PLAINTIFF'S
EXHIBIT
CEL-749

SAFE USE OF FOAMED PLASTIC INSULATIONS

DEFINITION

Foamed plastic as an insulating material will include polyurethane, polystyrene and polyisocynurate compounds.

SCOPE

Insulating uses covered by this administrative procedure include:

I. Roof Insulations

II. Below Grade Insulations

III. Wall Applications

IV. Ceiling Applications

V. Airconditioning Ducting

VI. Tank (and Equipment) Insulation

VII. General Safety Precautions

PROCEDURE

I. Roof Insulations

A. General

Insulations (glass, fiber, Perlite, mineral board or composites requiring UL listed "Fire Acceptable" metal deck roofing systems are in short supply. Proposals have been made to substitute foamed plastics in the roofing assembly. Foamed polyurethane or polyisocynurate boardstock that is listed by UL as having a flame spread rating of less than 25 can be substituted for other insulations in UL "Fire Acceptable" assemblies including directly above the steel deck, but the resultant roof would then be classified as combustible, and would of itself need sprinkler protection. It should be realized that this substitution of

foamed polyurethane or polyisocynurate is a downgrading of the UL "Fire Acceptable" roof deck constructions, and should only be accepted when there is a proven difficulty in obtaining the desired insulation, the building will be sprinklered, the corporate safety department is cognizant of the change to a combustible roof deck assembly, and the plant is fully informed as to why the resultant construction is considered a greater fire risk.

Foamed polystyrene insulation fastened directly to the metal deck is not acceptable under any conditions. It is only acceptable if a thermal barrier (such as one-half inch gypsum cement board) is provided between the steel deck and the plastic; and the final arrangement also classifies as a Class A roofing (to be explained in the following). Exposed foamed plastic of any type is not acceptable sprayed to the underside of steel deck roofs.

B. Foamed Plastics in Roof Deck Applications

Foamed plastics are being used for building construction application with increasing frequency. This section is intended to guide our engineering personnel in deciding whether or not to use these plastic-foam materials in roof-coverings and insulation applications. Acceptance considerations should include three major criteria (1) Fire exposure from above roof, (2) Internal fire exposure, (3) Wind uplift.

1. Fire Exposure From Above Roof

Underwriters Laboratories list roof-covering materials as either Class A, B or C as applied to external fire exposure. These classes are described in Part II, Classified Building Materials Index of the

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UL Building Materials Directory. This document indicates that the coverings are evaluated for external exposure only and not for fire exposure inside of the building. The latter consideration is essential in evaluating the fire performance of metal deck roof assemblies. Internal fire exposure is considered in the roof deck construction section of the Building Materials Directory.

There are available UL-listed, Class A roof coverings utilizing foamed plastics with either asphalt and gravel or plastic-film coverings. Problems associated with spray-applied foamed plastics as roof coverings include those of obtaining proper field mixing of the components for the foam system, temperature of the components, and temperature of the substrate to which the foam is applied. Improper mixing or application-temperatures may result in increased flammability or lower degradation-temperature of the foamed plastic.

The project engineer should consult the manufacturer to ascertain that these factors have been properly evaluated.

2. Internal Fire Exposure

Roof deck assemblies are evaluated by Underwriters Laboratories for internal fire exposure using a modified Steiner Tunnel Test. The time temperature curve for this test was obtained from the so called "White House" full-scale tests conducted following the General Motors, Livonia, Michigan loss in 1953. The UL Building Materials Directory describes this procedure.

The basic purpose of the UL Internal-Exposure test is to indicate

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that the localized fire within an unsprinklered building will not cause involvement of the roof assembly. The assembly tested is rated "Fire Acceptable" by UL if the fire does not propagate beyond set limits during the test. In the "Livonia" type roof, the asphalt used in the vapor barrier will vaporize and become involved in a fire at temperatures exceeding 800° F. Celanese insurers consider this roof as combustible construction and discourage its use. It is acceptable only to the same extent as that of other combustible constructions, with consideration given to the size of areas, values and combustibility of the occupancy. Sprinklers, which lower the under-roof air temperature and halt the flame propagation on the underside of the deck, are required.

Some foamed plastics, however, will depolymerize and decompose temperatures below 400° F. It is therefore possible that a fire developing under a metal deck roof with foamed plastic directly applied could travel ahead of sprinkler operation. Regardless of the flame-propagation characteristics of foamed plastics, an additional concern is the inherent potential for greater insulation loss. Mineral and fiberboard insulation can tolerate temporary elevated temperatures without significant effect on the insulating values. Most plastics, particularly foamed polystyrenes, degrade or melt at such relatively low temperatures that even in a controlled fire situation, large quantities may need replacement. For both of these reasons, a thermal barrier (to be outlined later) is needed below the foamed plastics to allow time for the sprinklers to cool the air below the roof deck to acceptable levels, and prevent depolymerization and decomposition of the foam.

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Underwriters Laboratories lists in the Building Materials Directory as "Fire Acceptable" several metal deck "built-up" roof assemblies which utilize foamed plastic components. All of these assemblies have a thermal barrier of listed "mineral or fiberboard" below the foam. Two assemblies actually include a layer of crushed stone of 1-1/2" maximum size spread over the foamed plastic insulation in an amount of at least 1,000 pounds per 100 square feet. In addition to the above construction, the Building Materials Directory lists as "Fire Acceptable" the use of Apache Millox insulation which is a composite of foamed plastic laminated to the top side of Perlite board.

The use of UL-listed foamed plastic insulation on a poured concrete or poured gypsum roof is acceptable since the thermal barrier is provided by the roof construction itself. Precast concrete, gypsum, or other mineral-based, fire tested and listed, roof deck units are also acceptable as thermal barriers if the joints are grouted.

3. Wind Uplift

Spray-on foamed polyurethane will normally develop a good bond to the substrate upon which it is applied. This bond, however, will be rapidly destroyed at elevated temperatures. Therefore, if some degree of thermal protection is not provided (as indicated in item 2), there exists in addition to the potential fire hazard, the probability of replacing large portions of the roof following a fire because of loss of windstorm resistance.

Foamed plastic boardstock should be firmly secured to the thermal barrier material or to concrete or wood decks. Hot asphalt mopping is preferred with the boardstock immediately embedded into it.

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Manufacturers installation recommendations should be strictly followed.

Underwriters Laboratories lists various types of roof deck assemblies for wind uplift resistance as being Class 30, 60 or 90, the higher ratings of which are needed for coastal areas or high rise buildings. Note that all "Fire Acceptable" roof assemblies listed in the UL Building Materials Directory are not investigated for wind uplift.

Exhibit A includes the various types of roof coverings involving foamed plastics which might be encountered, and shows whether or not each is acceptable, either with or without sprinklers.

II. Below Grade Insulation

Foam used as frost protection below concrete slab floors is shielded by several inches of concrete and is perfectly acceptable.

III. Wall Applications

A. General

Underwriters Laboratories-classified "Insulated Wall Constructions" can be considered as "noncombustible construction" and are acceptable as such for use in any building with any occupancy except where smoke damage would be critical. Unless the wall panels are Underwriters Laboratories-classified for insulated wall constructions, acceptable thermal barriers (to be explained later) must be provided if foamed plastics are incorporated in the building wall construction.

B. Acceptable Thermal Barriers

Exhibit B lists acceptable thermal barriers for various applications of foamed plastics. Some panels which have been recently offered commercially incorporate a 1/2" thick facing of gypsum board and are

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inherently acceptable without being UL classified.

An analysis of the method of bonding or attaching the thermal barrier to wall must be made to determine that the attachment will not fail prior to degradation or melting of the foamed plastic. For example, adhesives used in attaching gypsum board to polystyrene foam must not melt at below 160°F., the degradation of most polystyrene foam.

Basically, foamed plastics are used either as an insulating core between various types of facings or as a foamed-in-place, spray-on insulation. When used as a core insulation, foamed plastics can be installed either as part of a prefabricated encapsulated panel, or as boardstock with the facing added on the site during construction. The foamed plastic core may be either polyurethane foam, polyisocynurate foam or polystyrene foam. Commercially available encapsulated panels are usually faced with steel, aluminum or plastic sheets; gypsum board, plywood or wood particle board. Various methods enjoining the encapsulated panels to the building support are used. Most encapsulated panels are fabricated with some type of joint treatment for joining the panels. At the present time, the foamed-in-place (sprayed-on) foamed plastics are limited to the polyurethane and polyisocynurate types and can be applied in varying thicknesses at varying densities to achieve the desired insulating properties.

Foamed plastic boardstock can be placed on the interior of concrete slab or concrete block walls and affixed by various means. The boardstock, not normally left bare, is usually covered by metal, plastic or other facings.

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IV. Ceiling Applications

Large areas of exposed polyurethane, polystyrene or polyisocynurate foam as an interior finish on walls, or ceiling, or in concealed spaces such as in plenums and above hung ceilings can present an extreme fire hazard because of the expanse of foam involved and the interior location of the foam. If both ceiling and walls are covered with exposed foam, the hazard is greatly increased. In a number of cases, the urethane foam has caught fire at the ceiling by a process not fully understood but which can be experimentally duplicated. In all of these fires, a high intensity heat source (welding or cutting torch), often well below the ceiling level, was used on metal work covered with, or in close proximity to, urethane foams on walls. In most cases, a small flame developed at the heating site and was quickly extinguished by the operator. Then at some time shortly thereafter as stated in a documented report describing the first recorded instance of this phenomena, "the foam on the ceiling unaccountably burst into flames almost simultaneously over the entire surface area." The same phenomena has been observed subsequently on several occasions with the flame front traveling along the ceiling with almost explosive rapidity as reported by witnesses; a rapidity much too great to be accounted for solely on the basis of the ordinary flame spread rate of foamed plastics. A theory has been postulated that in these particular situations, a pool of superheated gas could collect against a poorly insulated ceiling, heating the surface of the foam to a point at which decomposition can occur over the entire ceiling area almost simultaneously. The theory has been tested by at least one small-scale experiment which duplicated the flash-over phenomena.

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However, since the same phenomena has been observed in large, high-ceiling, metal or concrete buildings, it does not seem plausible that a small welding or cutting operation could generate sufficient "superheated gas" to involve the entire ceiling almost simultaneously. Whatever the cause of the phenomena, these fire occurrences have clearly demonstrated that (1) interior wall and ceiling areas of exposed foamed plastics are extreme fire hazards and (2) foamed plastics must not be used in ceiling applications, either exposed or covered, except in low-occupancy, low-hazard, cold-storage applications wherein foam is covered with a suitable fire resistant barrier. Ceiling as used herein is defined as the overhead inside lining of a room and shall not be so interpreted as to preclude external application of polyurethane or polyisocynurate foam as a roofing insulation according to accepted practice as outlined in I. in the foregoing.

V. Airconditioning Ducting

Under no conditions should foamed plastics be used on internal or external surfaces of duct work located on the inside of buildings or in plenum spaces. Outside duct work may be insulated with foamed plastics. If outside ducting is insulated on the roof, the following conditions must be met:

1. Fire hose reels or hose racks should be readily available and accessible

and

2. A material providing a half-hour thermal barrier should be provided or a weather barrier which lessens the probability of ignition should be complemented with a product of combustion detector at each air intake or opening where the possibility of smoke and soot entering the building exists.

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VI. Tank Insulation

Foamed plastics would not be acceptable where the insulation is intended as protection to the tank against fire exposure, or where loss of the insulation could create a hazardous condition such as with cryogenic storage of flammable fluids or potential overheating of a process. In addition, foamed plastics would not be advisable for concentrated process equipment arrays where a flammable liquid or vapor spill is likely. This type of insulation could be damaged by transient high temperatures that other insulations could survive and as a result, produce an abnormally high property damage loss. In addition, the use of foamed plastics should be limited as follows:

A. Prefabricated or laminated panel systems which encapsulate polyurethane or polyisocynurate foamed plastics with a flame spread rating of 25 or less within a metallic envelope are preferred. One such quality system is manufactured by Theracon Industries, Inc., Cherry Hill, New Jersey. Insulation systems of this type would be acceptable for applications on single tanks or vessels or on multiple groupings of the same.

B. Sprayed-on polyurethane and polyisocynurates with a flame spread rating of 25 or less would be acceptable for applications on single tanks or on tanks well separated by a distance equal to 50 percent of their height.

Sprayed-on plastics on exterior surfaces normally require weathering protection that is achieved by some type of top coating. Coatings listed in the UL Building Materials Directory under Roof Covering Materials for "spray-applied foam and coating system" suitable for a Class A rating will be acceptable.

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VII. General Safety Precautions

A. To reduce potential health hazards, the corporate safety department strongly recommends that any sawing, fly cutting, machining or other fabrication operation which generates polyurethane or polyisocynurate dust, the following precautions be observed:

1. Fabrication operations be conducted in an exclusion area specifically set up and reserved for such operations.
2. All power tools used for fabricating rigid polyurethane and polyisocynurate should be equipped with efficient specially engineered dust collecting devices and be grounded.
3. All floors, counter tops, machinery, exposed beams, piping, etc., should be kept free of foamed plastics dust by vacuuming, not blowing, at frequent intervals.
4. Personnel operating power equipment which generates foamed plastic dust should wear respiratory and eye protection. (Dust masks which mechanically filter and prevent inhalation of the dust and well fitted side shield goggles are usually sufficient.)
5. Filters and dust masks should be cleaned or replaced at sufficiently frequent intervals to allow free air passage and not impair breathing.
6. Any power tool operator or other person exposed to foamed plastics dust who develop symptoms of allergy or irritation (dermatitis, respiratory problems, puffiness around the eyes, etc.) be removed from the job and examined by a physician as soon as possible.

B. Catalysts are used in foamed plastics technology to control and balance the polymer forming and gas forming reactions possible for foaming. They are generally either of two types: metal salts or tertiary amines.

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Many of the organic metal salts have not yet been fully investigated. Limited studies indicate that they can be moderately toxic, capable of penetrating even the intact skin and capable of inducing sensitization. For these reasons, care should be exercised in their handling and exposure kept to a minimum. Skin and eye contact should be avoided.

Tertiary amines are used in relatively low concentrations of up to about 1.5 percent of the polyol component in rigid urethane pour systems and up to about 2.5 percent of the polyol component in rigid spray systems. They are alkaline in nature and their vapors are irritating to the eyes, upper respiratory tract and lungs. Chronic exposure to tertiary amines has produced liver and kidney damage in experimental animals. Vapor may produce asymttomatic transient fogging of the eyes, edema of the corneal epithelium (fluid in the corneal lining), causing the victim to see haloes, even in concentrations below those which produce eye or respiratory irritation. Liquid tertiary amines are readily absorbed even through intact skin. Skin contact may lead to dermatitis and skin sensitization. Eye contact can cause severe irritation or burning. Skin and eye contact should be avoided.

C. Equipment malfunction may result in a foam mixture high in isocyanate content which, in confined locations where excessive heat would be retained, could cause a temperature rise sufficient to ignite the foam. For this reason, the corporate safety department strongly recommends that all foam dispensing equipment whether pour, froth or spray, be calibrated daily before the day's work has begun to assure the equipment is delivering the foam plastic components within plus or minus two percent of the ratio specified by the system's supplier. In

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addition, scrap foam generated in startup of the operation should be caught in a disposable container and immediately removed to an outside safe area, away from the foaming operation. This is particularly important in spraying applications in which the components need not necessarily be off ratio to spontaneously ignite. In order to prevent sagging on vertical and overhead surfaces, spray foams are catalyzed to react exceedingly fast. Thus, their rate of heat generation may be considerably greater than that of a corresponding pour or froth system. Therefore, any practice of shooting waste shots of spray foam onto scraps of cardboard until layers several inches thick are built up should be avoided. Spontaneous fires can be caused by this practice. Waste shots should be limited to one or two passes and the scrap foam then removed to an outside safe area.

D. History has proven that most of the hazards involving foamed plastics occur during original construction and/or application stages. It is very important, therefore, that the plant incumbent responsible for loss prevention be especially alert to all possible hazards and take all conceivable precautions against the hazards of fire and toxicology. Extreme caution must be exercised in protecting fire fighters against toxic fumes when combatting fires involving foamed plastics.

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EXHIBIT A

Roof Construction	Sprinklered Buildings	Non-Sprinklered[1]
1. Foamed-in-place or preformed-board foamed plastic applied directly to:		
a. metal roof-decks[2]	Not Acceptable	Not Acceptable
b. thin vapor-barriers	Not Acceptable	Not Acceptable
c. listed-treated-noncombustible-wood roof decks less than actual 3/4" thick	Not Acceptable	Not Acceptable
d. combustible-wood roof decks less than actual 1" thick.	Not Acceptable	Not Acceptable
2. UL-listed "Fire-Acceptable"roof-deck assembly utilizing foamed plastic component, if wind uplift considerations are acceptable.	Acceptable	Acceptable
3. UL-listed, Class A, foamed-plastic and top-coat system applied over an existing "Fire-Acceptable" roof-deck assembly.	Acceptable	Acceptable
4. UL-listed, Class A, sprayed-on or pre-formed-board foamed-plastic and top-coat system applied over:		
a. listed-treated, noncombustible-wood roof-deck of actual 3/4" or greater thickness with tongue-and-groove or lap joints, or joints placed over joists or purlines.	Acceptable	Acceptable
b. Combustible-wood roof deck of actual 1" or greater thickness with-tongue and-groove or lap joints, or joints placed over joists or purlins.	Acceptable	Not Acceptable (Because of wood deck)
c. Precast-concrete roof-planks if joints are grouted or are tongue-and-groove.	Acceptable	Acceptable
d. Reinforced-concrete roof-decks without joints.	Acceptable	Acceptable
5. UL-listed, Class A, spray-on or pre-formed-board foamed plastic and top coat system applied over the following minimum thermal barriers as part of a built-up, insulated, metal-deck assembly that has acceptable wind-uplift design:		
a. ½" - poured lightweight gypsum concrete.	Acceptable	Acceptable
b. 1" - fiber board	Acceptable	Acceptable
c. 3/4" - mineral or perlite board	Acceptable	Acceptable
d. ½" - gypsum-plaster board	Acceptable	Acceptable

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Notes

(1) Assumes occupancy does not require sprinkler protection.

EXHIBIT B

ACCEPTABLE THERMAL BARRIERS FOR PROTECTION OF CELLULAR PLASTICS OTHER THAN INCORPORATED IN UL-CLASSIFIED "INSULATED WALL CONSTRUCTIONS"

APPLICATION	PROTECTION REQUIRED	
	Polyurethane Foam Flamespread less than 50	Polyurethane Foam Flamespread more than 50 and Polystyrene Foam
On interior face	½" gypsum board *	½" gypsum board *
	½" gypsum Plaster on metal lath	½" gypsum plaster on metal lath
	5/8" portland cement plaster on metal lath	5/8" portland cement plaster on metal lath
	¼" noncombustible plywood **	3/4" noncombustible plywood**
	3/4" ordinary plywood (sprinklered buildings only)	1" ordinary plywood (sprinklered buildings only)
On exterior face with very light exposure (small grass fires)	Prefabricated panels with aluminum or steel panel facing at least 0.032" thick	¼" noncombustible plywood ** (exterior grade)
		¼" flat cement-asbestos board *
On exterior face with moderate "point" exposure (loading dock, truck parking, small occasional pallet stacks)	Prefabricated panels with aluminum or steel panel facing at least 0.032" thick	¼" noncombustible plywood ** (exterior grade)
		¼" flat cement-asbestos board *
On exterior face with moderate to severe exposure (lumber yards, roiled paper, pulp, log yards, large pallet stacks)	Prefabricated panels with aluminum or steel panel facing at least 0.032" thick, and automatic sprinkler protection for exposures as outlined in NFPA No. 13, Chapter 6.	¼" noncombustible plywood ** (exterior grade) or ¼" flat cement-asbestos board * and automatic sprinkler protection for exposures as outlined in NFPA No. 13, Chapter 6

* Bonded by high-temperature adhesive, or nailed to studs spaced 16 inches on centers and imbedded in the foamed plastic so that the face of the studs and, therefore, the thermal barrier is flush with the foamed plastic.

** Classified by UL as having flamespread, fuel contributed, and smoke developed values of 25 or less and having been subjected to tests of 30 minute duration during which the flamespread did not exceed 25 and with no indication of significant progressive combustion.