SPONTANEOUS COMBUSTION
TECHNICAL AND LEGAL ISSUES

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I. INTRODUCTION

Many subrogation attorneys and insurance claims representatives have prosecuted claims arising out of fires allegedly caused by spontaneous combustion. The majority of these cases involve well-known spontaneous combustion hazards, such as products containing boiled linseed oil.[1] Others, such as those involving auto-ignition of moist organic materials, are not entirely understood, and are thus more difficult to prove. This paper first provides a technical foundation for understanding how, when and why spontaneous heating can occur, and when it can lead to self-ignition. It then examines products liability law regarding claims premised on defective warnings or instructions. Such claims are often asserted against manufacturers or distributors of products that can cause spontaneous combustion.

II. TECHNICAL BACKGROUND

The process of combustion falls within a class of chemical reactions known as oxidation, which is simply the chemical combination of a material with oxygen to produce relatively simple chemical compounds called oxides.[2] Although oxidation reactions are almost invariably

[1] The February, 1991, fire at One Meridian Plaza is notable not only as one of Cozen and O'Connor's most prominent cases, but also as perhaps the best known fire caused by spontaneous combustion. *See* JOHN D. DEHAAN, KIRK'S FIRE INVESTIGATION 118 (4th ed. 1997) (citing Meridian Plaza fire as being caused by spontaneous combustion of oily rags).

[2] NATIONAL FIRE PROTECTION ASS'N, FIRE PROTECTION HANDBOOK 4-4 (Arthur E. Cote et al. eds. 18th ed. 1997) (hereinafter FIRE PROTECTION HANDBOOK). The NFPA categorizes oxidizers into four classes:

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exothermic (i.e., they generate heat), many materials oxidize so slowly that no appreciable increase in temperature occurs.[3] This type of oxidation, which includes the rusting of iron and the yellowing of paper, is not combustion.[4] Even oxidation that generates a significant amount of heat is not necessarily combustion. By combining food with 200 gallons of atmospheric oxygen each day, for example, humans oxidize fuel rapidly enough to maintain our body temperature at nearly 100ºF (38ºC); obviously, however, this is not combustion.[5]

> **Classification of Oxidizers.** For the purpose of this section, oxidizers shall be classified according to the system described in this section. The classification is based on the NFPA's Technical Committee on Hazardous Chemicals' evaluation of available scientific and technical data, actual experience, and its considered opinion. (See definition of "Oxidizer" above). (430:1-6)
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> **Class 1.** An oxidizer whose primary hazard is that it slightly increases the burning rate but does not cause spontaneous ignition when it comes in contact with combustible materials. (430:1-6.1)
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> **Class 2.** An oxidizer that will cause a moderate increase in the burning rate or that causes spontaneous ignition of combustible materials with which it comes in contact. (430:1-6.2)
>
> **Class 3.** An oxidizer that will cause a severe increase in the burning rate of combustible materials with which it comes in contact or that will undergo vigorous self-sustained decomposition due to contamination or exposure to heat. (430:1-6.3)
>
> **Class 4.** An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock. In addition, the oxidizer will enhance the burning rate and can cause spontaneous ignition of combustibles. (430:1-6.4)

NATIONAL FIRE PROTECTION ASS'N, 1 FIRE PREVENTION CODE § 27-1.3 (1997).

[3] U.S. DEP'T OF ENERGY, DOE HANDBOOK: PRIMER ON SPONTANEOUS HEATING AND PYROPHORICITY DOE-HDBK-1081-94 (1994) < http://tis.eh.doe.gov/techstds/standard/hdbk1081/hbk1081.html>.

[4] NATIONAL FIRE PROTECTION ASS'N, 921 GUIDE FOR FIRE AND EXPLOSION INVESTIGATIONS § 3-1.1.4 (1998) [hereinafter NFPA 921].

[5] *See id.* There are, of course, those who insist that this reaction sometimes begets combustion. Although this article does not discuss spontaneous human combustion, the author directs the curious reader to Garth Haslam's appropriately skeptical website on

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Combustion is defined as "an exothermic, self-sustaining reaction involving a solid, liquid, and/or gas-phase fuel."[6] Because combustion requires fuel, heat and oxygen (or some other oxidizer), it is classically represented by the "fire triangle," where each of the triangle's sides represents one of these three elements.[7] If any of the sides is removed, the triangle collapses and combustion ceases.[8] In recent years, it has been recognized that flaming combustion also requires an uninhibited chemical chain reaction, in addition to fuel, heat and oxygen.[9] (Smoldering combustion, on the other hand, can continue in the absence of a fully uninhibited chain reaction.) Thus, a fourth side has been added to the

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the subject. *See* GARTH HASLAM, *Spontaneous Human Combustion* (visited Oct. 17, 2000) <http://www.sonic.net/~anomaly/articles/ga00003.shtml>.

[6] FIRE PROTECTION HANDBOOK, *supra* note 2, at 1-57.

[7] INTERNATIONAL FIRE SVC. TRAINING ASS'N, ESSENTIALS OF FIRE FIGHTING 13 (3d ed. 1992) [hereinafter IFSTA ESSENTIALS].

[8] This weakness of the fire triangle is exploited by firefighters, whose attacks target one or more of the triangle's sides in an attempt to halt combustion. First, fuel can be removed from a fire by draining a tank of flammable liquid, digging trenches or setting backfires in the path of an approaching wildland fire, or simply shutting off a gas flow. Second, heat is removed, most commonly, by the application of water to a fire. Water has a higher "specific heat" than almost any other substance, which means that it takes more heat to raise the temperature of water than of almost any other substance. *See* JAMES H. MEIDL, FLAMMABLE HAZARDOUS MATERIALS 15 (2d ed. 1978). This makes water an exceedingly effective remover of heat. Third, oxygen can be removed or displaced from a fire by applying carbon dioxide or foam, shoveling dirt onto smoldering grass, or sliding a cover over a burning pan of grease.

[9] *See* IFSTA ESSENTIALS, *supra* note 7, at 13.

conceptual fire triangle, resulting in a "fire tetrahedron"[10] or a "fire rectangle."[11]

Spontaneous combustion, which results from the accumulation of heat from oxidation reactions, is caused by one of three mechanisms: (1) spontaneous heating, (2) pyrophoricity, or (3) hypergolicity.[12] Spontaneous heating occurs when a slow oxidation reaction generates heat more quickly than it can be dissipated to its surroundings, ultimately resulting in self-ignition.[13] Pyrophoric substances, in contrast, ignite instantly upon exposure to air (atmospheric oxygen).[14] Although liquids and gases may be pyrophoric, the most common pyrophoric substances are finely divided metal solids.[15] Finally, hypergolic substances (of which pyrophoric substances comprise a subset) spontaneously combust upon exposure to *any* oxidizing agent.[16] This paper will focus primarily on spontaneous heating.

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[10] *Id.* In a fire, molecules break apart into simpler components, called radicals. *See* MEDIL, *supra* note 8, at 20. These radicals combine with oxygen, releasing energy; this propagates the reaction by transferring the energy to surrounding molecules. *See id.* The potassium bicarbonate or sodium bicarbonate (a.k.a. baking soda) found in common dry chemical extinguishers put out fires so effectively because they inhibit the transfer of energy between molecules, thereby breaking the reaction chain. *See id.* Thus, combustion can be halted by removing any of the four sides of the fire tetrahedron.

[11] MEIDL, *supra* note 8, at 19-20.

[12] *See* DOE HANDBOOK, *supra* note 3.

[13] DEHAAN, *supra* note 1, at 117.

[14] *See* DOE HANDBOOK, *supra* note 3.

[15] *See id.*

[16] *See id.*

A. Spontaneous Heating and Ignition of Organic Materials

Organic materials — those containing carbon as their principal constituent — are ubiquitous.[17] Including substances from plant and animal matter to fabrics and plastics, most organics contain varying amounts of oxygen and nitrogen, in addition to other elements.[18] Most organic materials burn readily, producing water (the oxide of hydrogen) and carbon dioxide. [19]

Under proper conditions, the oxidation of some hydrocarbons results in spontaneous heating and ignition.. Most commonly, this involves a combustible liquid hydrocarbon in contact with combustible materials, such as cotton rags.[20] Some solid hydrocarbons, including coal and charcoal, are also capable of reacting directly with atmospheric oxygen to spontaneously combust.[21]

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[17] *See* FIRE PROTECTION HANDBOOK, *supra* note 2, at 4-4.

[18] *See id.* Organic materials are divided into two broad classes: those that are based on hydrocarbon and those that based on cellulose. *See id.* Hydrocarbons are based on unoxidized hydrocarbon building blocks (—CH— or —CH_2—), whereas cellulose-based materials are derived from a partly oxidized carbon unit (—CH(OH)—). *See id.* Because materials based on cellulose are already partly oxidized, they consume less oxygen and produce less heat when they burn than those based on hydrocarbons. *See id.* Note that the amount of oxygen consumed is directly related to the heat produced, as stated by Thornton's Rule. *See id.*, *citing* W.M. THORNTON, 33 PHILOSOPHICAL MAGAZINE 196-203 (1917). This rule explains that the heat produced per unit weight of oxygen consumed by combustion differs by only about ten percent for different organic materials. *See id.* Consequently, although the heat of combustion varies greatly among organics materials, oxygen consumption may be used as a reasonable measure of heat produced. *See id.*

[19] *See id.*

[20] *See* DOE HANDBOOK, *supra* note 3.

[21] *See id.*

Several factors determine whether oxidation of such materials will result in ignition: (1) the rate of heat generation;[22] (2) the effects of ventilation;[23] (3) the insulating effects of the material's immediate surroundings;[24] (4) the ignition temperatures of the hydrocarbon and other combustibles, as well as of any gases liberated by the oxidation reaction;[25] (5) the specific area of the hydrocarbon exposed to an oxidizer;[26] and (6) the amount of moisture present in the atmosphere and fibrous combustible.[27]

If the rate of heat removal exceeds the rate of heat generation, the material will remain cool and will not ignite. Thus, if self-ignition is to occur, heat must be generated more quickly than it can be removed by conduction,[28] convection[29] and radiation.[30] As the temperature of the self-

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[22] *See* NFPA 921, *supra* note 4, at § 3-3.5.

[23] *See id.*

[24] *See id.*

[25] *See* DOE HANDBOOK, *supra* note 3.

[26] *See id.* This is expressed in units of cm^2/g, known as the "specific area" of a combustible substance, which refers to the surface area, per gram of material, which is exposed to an oxidizer. *See id.* Materials with high specific areas are more likely to self-ignite. *See id.* Combustible liquids on fibrous materials, for example, are particularly prone to self-heating, because the fibers allow the liquid to spread out over a large surface area, creating more exposure to atmospheric oxygen. *See id.*

[27] *See id.*

[28] "Conduction" refers to the transfer of heat between two bodies through direct contact. *See* IFSTA ESSENTIALS, *supra* note 7, at 9. Aluminum, steel and copper are good conductors, while fibrous materials, such as cloth and paper, are poor conductors. *See id.*

[29] "Convection" is the transfer of heat by the movement of air or liquid. *See id.* As air (or any gas or liquid) is heated, it expands – becoming lighter – and moves upward. *See id.* Cooler air takes its place at the lower levels, creating convection currents. *See id.* at 9-10.

[30] *See* DOE HANDBOOK, *supra* note 3. "(Thermal) radiation" refers to the transfer of heat via electromagnetic energy. *See* NFPA 921, *supra* note 4, at § 1-3. Radiated heat, also known as infra-red rays, is transmitted by the same mechanism as visible light, x-rays

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heating material begins to rise, the reaction rate often increases, which can result in a "runaway" reaction and, ultimately, ignition.[31]

B. Spontaneous Heating of Specific Materials

A comprehensive (though not exhaustive) list of materials subject to spontaneous combustion is published in NFPA's *Fire Protection Handbook*. Some of the more common culprits are addressed below.[32]

1. Drying oils

Most commonly derived from plants or animals, the class of oils known as "drying oils" includes linseed[33] (obtained from flaxseed), tung, fish, and soybean oils.[34] As they dry, the fatty acids in these oils oxidize and form a durable natural coating; for this attribute, drying oils have been used in paints and other finishes for centuries.[35] Although this oxidation reaction is exothermic, its rate depends on the relative amount of oil exposed to the air. Thus, while linseed oil in a can will not self-heat

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and radio waves; they differ only in the lengths of their waves. *See* IFSTA ESSENTIALS, *supra* note 7, at 10. Radiated heat is a major source of fire spread to exposures. *See id.*

[31] *See* DOE HANDBOOK, *supra* note 3. In such reactions, the reaction rate generally doubles with every 18ºF (10ºC) increase in temperature. *See* DEHAAN, *supra* note 1, at 117.

[32] Note that some of the general principles regarding self-heating, though discussed in the section about drying oils, apply equally to all materials subject to this phenomenon.

[33] Because it dries more quickly, "boiled" linseed oil is considerably more prone to spontaneous combustion than raw linseed oil. *See* DEHAAN, *supra* note 1, at 118. "Boiled linseed oil" refers not only to oil that has actually been boiled (which concentrates the reactive fatty acids), but also, more commonly, to oil to which a drying agent has been added. *See id.*

[34] *See id.*

[35] *See id.*

to the point of ignition, it may ignite when spread across the fibers of a cloth if other conditions are appropriate.[36]

If spontaneous combustion is to occur, the oil on the cloth must be exposed to sufficient air to permit rapid oxidation, and yet not be so well ventilated that the heat generated is carried away by convection.[37] A tightly bound bale of oily rags would not likely self-heat because of insufficient oxygen, while an oily rag that has been hung on a clothesline will not appreciably self-heat because the heat dissipates (primarily through convection) as quickly as it is generated.

Spontaneous heating also depends on the insulating effects of a material's immediate surroundings.[38] A crumpled rag soaked with linseed oil would be likely to ignite at the bottom of a wastebasket, where it is insulated by the wastebasket as well as by the rag itself.[39] Similarly, a large pile of material may insulate the core of the pile well enough for ignition to occur.[40]

Although common cooking oils will rarely self-ignite — even if spread onto combustibles such as cotton fabrics — they may do so when provided with an initial push: that is, when they are raised to an elevated starting temperature.[41] This seems to occur most frequently when towels or other fabrics containing cooking oil residues are dried in a dryer. The

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36 *See id.* For a discussion of specific area and its effect on self-heating, see *supra* note 26.

37 *See* NFPA 921, *supra* note 4, at § 3-3.5.

38 *See id.*

39 *See id.*

40 *See id.* Of course, the pile must be of a material sufficiently porous to allow enough air to permeate for oxidation to occur.

high temperature created by the dryer speeds up the oxidation reaction to the point where self-heating and -ignition can occur, resulting in ignition several hours after the towels have been removed from the dryer.[42]

2. Hay, straw and vegetable residues

Although spontaneous combustion commonly occurs in piles of moist organic material, such as hay and mulch, the mechanism of this reaction is not entirely understood.[43] In the incipient stages, heat is generated by the respiration of bacteria, molds and microorganisms.[44] Because such vigorous activity can only occur in a very moist environment, this heating can be controlled by ensuring that the moisture content does not exceed a predetermined level.[45] This process can only raise the material's temperature to between 122º and 212ºF (50º to 100ºC), however, above which point the living organisms perish.[46] Beyond this stage, scientists debate the method by which self-heating is propagated to the point of ignition.[47]

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[41] *See* DEHAAN, *supra* note 1, at 118.

[42] *See id.* at 121 (noting that residues of bleaches, which are oxidizers, may contribute to self-heating of laundry).

[43] *See id.* at 119-20.

[44] *See* DOE HANDBOOK, *supra* note 3.

[45] *See id.* A moisture content of 12 to 21%, typical in partially cured hay, is ideal for the generation of heat by biological processes. *See* DEHAAN, *supra* note 1, at 119.

[46] *See* DOE HANDBOOK, *supra* note 3 (stating that organic heating can raise temperature to 122º to 167ºF (50º to 75ºC)) & DEHAAN, *supra* note 1, at 119 (using 160º to 212ºF (70º to 100ºC)).

[47] *See* DEHAAN, *supra* note 1, at 119-20 (explaining that theories include the production of pyrophoric carbon or pyrophoric iron, heat from enzyme action, autooxidation of oils in the seeds and formation of acidic degradation products).

Several facts regarding spontaneous combustion of stacked hay can be stated with certainty. Such fires do not occur less than ten to fourteen days after the hay is stacked, and generally require five to ten weeks.[48] Whereas hay ignited by an external source generally shows evidence of burning from the outside in, a spontaneously occurring fire starts in the center of the stack and burns outward, often forming a sort of chimney to the exterior.[49] Finally, unburned hay from a stack that self-ignited is very dark in color, and may be more acidic than normal.[50]

3. Coal and charcoal

Although less well-known for self-ignition than oily rags and hay, coal and charcoal are also susceptible to this hazard.[51] Various grades of coal absorb oxygen (i.e., oxidize) far more readily than others; those which oxidize more easily have, not surprisingly, a greater tendency to self-heat.[52] Spontaneous ignition seems to occur when there is just enough airflow that the coal is able to absorb most of the atmospheric oxygen, and yet not so much airflow that it carries away the heat that is generated.[53]

As with hay, moisture content is a critical factor in the spontaneous combustion of coal and charcoal.[54] The higher the inherent moisture, the

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[48] *See id.* at 120.

[49] *See id.*

[50] *See id.*

[51] *See id.*

[52] *See* FIRE PROTECTION HANDBOOK, *supra* note 2, at 3-267.

[53] *See id.*

[54] *See* DEHAAN, *supra* note 1, at 120.

greater the oxidizing tendency.[55] Finer particles of coal are more prone to self-ignite,[56] as is freshly mined coal (upon its initial exposure to atmospheric oxygen).[57] While massive quantities of coal are generally required before coal can spontaneously combust, activated charcoal can self-heat in quantities of just several pounds.[58] Moreover, whereas coal will not spontaneously achieve flaming combustion until days or weeks have passed, activated charcoal can ignite in as little as several hours.[59] Charcoal briquettes, however, are unlikely to self-ignite unless stored in quantities exceeding fifty pounds (22.5 kg).[60]

III. LEGAL ISSUES: MANUFACTURERS' WARNINGS

While various jurisdictions have adopted products liability law in various ways,[61] the law of most states at least parallels section 402A of the *Restatement (Second) of Torts.* Section 402A states that "[o]ne who sells any product in a defective condition unreasonably dangerous to the user or consumer or to his property is subject to liability for physical harm

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[55] *See* FIRE PROTECTION HANDBOOK, *supra* note 2, at 3-267.

[56] *See* DEHAAN, *supra* note 1, at 121.

[57] *See* FIRE PROTECTION HANDBOOK, *supra* note 2, at 3-267 (warning that a hot spot may not appear in a pile before one or two months).

[58] *See* DEHAAN, *supra* note 1, at 121.

[59] *See id.*

[60] *See id.*

[61] Pennsylvania, for example, has expressly adopted Section 402A of the *Restatement (Second) of Torts*. New Jersey's legislature has codified that state's products liability law, at N.J. STAT. § 2A:58C-2, as have Connecticut's (CONN. GEN. STAT. § 52-572m(b)), Michigan's (MICH. COMP. LAWS § 600.2945(h)-(I)) and Ohio's (OHIO REV. CODE §§ 2307.74-.76).

thereby caused to the ultimate user or consumer, or to his property . . . ."[62] Liability under section 402A is strictly imposed; that is, a seller of a defective product is liable even though he has "exercised all possible care in the preparation and sale of his product."[63] A product can be found defective in three ways: defective manufacture, defective design, or defective warnings or instructions.[64] This article will examine the third category of defect: the warnings defect.

Liability imposed for warnings defects, unlike that imposed for manufacturing or design defects, carries with it an aspect of fault.[65] In other words, courts tend to treat warnings claims the same way whether they are based on negligence or strict liability.[66] As explained by Ohio's supreme court, "commentators and courts have long recognized that both approaches deal with the same question of foreseeability of harm and are therefore '. . . two sides of the same standard.'"[67] In most states, then, a

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[62] RESTATEMENT (SECOND) OF TORTS § 402A (1965) [hereinafter SECOND RESTATEMENT]. Section 402A applies only to sellers who are engaged in the business of selling such products, and only when the product is expected to and does reach the user without a substantial change in condition. *See id.* The *Third Restatement* explains that "[o]ne engaged in the business of selling or otherwise distributing products who sells or distributes a defective product is subject to liability for harm to persons or property caused by the defect." RESTATEMENT (THIRD) OF TORTS § 1 (1998) [hereinafter THIRD RESTATEMENT].

[63] *See id.*

[64] *See* THIRD RESTATEMENT at § 2.

[65] *See* JAMES T. O'REILLY, PRODUCT WARNINGS, DEFECTS AND HAZARDS § 6.01 (2000).

[66] *See* LOUIS R. FRUMER & MELVIN I. FRIEDMAN, 2 PRODUCTS LIABILITY § 12.02[1] (1999). Courts have ruled that, under differing theories of liability, any distinction is "illusory," *Olson v. Prosoco, Inc.*, 522 N.W.2d 284, 289 (Iowa 1994); that warnings claims bear a "strong resemblance" to each other, *Lorfano v. Dura Stone Steps, Inc.*, 569 A.2d 195, 196 (Me. 1990); that the claims are "equivalent," *Martin v. Hacker*, 628 N.E.2d 1308, 1311 n.1 (N.Y. 1993) and *Feldman v. Lederle Lab.*, 479 A.2d 374, 386 (N.J. 1984); and that they are "virtually inextricable," *Hartford Mut. Ins. Co. v. Moorhead*, 578 A.2d 492, 500 (Pa. Super. Ct. 1990).

[67] *Crislip v. TCH Liquidating Co.*, 556 N.E.2d 1177, 1180-83 (Ohio 1990) (citation omitted).

products liability plaintiff must establish that the defendant knew or should have known of the danger, even if the claim sounds in strict liability.[68] While this issue rarely presents difficulties in claims involving spontaneous combustion, as the propensity of some products to self-heat is well known, it is nonetheless merits mention in any discussion of claims based on warnings.

Several other issues, however, regularly arise when pursuing manufacturers for inadequate warnings or instructions on products that have self-ignited. The following sections address these issues, which include the prominence and adequacy of warnings and the so-called "heeding presumption."

A. Prominence and Adequacy

It is well established that, once a duty to warn has attached, a manufacturer or product seller will be held equally liable for providing an inadequate warning as for providing no warning at all.[69] Determining the adequacy of any particular warning is fact-intensive, and is usually a question of fact for the jury.[70] A legally adequate warning must satisfy

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[68] FRUMER & FRIEDMAN, *supra* note 66, at § 12.02[3]. *But see Beshada v. Johns-Manville Products Corp.*, 447 A.2d 539, 546-49 (N.J. 1982) (imposing strict liability for failure to warn of unknowable dangers).

[69] *See, e.g., Lust v. Clark Equip. Co., Inc.*, 792 F.2d 436 (4th Cir. 1986) & *Alexander v. Morning Pride Mfg., Inc.,* 913 F. Supp. 362, 370 (E.D. Pa. 1995) (involving claim against manufacturer of firefighting bunker gear, for inadequate warnings regarding possibility of burn injuries). *See also Spruill v. Boyle-Midway, Inc.,* 308 F.2d 79, 87 (4th Cir. 1962) (ruling that "where the manufacturer is obligated to give an adequate warning of danger the giving of an inadequate warning is as complete a violation of its duty as would be the failure to give any warning at all").

[70] *See* FRUMER & FRIEDMAN, *supra* note 66, at §§ 12.03[1]-[1][a], *citing Sharp v. Wyatt, Inc.,* 627 A.2d 1347, 1381 (Conn. App. Ct. 1993), *aff'd*, 644 A.2d 871 (1994) (underground tank); *East Penn Mfg. Co. v. Pineda,* 578 A.2d 1113 (D.C. 1990) (exploding truck battery); *Martin*

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form and content requirements. Generally, a warning must be provided in a form that "could reasonably be expected to catch the attention of the reasonably prudent man in the circumstances of its use," and its content "must be of such a nature as to be comprehensible to the average user and to convey a fair indication of the nature and the extent of the danger to the mind of a reasonably prudent person."[71]

Warnings should be specific enough to motivate the user to exercise appropriate caution. The Louisiana Supreme Court confronted this issue in its seminal opinion, *Bloxom v. Bloxom*, which involved a fire ignited by the hot catalytic converter on a car that had just been parked in a barn, on top of enough hay to reach the bottom of the driver's side door.[72] Deciding the issue of adequacy "as a trier of fact from the record," the court addressed the location, clarity, intensity and context of the warnings, and found that, overall, the warnings lacked "sufficient clarity and intensity to adequately communicate the nature of the danger and the means of avoidance to those who will foreseeably use the automobile."[73]

Although the adequacy of warnings or instructions is, in several states, defined by statute,[74] more often, it is determined by a wide range of

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by Martin v. Ortho Pharm. Corp., 645 N.E.2d 431, 436 (Ill. App. Ct. 1994) (oral contraceptive); *Jarrell v. Monsanto Co.*, 528 N.E.2d ll58, 1162 (Ind. Ct. App. 1988) (sulfur); *Pottle v. Up-Right, Inc.*, 628 A.2d 672, 775 (Me. 1993) (scaffold); *Beyrle v. Finneron*, 606 N.Y.S.2d 465, 466 (1993), *modified on other grounds*, 645 N.Y.S.2d 192 (1996) (drain cleaner); *Dougherty v. Hooker Chem. Corp.*, 549 F.2d 174, 177 (3d Cir. (Pa.) 1976) (trichloroethylene); and *McCullock v. H.B. Fuller Co.*, 981 F.2d 656, 658 (2d Cir. (Vt.) 1991) (hot glue).

[71] *Bituminous Cas. Corp. v. Black & Decker Mfg. Co.*, 518 S.W.2d 868, 872-73 (Tex. Ct. App. 1974) (grinding wheel).

[72] 512 So. 2d 839 (La. 1987).

[73] *Id.* at 845.

[74] *See, e.g.*, N.J. Stat. § 2A:58C-4 and Conn. Gen. Stat. § 52-572q.

court-defined factors.[75] First, courts often examine the warnings' conspicuity. In the spontaneous combustion case *Stanley Indus., Inc. v. W.M. Barr & Co., Inc.,* for example, the Southern District of Florida denied defendants' motion for summary judgment, ruling that "a warning is adequate if it is communicated by means of positioning, lettering, coloring and *language* that will convey to the typical user of average intelligence the information necessary to permit the user to avoid the risk and to use the product safely."[76] Although the obvious conspicuity factors include size, shape, color and contrast, and the use of type, pictures or symbols, conspicuity also refers to the shape, design and configuration of warnings.

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[75] Common factors include:

Severity of the danger. *See, e.g. Bickram v. Case I.H.,* 712 F. Supp. 18, 21 (E.D.N.Y. 1989) (backhoe).

Likelihood that warning will attract user's attention. *See, e.g., Wolfe v. Ford Motor Co.,* 376 N.E.2d 143, 145 (1978) (recreational vehicle tire); *Nowak by and through Nowak v. Faberge U.S.A., Inc.*, 812 F. Supp. 492, 492 (M.D. Pa. 1992), *aff'd*, 32 F.3d 755 (3d Cir. 1994) (can of hair spray); and *Spruill v. Boyle-Midway, Inc.,* 308 F.2d 79, 87 (4th Cir. 1962) (furniture polish (ingestion of)).

Intensity of the warning. *See, e.g., General Chem. Corp. v. De la Lastra*, 815 S.W.2d 750, 754 (Tex. Ct. App. 1991) (sodium metabisulfite (used to preserve color of shrimp)).

[76] 784 F. Supp. 1570, 1575 (S.D. Florida 1992) (emphasis in original). The fact that the label on the can of boiled linseed oil at issue in this case lacked warnings printed in Spanish was particularly significant because the product had been advertised in Spanish in Miami, a city with a high Hispanic concentration. *See id.* Moreover, the two employees who used the product were recent immigrants from Nicaragua, each of whom had little or no understanding of English. *See id.*

See also Jarrell v. Monsanto Co., 528 N.E.2d 1158, 1163 (Ind. Ct. App. 1988) (ruling that warnings on bags of sulfur "were not appropriate by reason of their poor location, unsufficiently startling colors, lack of signal symbols, and inadequate content"); *Pottle v. Up-Right, Inc.*, 628 A.2d 672, 675 (Me. 1993) (denying summary judgment when warning was low on scaffold leg and color blended into color of leg); *Johnson v. Johnson Chem. Co., Inc.,* 588 N.Y.S.2d 607 (finding that plaintiff's failure to read warnings did not preclude recovery as a matter of law, because she may have read them if they were adequately conspicuous); and *Nowak by and through Nowak v. Faberge U.S.A., Inc.,* 812 F. Supp. 492, 497 (M.D. Pa. 1992), *aff'd*, 32 F.3d 755 (3d Cir. 1994) (ruling that warning on can of hair spray may be inadequate due to size or positioning).

Second, the location of a warning contributes to its adequacy.[77] Third, the intensity of the language of the warning will be considered.[78] Notably, a federal court recently ruled that an adequate product warning need not inform the user exactly how his failure to heed the warning may cause injury.[79]

Finally, if too many warnings are included on a product, “warnings dilution” or “warnings clutter” can undermine the adequacy of each one individually.[80] As explained by the District Court for the District of Maryland, manufacturers must keep warnings “simple and succinct enough to be readable and effective; the more detailed, the less chance there is that they will be read at all, thereby perversely increasing the risk of injury instead of lessening it.”[81] This same argument is effectively used, however, by defendants who claim that there were too many warnings to put each on the product itself; thus warnings were adequate when included only in the user manual.[82]

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[77] *See, e.g., Pottle*, 628 A.2d at 675; *Bickram v. Case I.H.*, 712 F. Supp. 18, 22 (E.D.N.Y. 1989) (warning to only operate backhoe from inside cab was only located inside cab); *Nowak*, 812 F. Supp. at 497 (improper location of warning on hair spray can).

[78] *See, e.g., Jarrell*, 528 N.E.2d at 1162-63; *Johnson Chem. Co.*, 588 N.Y.S.2d at 611; and *Nowak*, 812 F. Supp. at 497.

[79] *See Hood v. Ryobi N.A., Inc.* 17 F. Supp. 2d 448 (D. Md. 1998), *aff'd* 999 U.S. App. LEXIS 13768 (4th Cir. June 23, 1999) (ruling that, where blade flew off miter saw, manufacturer’s warning that removing blade guard can cause severe lacerating injuries was adequate, despite plaintiff’s belief that danger was limited to risk of clothing or fingers contacting exposed blade).

[80] *See, e.g., Cotton v. Buckeye Gas Prods. Co.*, 840 F.2d 935, 937 (D.C. Cir. 1988) (applying Va. law).

[81] *Liesener v. Weslo, Inc.*, 775 F. Supp. 857, 861 (D. Md. 1991) (trampoline).

[82] *See Scott v. Black & Decker, Inc.*, 717 F.2d 251, 254 (5th Cir. 1983) (handheld band saw) & *Broussard v. Continental Oil Co.*, 433 So. 2d 354 (La. Ct. App. 1983) (power drill).

Although expert testimony may be permitted regarding the adequacy of warnings if the expert satisfies the *Daubert* test,[83] there are few questions "more appropriately left to a common sense lay judgment than that of whether a written warning gets its message across to an average person. After all, it is to the layman that the warning is addressed, not to the expert on labeling."[84]

B. The Heeding Presumption

In every warnings case, as in any negligence or products liability case, the plaintiff must establish that the absence or inadequacy of warnings proximately caused his injury. In other words, the plaintiff must prove that, had the manufacturer provided adequate warnings, the user of the product would have followed them and the plaintiff's injuries would have been avoided.[85] Thus, where a plaintiff admitted that she did not even try to read the product's label before adding hot water to a chemical drain cleaner — because it was not her custom do so — she could not recover because the alleged defective warnings were not the proximate cause of her injuries.[86]

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[83] *See, e.g., Doblar v. Unverferth Mfg. Co.*, Prod. Liab. Rep. (CCH) ¶ 15,088, – F. Supp. – (D.S.D. 1997) (permitting engineer to testify that absence of instructions for adjusting screw on gravity grain box contributed to inadequacy of box's manufacturer's warnings).

[84] *Ferebee v. Chevron Chem. Co.*, 552 F. Supp. 1293, 1304 (D.D.C. 1982).

[85] *See, e.g., Battistoni v. Weatherking Prods., Inc.*, 676 A.2d 890, 895 (Conn. App. Ct. 1996) (vinyl pool liner); *Garside v. Osco Drug, Inc.*, 976 F.2d 77, 81 (1st Cir. (Mass.) 1992) (amoxicillin and phenobarbital); *Ferlito v. Johnson & Johnson Prods., Inc.*, 771 F. Supp. 196, 199 (E.D. Mich. 1991), *aff'd without opinion*, 983 F.2d 1066 (6th Cir. 1992) (cotton batting); *Menard v. Newhall*, 373 A.2d 505, 505 (Vt. 1977) (BB gun); and *Stanback v. Parke, Davis & Co.*, 657 F.2d 642, 646 (4th Cir. (Va.) 1981) (Flugen flu vaccine).

[86] *See Guadalupe v. Drackett Prods. Co.*, 676 N.Y.S.2d 177 (N.Y. App. Div. 1998). *But see Johnson v. Johnson Chem. Co., Inc., (*finding that plaintiff's failure to read warnings did not preclude recovery as a matter of law, because she may have read them if they were adequately conspicuous). *See also Ayers v. Johnson & Johnson Baby Products Co.*, 818 P.2d

(continues)

In order to lighten the plaintiff's heavy burden of proving that adequate warnings would have been followed, many courts permit a presumption that, if an adequate warning had been provided, the user would have heeded the warning and, thus, avoided the injury.[87] In many states, including Pennsylvania, this "heeding presumption" has been found to flow from comment j to section 402A of the *Second Restatement*, which provides as follows: "Where warning is given, the seller may reasonably assume that it will be read and heeded; and a product bearing such a warning, which is safe for use if it is followed, is not in defective condition, nor is it unreasonably dangerous."[88]

The heeding presumption allows the plaintiff to establish a prima facie case of proximate cause without offering any supporting evidence, and thereby shifts the burden of proof to the defendant to show that an improved warning would not have been followed.[89] Of course, the heeding presumption can be rebutted. In *Sharpe v. Bestop*,[90] for example, involving a plaintiff who was ejected from a Jeep, the Supreme Court of

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1337 (Wash. 1991) (finding that inadequate warnings proximately caused injuries to 15-month-old plaintiff who aspirated baby oil, where mother was a "label reader" and would have taken more precautions had she been warned about how dangerous ingestion of baby oil could be).

[87] *See, e.g.*, *Nissen Trampoline Co. v. Terre Haute First Nat'l Bank*, 332 N,E,2d 820, 826-27 (Ind. Ct. App. 1975), *rev'd on other grounds*, 358 N.E.2d 974 (1976); *Rowson v. Kawasaki Heavy Indus.*, 866 F. Supp. 1221, 1232-40 (N.D. Iowa 1994); *United States Gypsum Co. v. mayor of Baltimore*, 647 A.2d 405, 413 (Md. 1994); *Wolfe v. Ford Motor Co.*, 376 N.E.2d 143, 147 (Mass. 1978); Bordeaux v. Celotex Corp., 511 N.W.2d 899, 904 (Mich. Ct. App. 1993); *Coffman v. Keene Corp.*, 628 A.2d 710, 716-20 (N.J. 1993); *Crespo v. Chrysler Corp.*, Civ. 97-8246, 1998 U.S. Dist. LEXIS 13105, at *5 (S.D.N.Y. 1998); and *Pavlik v. Lane Ltd./Tobacco Exporters Int'l*, 135 F.3d 876 (3d Cir. (Pa.) 1998).

But see Raney v. Owens-Illinois, Inc., 897 F.2d 94 (2d Cir. (N.Y.) 1990) (seeming to reject heeding presumption in favor of inference).

[88] RESTATEMENT (SECOND) OF TORTS § 402A cmt. j (1965).

[89] *See* FRUMER & FRIEDMAN, *supra* note 66, at § 12.04[2][a].

New Jersey found that the presumption was rebutted where the jury found that plaintiff would likely have ignored warnings and failed to wear a seatbelt, even had legally adequate warnings been provided.

Because the *Restatement (Third) of Torts: Products Liability* does not include the heeding presumption (or another equivalent to comment j), it remains to be seen whether any courts that have allowed the presumption will adopt a different approach.[91]

Finally, several states, including Connecticut, have rejected the heeding presumption outright.[92]

IV. CONCLUSION

No longer dismissed with alchemy as the stuff of chemistry lore, the mechanisms of spontaneous combustion and the circumstances under which it can occur have been scientifically explained and documented. Because the ability of many substances to self-ignite is well known, parties involved in the manufacture, distribution or use of products containing those substances must exercise reasonable care in their sale, storage and use. When a party's failure to do so causes a fire, an understanding of the technical and legal aspects of spontaneous combustion allows us to hold that party liable for the resultant damage.

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[90] A-53 Sept. Term 1998, 1999 N.J. LEXIS 543 (May 12, 1999).

[91] *See* FRUMER & FRIEDMAN, *supra* note 66, at § 12.04[2][b].

[92] *See DeJesus v. Craftsman Mach. Co.*,, 548 A.2d 736, 744 (Conn. App. Ct. 1988) (finding no basis for heeding presumption in Conn. Gen. Stat. § 52-572q).