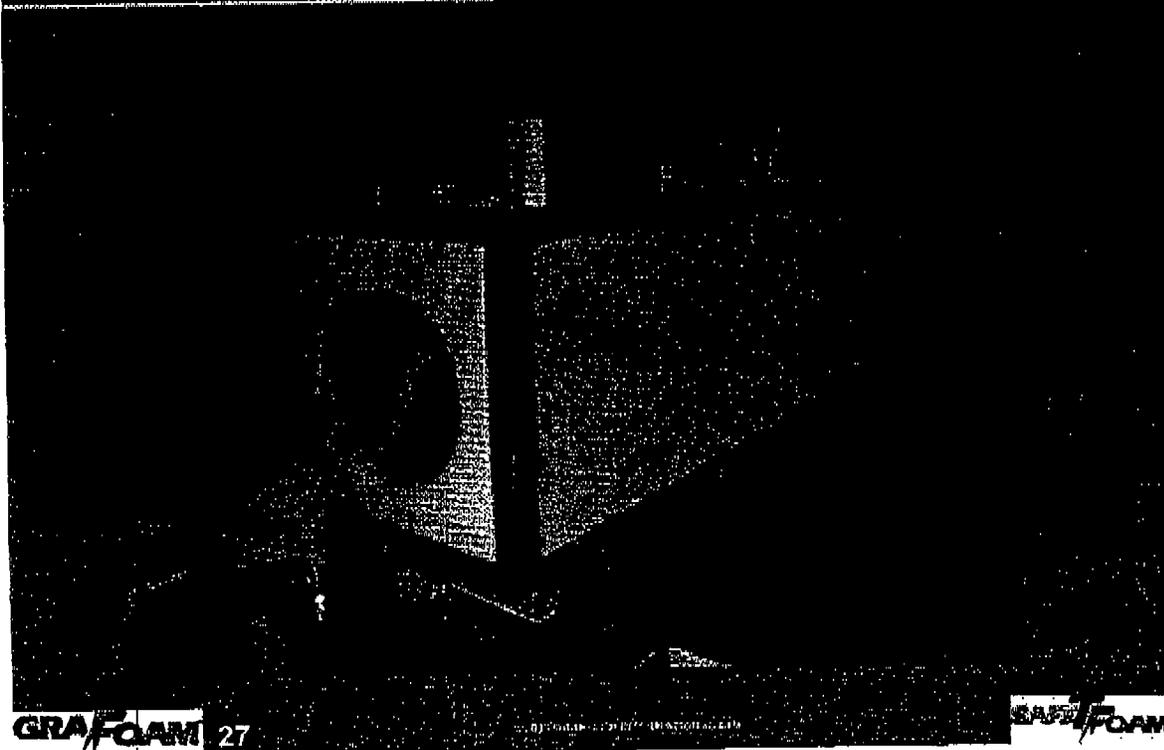


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CONRAD LAW OFFICES

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Safehouse Construction



GRAFOAM 27

CONRAD LAW OFFICES

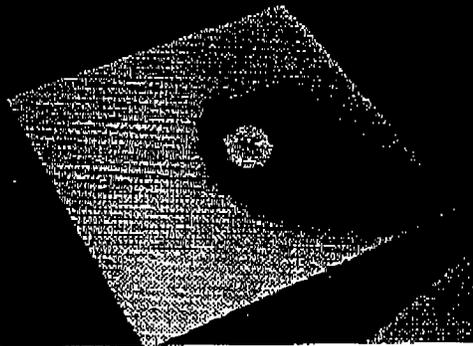
GRAFOAM

Fire Retardence

Fire retardency of Mine Safe House will be accomplished through two steps

- Use of proven fire resistant structural panels and joints
- Coating the mine safe house with a tested fire retarding intumescent paint

After 60 min at 1000°C



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GRA/FOAM

Why CFC for Mine Safehouse?

- Mine safehouse built with composites structural panels will have the following advantages
 - Fire retardant without significant cost (i.e., no need for high temperature alloys)
 - Light weight for easy transportation
 - Durable for long term use in underground mine environment

Constructed Facilities Center is uniquely positioned to design and develop a composite safe house by leveraging its extensive R&D experience in structural composites.

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Mine Safehouse

Partners



Fiber-Tech Industries, Inc

Another Celstar Company

North America's Largest Manufacturer
of Fiberglass Panel Manufacturing

Over 30 years manufacturing
experience

All panels custom built to
customer specifications



Fiber-Tech Industries, Inc

Another Celstar Company

Serving the Construction, Marine, & Transportation Markets with Structural Fiberglass Reinforced Panels!



Up to 10' x 58' Seamless Panels



Fiber-Tech Industries, Inc

Another Celstar Company

Three Manufacturing Locations in the U.S.

Washington

Michigan /

Ohio

www.fiber-tech.net

Carbon Foam

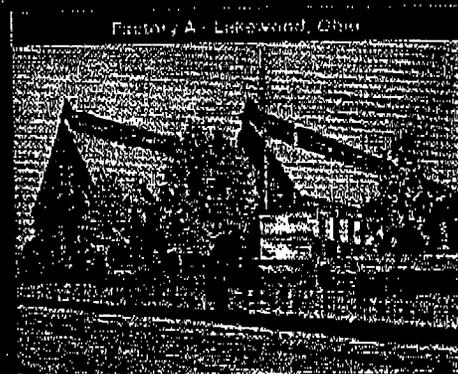


Tradition & Excellence



- 1886: Founded as the National Carbon Company

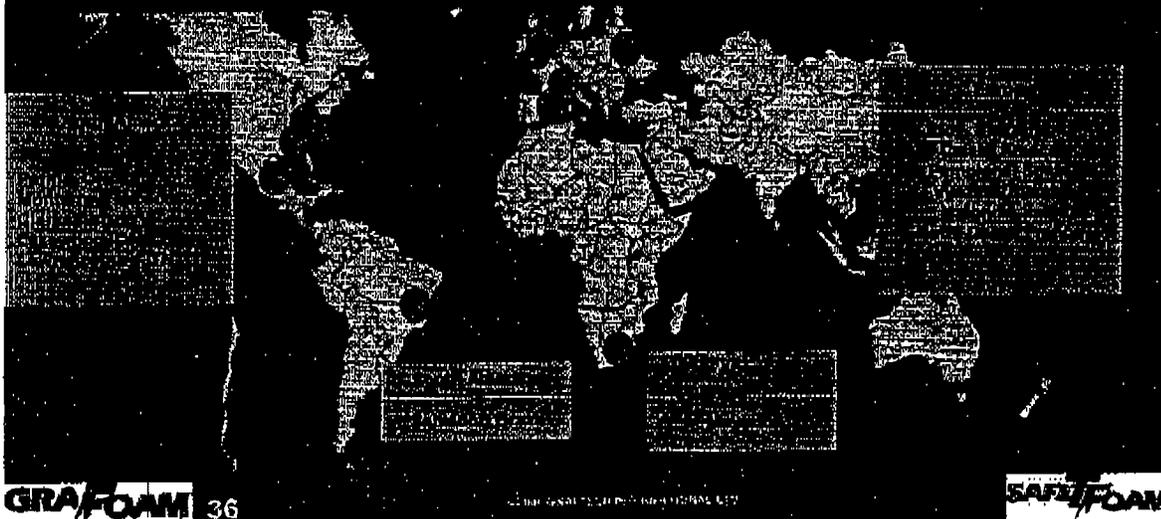
- Graftech International Ltd.
 - \$848 million revenue
 - 3,900 employees
 - Industry leading global supplier
 - ISO & QS certified



GrafTech International LTD. Extensive Manufacturing Network

GTI Vision

We enable customer leadership, in new and existing markets, better and faster than our competition, through the creation, innovation and manufacture of carbon and graphite material science based solutions.



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GrafTech Builds on Core Strengths:

100 years expertise in Carbon/Graphite Science

- Fuel Cells – Ballard partnership
- Electronic Thermal Management – displace Cu & Al in computers, TV screens, cell phones
- Electrodes – introduced revolutionary product in 2004
- GRAFOAM™ Carbon foam - aerospace, transportation, marine



GTI

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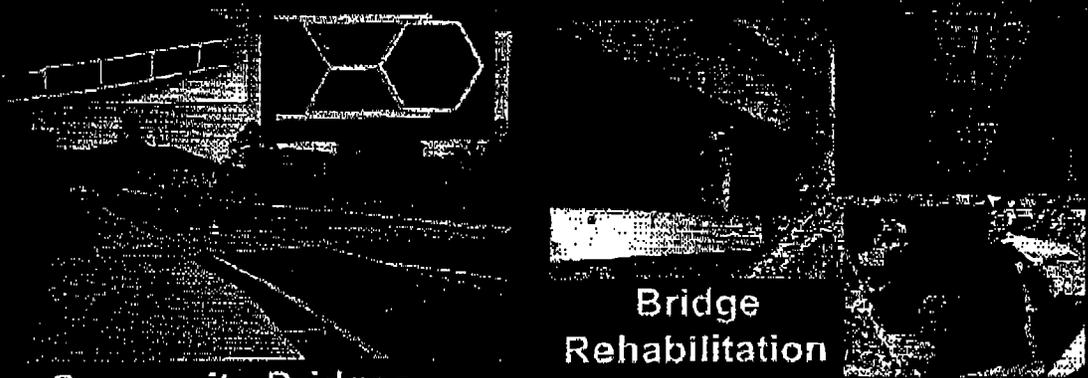


Constructed Facilities Center – West Virginia University (CFC-WVU)

Some of the R&D at CFC – WVU

- Development of structural fiber reinforced composite components (e.g., bridge decks)
- Rehabilitation of existing (concrete & timber) structures using glass and carbon composites to improve their service life and durability
- Research into advanced composite technologies
 - 1) nano composites
 - 2) fire retardant resins
 - 3) 3D stitched fabrics

Composites Research



Composite Bridges

Bridge Rehabilitation

Composites for US Military Applications

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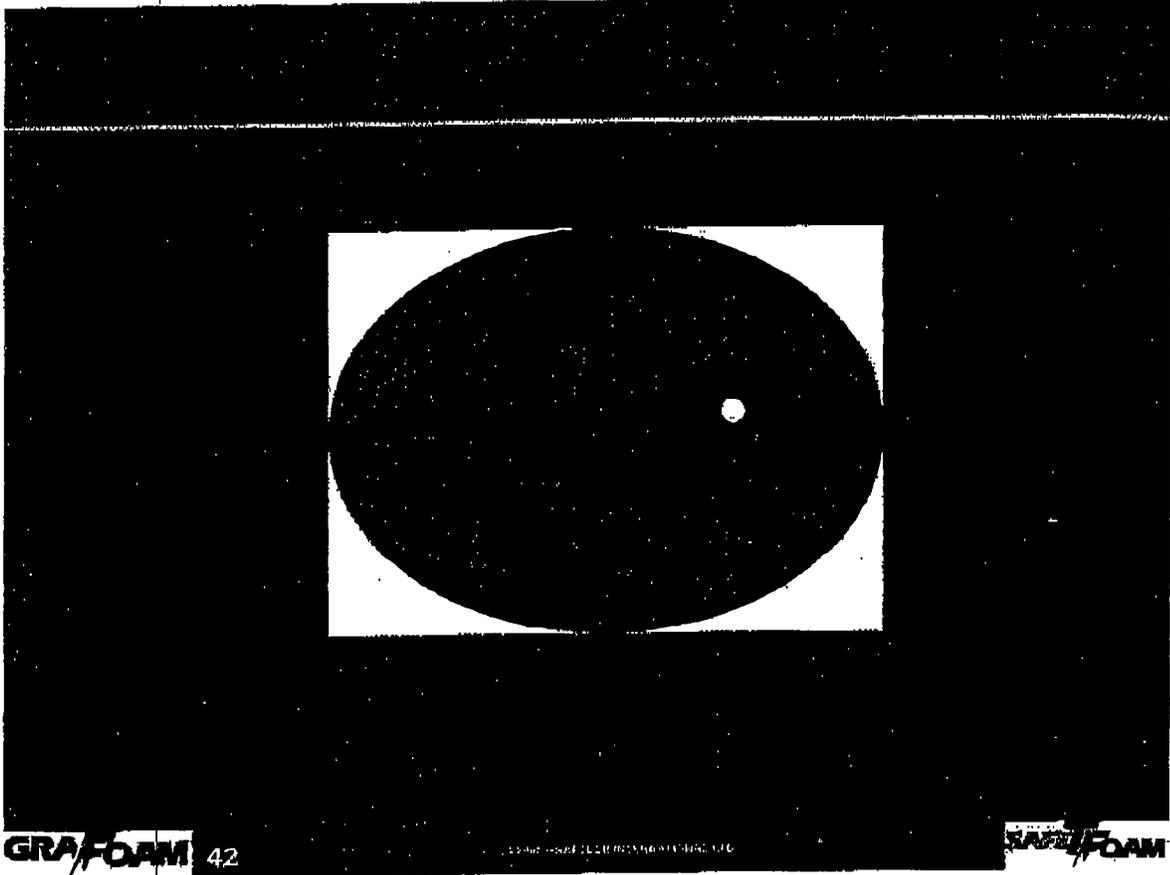


WebCore Technologies, Inc.

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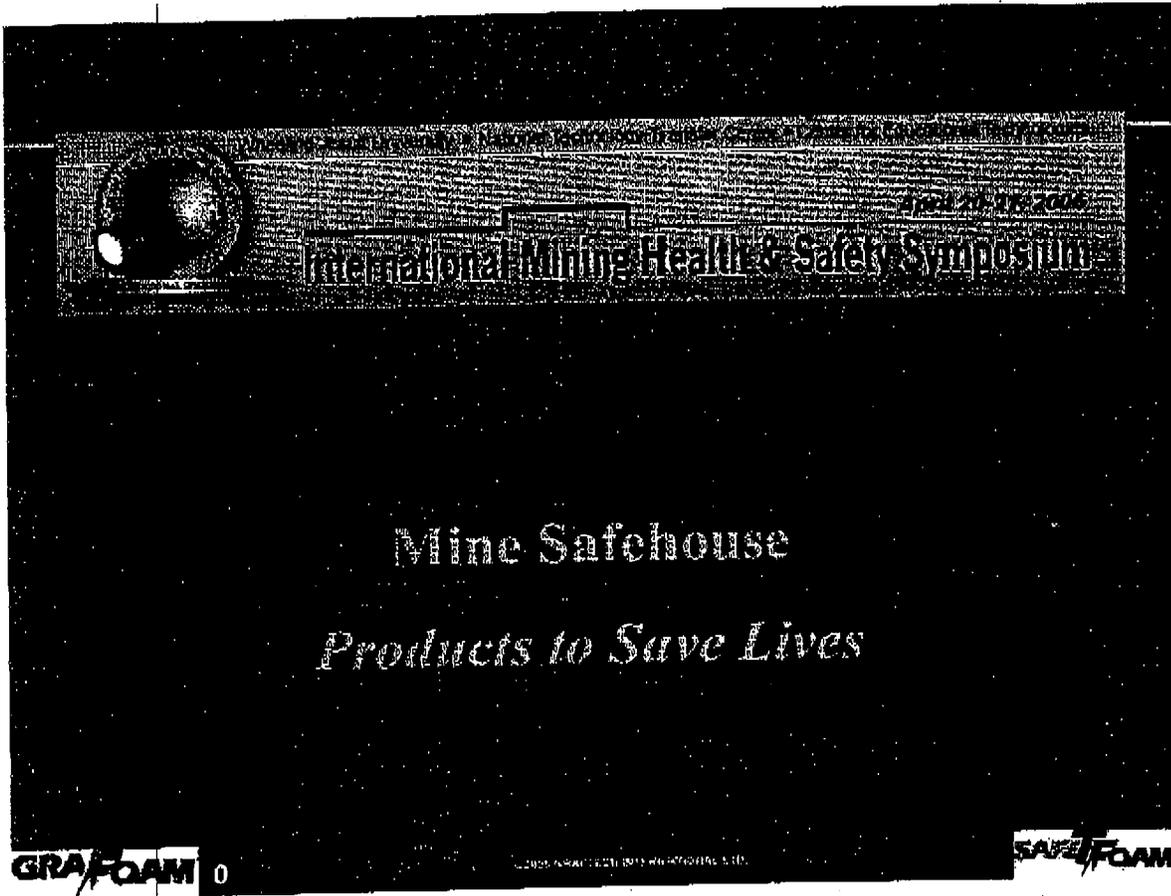
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GRAFOAM



Safehouses, Saferooms, Cache Houses

-products to save lives

Built in cooperation with the following companies:



Fiber-Tech Industries, Inc.





WebCore Technologies, Inc.



For more information call Bret Chandler: (304) 755-8811 or email: blchandler@darktruck.com