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Products Liability and Uprating of Electronic Components

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I. INTRODUCTION

This Comment discusses products liability with respect to electronic parts incorporated into assembled products and in particular to parts that are operated at temperatures beyond those recommended by their manufacturers. The treatment here applies to operation of the devices at temperatures higher than the maximum and lower than the minimum recommended by the manufacturer. Is the parts manufacturer liable when parts fail under these conditions? Analogous situations would be the use of mechanical parts beyond their margin of safety, where liability may turn on whether the defect, or the misuse, caused any resulting injury. Such situations might include farm equipment running faster than recommended whose pulleys explode and cause injury, automobiles that crash

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1 See Restatement (Third) of Torts: Products Liability § 5 cmt. b (1998) (stating that if aluminum used to manufacture aircraft engines departs from the aluminum manufacturer’s specifications due to the presence of foreign particles, the seller of the defective aluminum is subject to liability for harm to persons or property caused by the defects in the aluminum). Comment a states, however, that as a general rule, component sellers should not be liable when the component itself is not defective. Id. at cmt. a. Thus, a seller of aluminum without defect would not be liable if the purchaser uses the aluminum in a way that causes harm.

2 See Lovejoy v. Minneapolis-Moline Power Implement Co., 79 N.W.2d 688 (Minn. 1956). In Lovejoy, the Minnesota Supreme Court overturned a lower court’s directed verdict for the defendant manufacturer and ordered a new trial. Id. at 697. The court noted that it was the law in Minnesota that there was no negligence if risk could not reasonably be anticipated, but that it was a question
when driven at excessive speeds and harm others, and aircraft that break up when carrying loads in excess of their design limit.

This comment first examines electronics by discussing briefly the differences between older vacuum-tube technology and the present state of the art in solid-state electronics. Just as vacuum tube applications changed to solid-state devices, another change is now sweeping over electronics as plastic-encapsulated microcircuits replace older, hermetic technologies.

for the jury whether the manufacturer should have anticipated that the engine of the farm tractor would be driven on a down-hill road, at a speed that would rotate the pulley faster than the material and the design used for its manufacture. See id. at 693. It was undisputed that the manufacturer had given instructions concerning the recommended maximum speed of the machine and the pulley. See id. at 691.

See Schemel v. General Motors Corp., 384 F.2d 802 (7th Cir. 1967). Schemel was riding in a car struck in the rear by the driver of a GM-manufactured car. See id. at 803. Schemel claimed that GM should have foreseen that someone would drive cars capable of 115 miles per hour at excessive and unlawful speeds, creating a risk to the public in general and, in particular, to bystanders such as him. See id. at 804. The Seventh Circuit affirmed GM's motion to dismiss, and noted that the manufacturer is not an insurer of its products; therefore, it is under no duty to anticipate and guard against grossly careless misuse of its product by reckless drivers. See id. at 805. Schemel argued that any automobile that can be driven at speeds of 110-115 miles per hour on roads not designed for such speeds is dangerous for the uses for which it was manufactured. See id. at 804. The court agreed with GM, however, ruling that GM was under no duty to conceal in its advertising the "reserve power" built into the car in order to avoid possible misuse of that power by a wantonly negligent driver. See id. at 805.

See British Airways Bd. v. Boeing Co., 585 F.2d 946 (9th Cir. 1978). A Boeing 707 jet aircraft crashed near Mt. Fuji, Japan, and British Airways, the operator, sued Boeing Co., the manufacturer, under several theories, including products liability. See id. at 949. Boeing argued that the accident was not due to manufacturing or design defects, but to severe air turbulence encountered when the pilot flew too close to Mt. Fuji at too low an altitude. See id. at 950. Boeing claimed that the turbulence was so severe that the aircraft exceeded its design strength, causing the aircraft to disintegrate. See id. at 952. The Japan Civil Aeronautics Board's report stated that the probable cause of the accident was that the aircraft suddenly encountered abnormally severe turbulence which imposed a "gust load" considerably in excess of the aircraft's design limit. See id. at 952 & n.10. The trial court granted summary judgment in favor of Boeing in spite of undisputed evidence of some fatigue failure in important components, ruling that these failures were not a contributing cause of the accident. See British Airways Bd., 585 F.2d at 949-50. The Ninth Circuit affirmed, noting that British Airways had never gone beyond allegations of causation. See id. at 954-55.

See Michael G. Pecht, et al., Plastic-Encapsulated Microelectronics: Materials, Processes, Quality, Reliability, and Applications I (1995) [hereinafter Pecht] (stating that over 97% of the world's microcircuits use plastic packages). Pecht states that the "package" is that part of the device that contains an integrated microcircuit "chip," the leadframe, which is electrically intercon-
In the background, I look closely at a case in which the failure of electronic parts may have contributed to a tragic loss of life.\(^6\) In the discussion, I examine lawsuits concerning components in light of the several theories of products liability. I then gather defenses to products liability causes of action, and see how the theories of liability interact with the defenses. I have concluded that the use of a part outside its recommended operating envelope acts to interpose a number of defenses between the manufacturer and liability for the product.\(^7\) While there may still be liability under some circumstances, the conduct of the user and the reasonableness of his actions, or the lack thereof, may be the principal determinant of liability. Specific coverage may be found elsewhere for cases involving personal injury or death caused by product misuse generally,\(^8\) by contributory negligence or assumption of the risk in use of products,\(^9\) by misuse of electrical equipment specifically,\(^10\) and by defects in aircraft parts or equipment.\(^11\)

Modern aircraft and other equipment with a high need for reliability depend on solid-state electronics to a great degree.\(^12\)

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\(^6\) See Woodling v. Garrett Corp., 813 F.2d 543, 554 (2d Cir. 1987).

\(^7\) See generally Linda A. Banks, Legal Implications of Using Parts Outside of the Manufacturer's Specifications, CALCE Electronic Products and Systems Consortium, University of Maryland, June 17, 1998. CALCE stands for the University of Maryland's Computer-Aided Life Cycle Engineering Center, an institution which has focused in recent years on the durability and economics of microelectronics. CALCE is now a leading center of research into the reasons for failure and mechanisms of failure of electronic parts, and an advocate for failure reporting and corrective action systems for failed electronic parts. See generally Pecht, supra note 5. Banks explores the topic of products liability for components manufacturers. See APEM Course, infra note 25.


\(^11\) See Sonja A. Soehnel, Annotation, Products Liability: Personal Injury or Death Allegedly Caused by Defect in Aircraft or Its Parts, Supplies, or Equipment, 97 A.L.R.3D 627 (1980).

\(^12\) See Michael G. Pecht, Open Forum Editorial, 20 I.E.E.E. TRANSACTIONS ON COMPONENTS, PACKAGING, AND MANUFACTURING TECHNOLOGY- PART A 251 (1997)
All parties concerned with the manufacture, distribution, assembly and sale of these products may face liability for every component in the end item. A harmed person need not have privity of contract with anyone in the chain of distribution in order to bring a lawsuit.

The state of the art in electronics has evolved steadily since the invention of the transistor in 1948. Modern electronics are almost entirely "solid state," with notable exceptions, such as high power electronics. All types of modern circuitry are now manufactured as solid-state devices, from simple diodes to very complicated integrated circuits and microprocessors. The distinguishing characteristic of solid state devices is the "pn" junction, which replaces the gap between the anode and the cathode...

[hereinafter Pecht, Editorial] (stating that avionics systems, as well as automotive systems, use semiconductor devices suitable for various temperature ranges, including commercial parts (0-70°C), industrial (-40 to +85°C), automotive (-40 to +125°C), and military (-55 to +125°C). The Fahrenheit temperature ranges corresponding to these are 32-158°F for commercial, -40 to +185°F for industrial, -40 to +257°F for automotive, and -67 to +257°F for military).

See Restatement (Second) of Torts § 402A cmt. b, illus. 1 (1965) [hereinafter § 402A], (stating that retailers are responsible for a duty of care arising from an undetectable defect in a hypothetical "can of beans" that passes through their hands). The rule applies although the seller has exercised all possible care in the preparation and sale of his product. See id. at § 402A, cmt. a.

See id. at cmt. 1. (stating that the rule applies although the user or seller has not brought the product from or entered into any contractual relation with the seller).

See George Gilder, Microcosm: The Quantum Revolution in Economics and Technology 49 (First Touchstone ed. 1990) (stating that the transistor was invented in 1948 and noting that the transistor is primarily a switch). Gilder's book is an excellent history of the evolution of electronics technology from the theories of matter of Bohr and Einstein to microcomputers.

See Robert S. Symons, Tubes: Still Vital After All These Years, 35 I.E.E.E. Spectrum 52, 53 (Apr. 1998) (stating that people are beginning to realize most electron tubes have been eliminated, and opining that those who make a living selling new equipment to the government think they can make their job a little easier if they conjure up a national memory of putting all the tubes from a TV into a little brown bag and taking them to the tube-testing machine at the local drug store).

See Gilder, supra note 15, at 68 (noting that transistors, based on silicon, are the basis for large-scale integrated circuits and microprocessors, and are used to shape the information age and run personal computers). A good treatment of small-power and control circuits can be found in Theodore F. Bogart, Jr., Electronic Devices and Circuits (3d ed. 1993) [hereinafter Bogart], while power electronics circuits are well-covered in Ned Mohan et. al., Power Electronics: Converters, Applications, and Design (1989) [hereinafter Mohan].
in vacuum tubes.\textsuperscript{18} The pn junction acts as a switch and forms the basis for many other solid-state devices.\textsuperscript{19} These devices are used in many kinds of circuits and end-items, including computers, automobiles, aircraft, and military and space vehicles.\textsuperscript{20} After manufacture of the devices themselves, the circuits are tested, separated from one another and mounted in packages.\textsuperscript{21}

Hermetic packaging, once the dominant choice in the industry, now consumes less than three percent of the integrated circuit market.\textsuperscript{22} Despite the low production volumes for hermetic

\textsuperscript{18} See Adel S. Sedra & Kenneth C. Smith, Microelectronic Circuits 118 (3d ed. 1991) [hereinafter Sedra] (stating that even the terminology of the two ends of a diode, the anode and the cathode, are a carryover from the days of vacuum-tube diodes). The pn junction is formed when p-type semiconductor material is brought into close contact with n-type material. See id. at 169. N-type semiconductor material is formed when silicon is doped with a small amount of an electron-donating impurity such as phosphorus, while p-type material is formed when the silicon is doped with a small amount of electron-accepting impurity such as boron. See id. at 171-72.

\textsuperscript{19} See id. at 117; Bogart and Mohan, supra note 17, for examples. The familiar transistor is the first step up from a diode. A bipolar junction transistor consists of two pn junctions, in the form of n-p-n or p-n-p junctions. See Bogart, supra note 17, at 88.

\textsuperscript{20} See Gilder, supra note 15, at 80 (noting that the motivation for use in missiles and space vehicles was the concept of miniaturization, and that it was achieved through new semiconductor companies).

\textsuperscript{21} See Sedra, supra note 18, at A-3 to A-4 (stating that a finished silicon wafer may contain 100 to 1000 finished circuits or chips, each containing from 10 to 10 million transistors). The circuits are first tested electrically with automatic probing equipment, and they are then separated and mounted in packages, which are sealed under vacuum or in an inert atmosphere. See id.

\textsuperscript{22} See Pecht, supra note 5, at 1 (stating that 97\% of the world's microcircuits use plastic packages). Hermetics include metal, glass and ceramic packages, impervious to water vapor or other intrusions. Plastics typically use an epoxy resin to protect the semiconductor die from the outside environment. Pecht makes the point in a later article that the applications which drive the semiconductor industry, and hence the technology, are the computer, consumer, and telecommunications industries. See Pecht, Editorial, supra note 12, at 251. In this 1997 publication, he estimates that these three industries will have a combined market share of 93\% by the year 2000. See id.

Here, the concern is primarily with what are called "plastic encapsulated microcircuits." A plastic encapsulated microcircuit (PEM), often called a plastic package, consists of an integrated circuit chip physically attached to a leadframe, electrically interconnected to input-output leads, and molded in a plastic that is in direct contact with the chip, the leadframe and the interconnecting parts of the circuit. See Pecht, supra note 5, at 1. In comparison, a hermetically sealed microcircuit (generally called a hermetic package) consists of an integrated circuit chip mounted in a metal or ceramic cavity, interconnected to the leads, and hermetically sealed to maintain a contact environment within the package. See id.
parts, the industry has only recently dispelled the notion that hermetic packaging is superior to plastic packaging.\textsuperscript{23} The military market in particular is characterized by the need for highly reliable circuits, their use guarded by defense department standards and handbooks.\textsuperscript{24} Despite this high demand, fewer and fewer parts are now available in "mil spec" ratings between minus sixty-five Celsius and positive one hundred twenty-five Celsius (-65°C to +125°C).\textsuperscript{25} As a result, a user of such parts must rely more and more on non-hermetic parts.\textsuperscript{26} Such parts may or may not be available in specifications guaranteed by the manufacturer for ranges outside those considered standard, the "commercial" grade at 0-70°C, or "industrial" at -40 to +85°C.\textsuperscript{27} If a particular part is available in a range outside of these two grades, it will likely be hermetically packaged and graded as "military," and will typically be suitable for temperatures ranging from -55°C to +125°C.\textsuperscript{28} The more economical plastic encapsulated parts are generally not offered in temperature ranges above "industrial."\textsuperscript{29} The need for higher temperature capabilities, and the paucity of parts offerings in this range, has led to the practice of "uprating."\textsuperscript{30} Uprating is defined as the practice of using commercial

\textsuperscript{23} See id. at 2.
\textsuperscript{24} See Id.
\textsuperscript{25} See Advanced Plastic Encapsulated Microelectronics Course, University of Maryland, CALCE Electronic Packaging Research Center, Aug. 20, 1996, at § 2.1 [hereinafter APEM course] (naming ten companies that have exited the marketplace for various military applications between 1992 and 1995, including Motorola and Advanced Micro Devices).
\textsuperscript{26} See APEM course, supra note 25, at § 7 (stating that avionics for air transport aircraft is essentially a plastics-dominated business).
\textsuperscript{28} Id. (listing the same parts in a ceramic package for -55 to +125°C temperature range).
\textsuperscript{29} APEM Course, supra note 25, at § 2.1 (stating that there are only four vendors approved to supply such plastic surface-mount parts).
\textsuperscript{30} See generally Patrick McCluskey, Uprating of Parts for Use in Harsh Environments, (last updated 3/18/97) <http://www.CALCE.UMD.edu/general/projects/summary/1997/C97-05.htm> [hereinafter McCluskey]; Pecht \textit{Editorial}, supra note 12, at 251 (stating that, for example, many military systems such as the new
or industrial parts in environments where conditions are beyond
the manufacturer's ratings. Uses contemplated specifically in-
clude such harsh environments as avionics and automotive under-
hood uses. Progress has been good, and recent studies find little evidence of failures of the devices, such as delamina-
tion and cracking, at temperatures as low as -65°C (-85°F), at the
fastest ramping rates, and even with moisture saturated de-
vices. Research continues and the practice has found accept-
ance with the manufacturers of most of the world's transport
aircraft. In the next section of this comment, I will illustrates
Camanche helicopter use commercial devices, and automotive systems and avion-
ics systems, such as those used on the Boeing 777, use devices from all tempera-
ture categories of semiconductor devices: commercial, industrial, automotive and
military).

See McCluskey, supra note 30, at 1.

CALCE recommends that a company using uprating have a well-developed
product liability prevention program, or an injured party's lawyer will be able to
exploit the facts concerning uprating activities in future lawsuits. See CALCE

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See id. Moisture saturation of a device may lead to liquid water, which ex-
spands when warmed and can instantaneously break apart a circuit. See Pecht,
supra note 5, at 174. This phenomenon is known as "popcorning." Id.

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Risks associated with the use of components or systems outside the manufac-
turer's environmental specifications can be divided into three categories: reliabil-
ity of the die itself, reliability of the package, and the electrical performance of
the component or product. See Mark B. Wright, et al., Uprating Elec-

tronic Components for Use Outside Their Temperature Specification Limits, 20 I.E.E.E.
Transactions on Components, Packaging, and Manufacturing Technology- Part A 252
(1997) [hereinafter Wright].

Issues which have at least been identified in the processes of uprating include
the following:

1) Is uprating a performance issue or a reliability issue?
2) How should samples be uprated for performance?
3) Should 100% of a lot [of parts] be uprated? Or is sampling
   sufficient?
4) How are lot-to-lot variations addressed?
5) Does the act of uprating affect reliability?
6) What die level changes affect uprating and how are they
   addressed?
7) What are the system level concerns with uprating?
8) Should uprating be combined with derating? [Derating con-
   cerns limitations on design because of expected environmental or
   performance concerns.]
9) What is the legal liability? Who bears the burden?
10) Who should perform uprating?

Id. at 253.
the importance of electronics performance and reliability in a typical aviation application.

II. BACKGROUND

February 11, 1981, was a dark, stormy night at Westchester County Airport in White Plains, New York. Because visibility was limited by the weather, a Lockheed Jetstar business jet was attempting an instrument landing approach. On board the aircraft were two pilots and six passengers. The Jetstar had four engines and four engine-mounted generators to supply the electricity needed to operate the aircraft. As an added measure of reassurance for those onboard, White Plains was home base for the pilots and the aircraft: Texasgulf Aviation, Inc.

The aircraft (tail number N520S) and an identical sister ship (tail number N320S) had been purchased by Texasgulf Aviation, Inc. seven years earlier. Both aircraft were subsequently outfitted with new Garrett jet engines. Each engine was also equipped with an electrical generator which generates the electricity needed to heat and light the craft, and to operate the communications, navigation and electronic equipment. The previous summer, N320S had been outfitted with new solid-state generator control units (GCUs), which provide the basic function of regulating the electricity produced by the generators and sensing voltage irregularities.

The plane approaching its landing, N520S, had received its new generator control units in January 1981. The Texasgulf Aviation maintenance crew was capable of performing only mi-

56 See Woodling, 813 F.2d at 554.
57 See id. at 546.
58 See id. at 554.
60 See id. at 651.
61 See id.
62 See id. A fifth generator, an auxiliary power unit (APU), generates power on the ground when the aircraft engines are not running. See id.
63 See Texasgulf, Inc., 615 F. Suppl. At 651. A generator control unit (GCU) controls the functioning and monitors the output of each electrical generator. A GCU will typically contain several printed circuit boards and may have hundreds of microcircuits, along with resistors, capacitors and other devices necessary for proper functioning.
64 See id. at 652.
Therefore, the aircraft was sent to a facility maintained by Garrett AiResearch at MacArthur Airport, Long Island. There, the aircraft received extensive maintenance and inspection, along with its new generator control units. These particular GCUs were designed and manufactured by Phoenix Aerospace, Inc., as part of a system installation package for Garrett AiResearch.

The installation did not run smoothly. During one run-up of the electrical systems while the aircraft was on the ground, the number four generator tripped off line, and its GCU smoked. The GCU was replaced and the Garrett AiResearch crew ran more tests. On the first two test flights, there were generator trips and one instance when all four generators tripped off. Of course, sophisticated aircraft such as these generally have battery back-ups. Using battery power, the GCUs were re-set and the flight continued. On a third test flight, the crew attempted to overload the electrical system and force a trip, but the system worked properly. Texasgulf Aviation’s chief test pilot, Jimmy Markham, accepted the aircraft on that day, January 31, 1981.

Markham later flew the aircraft to Chicago’s Midway Airport. During that flight, the number two generator tripped off twice and was reset twice without difficulty. During the return flight on February 3, the pilot experienced three generator trips during his climb. Two were reset and the third was left off. Usually, one generator alone will provide sufficient power for flight-essential equipment at least for short periods of time, and this aircraft had four generators. Later in the flight, the same two generators tripped off again, and were again reset. Markham told his boss and president of Texasgulf Aviation, Morgan Greg-

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45 See id.
46 See id.
47 See id.
48 See Woodling, 813 F.2d at 546.
50 See id.
51 See id.
52 See id.
53 See id.
54 See id.
55 See Texasgulf, Inc., 813 F.2d at 652.
56 See id.
57 See id.
58 See id.
ory, that he would not fly the aircraft again until the generator-tripping situation was corrected.\(^59\) Gregory was on the flight heading to White Plains on the evening of February 11.\(^60\)

The plane was flown and tested on February 5 and 6.\(^61\) Technicians from the GCU manufacturer (Colt) and the system integrator (Phoenix) found wiring discrepancies on the aircraft, as well as continued generator trippings.\(^62\) The Colt technician declined to fly the aircraft.\(^63\) On the last flight prior to February 11, the number two generator tripped and was reset.\(^64\) The report made to Texasgulf Aviation was that the number two and number three generator systems had certain faults, which were to be corrected.\(^65\) The changes, however, would have required removing the number two and number three engines, an operation beyond the normal maintenance capability of the Texasgulf facility.\(^66\) The changes had not been made when the aircraft took off on February 11.\(^67\)

As the aircraft returned to Westchester County Airport on the evening of February 11, all four GCUs tripped.\(^68\) Initially, the batteries provided power to reset the generators and run the essential equipment,\(^69\) but the GCUs continued to disconnect, causing the batteries to deplete and finally exhaust.\(^70\) The FAA report on this incident concluded that the final tripping occurred when the plane was about 500 feet off the ground.\(^71\) The plane crashed approximately 20 seconds later, a mile short of the runway.\(^72\)

\(^{59}\) See id. The other Jetstar, tail N320S, had "a few incidents of generator tripping." Garrett repaired that aircraft. Id.

\(^{60}\) Texasgulf, Inc., 813 F.2d at 653.

\(^{61}\) See id. at 652-53.

\(^{62}\) See id. After consultation with Garrett, the technicians from Colt and Phoenix corrected the wiring installation, performed by Garrett. See id.

\(^{63}\) See id. at 653.

\(^{64}\) See Texasgulf, Inc., 813 F.2d at 653.

\(^{65}\) See id. The technicians from Colt and Phoenix told the chief maintenance technician of Texasgulf Aviation that the number two GCU should be replaced, along with the number two ground fault transformer and the number three ground fault sensor. See id.

\(^{66}\) See id.

\(^{67}\) See id.

\(^{68}\) See Woodling, 813 F.2d at 554.

\(^{69}\) See id.

\(^{70}\) See id.

\(^{71}\) See id.

\(^{72}\) See id. at 546, 554.
Twenty-one related actions in litigation were born of this tragic event. The story of the Texasgulf Jetstar and its solid-state GCUs provides an ideal setting for a discussion concerning the reliability of electrical and electronic parts, particularly in instances where they may constitute defective products.

III. THEORIES OF PRODUCTS LIABILITY

Dean Prosser believed there were two types of defective conditions that could result in a loss either to the purchaser or to a third party. The first is a dangerous condition or product hazard that may result in traffic accidents, industrial accidents, medical mishaps or airplane crashes. The second refers to an inferior condition of the product, that “may disappoint the purchaser’s expectations as to [the product’s] efficacy or fitness for

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73 See Gregory v. Garrett Corp., 578 F. Supp. 871, 875 (S.D.N.Y. 1983) (stating that those involved in the litigation included the decedents' families, estates and employers, the United States government, and all corporations involved in the design, manufacture, sale, installation, maintenance or inspection of the critical aircraft components that may have caused the aircraft to crash).

74 See RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY, supra note 1, § 1. The Restatement begins by calling for liability of an explicitly commercial seller or distributor when harm is caused by their defective products. “One 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.” Id. On its face, this is different from the former Restatement for products liability, section 402A:

One 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 thereby caused to the ultimate user or consumer, or to his property, if (a) the seller is engaged in the business of selling such a product, and (b) it is expected to and does reach the user or consumer without substantial change in the condition in which it is sold.


75 See W. PAGE KEETON ET AL., PROSSER AND KEETON ON THE LAW OF TORTS § 95, at 677 (5th ed. 1984) [hereinafter PROSSER].

76 See id. at 677-78. Prosser further categorizes four different kinds of injuries from the first condition. There may be personal injuries, physical harm to objects or property other than the defective product, physical harm to or destruction of the assembled product purchased by the first purchaser to use, and physical harm to or destruction of a product that was constructed with or repaired with the seller’s component part. See id. at 678.

the purposes intended." The second type is "likely to cause only intangible economic losses." In this paper, I will address primarily the first type of defect, one that may lead to injury or death. In this section, I explore three theories of liability available to aggrieved plaintiffs against the vendors of defective products: negligence in tort, strict liability in tort, and strict liability in warranty.

A. THE GENESIS OF PRODUCTS LIABILITY: NEGLIGENCE

The first line of products liability cases arose due to defective components beginning with *MacPherson v. Buick Motor Co.* In *MacPherson*, Buick Motor Co. sold an automobile to a dealer. After the dealer sold the car to MacPherson, a wheel made from defective wood collapsed. The court found that the purchaser had a cause of action against the manufacturer, even though MacPherson had not purchased the automobile from the manufacturer. The requirement of privity would have meant that the liability of the manufacturer was limited to the dealer alone. Justice Cardozo, writing for the Court of Appeals of New York, found a general rule of product liability:

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77 Prosser, supra note 75, at 678. Prosser also mentioned direct economic loss resulting from the purchase of an inferior product and consequential losses, such as loss of profits. See id. He highlights an example of faulty plastic pipe which must be replaced in a golf course irrigation system. See id. (citing Travelers Indem. Co. v. Evans Pipe Co., 432 F.2d 211 (6th Cir. 1970)).

A more recent case favoring contract law, rather than tort law, is McDonnell Douglas Corp. v. Thiokol Corp., 124 F.3d 1173 (9th Cir. 1997) (applying California law). Upper-stage motors made by Thiokol may have been defective, resulting in two McDonnell Douglas' satellites failing to reach their desired orbit. See id. at 1175. At trial, when McDonnell Douglas attempted to use a products liability definition of "defect," the court found no reason to interpret the contract between the parties to include the law of products liability "and all of the social concerns regarding distribution of risk that it connotes." Id. at 1177.

78 Prosser, supra note 75, at 678. For a further discussion on economic losses in products liability actions, see Two Rivers Co. v. Curtiss Breeding Serv., 624 F.2d 1242 (5th Cir. 1980), cert. denied, 450 U.S. 920 (1981).


80 See id. at 1051. "While the plaintiff was in the car it suddenly collapsed. He was thrown out and injured. One of the wheels was made of defective wood, and its spokes crumbled into fragments. The wheel was not made by the defendant; it was bought from another manufacturer." Id.

81 See id. at 1053 (stating that when the consequences of negligence may be foreseen in an unbroken chain of cause and effect, the duty to safeguard life and limb does not arise from contract, but from the law).

82 See id. ("The dealer was indeed the one person by whom it might be said with some approach to certainty that by him the car would not be used.").
If the nature of a thing is such that it is reasonably certain to place life and limb in peril when negligently made, it is then a thing of danger. . . . If to the element of danger there is added knowledge that the thing will be used by persons other than the purchaser, and used without new tests, then, irrespective of contract, the manufacturer of this thing of danger is under a duty to make it carefully. 83

*MacPherson* is generally regarded as the case that broke the privity barrier in negligence cases. 84 Although the plaintiff still had to prove negligence by the manufacturer, he was relieved from having to allege and prove contractual privity. 85

In a negligence case, a plaintiff must prove that the defendant had a duty of care to the plaintiff, that the duty was breached, that injury or damages resulted to the plaintiff, and that the breach was the proximate cause of the injury or damages. 86 Foreseeability is also an element of a products liability negligence case. 87 As Justice Cardozo opined, "[w]e think that injury

83 Id. Justice Cardozo also foresaw the elements of testing and foreseeability, even at this early stage (1916). In speaking of danger to persons other than the buyer, he noted:

The proximity or remoteness of the relation is a factor to be considered. We are dealing now with the liability of the manufacturer of the finished product, who puts it on the market to be used without inspection by his customers. If he is negligent, where danger is to be foreseen, liability will follow.

*MacPherson*, 111 N.E. at 1053.

Justice Cardozo also saw a concern for the parts-makers:

We are not required, at this time, to say that it is legitimate to go back of the manufacturer of the finished product and hold the manufacturers of the component parts. To make their negligence a cause of imminent danger, an independent cause must often intervene; the manufacturer of the finished product must also fail in his duty of inspection. It may be that in those circumstances the negligence of the earlier members of the series is too remote to constitute, as to the ultimate user, an actionable wrong.

Id.


85 See id. (noting that the plaintiff still had to prove that negligence attributable to the manufacturer caused a defect to be present, and that the defect was the proximate cause of the product's breakdown and the plaintiff's injuries). The text also hints that res ipsa loquitur arguments are available. See Prosser, *supra* note 75, at 683.

86 See id. at 164-65.

87 See Henderson, *supra* note 84, at 595-96 (stating that a plaintiff must show that the resulting harm was within the range of foreseeable risks created by the
to others is to be foreseen not merely as a possible, but as an almost inevitable, result."^{88}

*MacPherson* concerned injury to the actual purchaser of a defective product. What happens in a products liability case if a defective component causes injury to persons other than the party purchasing the product?

### B. The Courts Find Liability in Warranty

In *Henningsen v. Bloomfield Motors, Inc.*, Mrs. Henningsen was driving a new car her husband had given her as a Mother’s Day gift.\(^9\) Only ten days and 468 miles after receiving the car, the car veered off the road at a right angle to the direction it had been traveling.\(^9\) Although Mrs. Henningsen had been driving at a rate of only 20-22 miles per hour, the car was so badly damaged that it was not possible to tell if any of the parts or workmanship of the steering mechanism were defective.\(^9\) The court took judicial notice of the extensive advertising programs of automobile manufacturers, and noted that the "consumer" being courted was not necessarily the buyer of the product.\(^9\) The court explained that it was unfair to create demand with implied

defect, and that this requirement applies to negligence, warranty, and strict liability in tort and product liability cases).

\(^{88}\) *MacPherson*, 111 N.E. at 1054. Cardozo’s observation of the foreseeability requirement lives on in modern caselaw. See, e.g., Juno Indus., Inc. v. Bielawski, 701 So. 2d 1186 (Fla. Dist. Ct. App. 1997) (finding no liability where a contractor furnished a faulty 200-foot length of pipe, and the contractor specifically foresaw the possibility of injury in the case of a defective product and required the purchaser to test the pipe). The Florida court referred specifically to Justice Cardozo’s example in *MacPherson* of a landlord who leases a tumble-down house to a renter, whose guest subsequently is injured because of the poor condition of the property. See id. at 1188. Cardozo believed that the landlord was not liable to the injured guest because the tenant was under a duty of care to his guests—the landlord legitimately expected the tenant to “test the product”—and thus the tenant had a duty to test and repair the house. See id. See also Minton v. Krish, 642 A.2d 18, 22 (Conn. App. Ct. 1994) (holding that foreseeability of an injury replaces the “completed and accepted” rule in actions for personal injury as a result of a contractor’s negligence).


\(^9\) See id. at 75.

\(^9\) See id. Experts at the trial opined that “something definitely went ‘wrong from the steering wheel down to the front wheels’ and that the untoward happening must have been due to mechanical defect or failure . . . .” Id. “‘[S]omething down there had to drop off or break loose to cause the car’ to act in the manner described.” Id.

\(^{92}\) See id. at 80-84.
warranties, based on that advertising, and then limit a manufacturer’s liability with a very restrictive express warranty.\textsuperscript{93} The Supreme Court of New Jersey then found in favor of Mrs. Henningsen, holding “that under modern marketing conditions, when a manufacturer puts a new automobile in the stream of trade and promotes its purchase by the public, an implied warranty that it is reasonably suitable for use as such accompanies it into the hands of the ultimate purchaser.”\textsuperscript{94} In this way, the burden of losses caused by defective articles would be “borne by those who [were] in a position to either control the danger or make an equitable distribution of the losses when they do occur.”\textsuperscript{95} While this case did not mention the concept of strict liability, there was not enough evidence to show fault on the part of the dealer or the manufacturer.\textsuperscript{96} Under the theory of strict liability in warranty, it can be said “[t]he plaintiff [was] no longer required to impugn the maker, but he was required to impugn the product.”\textsuperscript{97}

For states choosing to recognize the \textit{MacPherson} holding, a negligence theory of products liability was now possible without

\textsuperscript{93} See \textit{Henningsen}, 161 A.2d at 89, 92-93. The court also held that an implied warranty of merchantability, from either the manufacturer or the dealer, extends to the purchaser of the car, the members of his family, and to others occupying it or using it with his consent. \textit{See id.} at 79-80, 101-02. In formulating its holding, the court noted great changes in distribution systems and contracting parties from the early days of the common law until modern times. \textit{See id.} at 77-78. Echoing Cardozo’s holding from \textit{MacPherson}, the court also held that where the commodities sold are such that if defectively manufactured they will be dangerous to life and limb, “then society’s interests can only be protected by eliminating the requirement of privity between the maker and his dealers and the reasonably expected ultimate consumer.” \textit{Id.} at 81.

\textsuperscript{94} \textit{Id.} at 84. The court treated foreseeability in a back-handed way. The express warranty was a standardized form used by all members of the Automobile Manufacturers Association, including General Motors, Ford, Chrysler, and five smaller manufacturers. \textit{See id.} at 87. The form could not be altered, and the function of the dealer was merely ministerial—he was simply to deliver the warranty. \textit{See Henningsen,} 161 A.2d at 87. But the warranty was so artfully worded as to be illusory. \textit{See id.} at 79. The court noted that the terms of the warranty were a “sad commentary” on the marketing practices of the automobile manufacturers, in that the warranty had “metamorphosed” into a device to limit the manufacturer’s liability. \textit{Id.} at 78. The only reason to so insulate the manufacturers from liability was the knowledge that defective products were not merely probable, but certain to follow from the mass marketing of so many vehicles.

\textsuperscript{95} \textit{Id.} at 81.

\textsuperscript{96} \textit{Id.} at 75 (stating that “proof was not sufficient to make out a Prima facie case as to the negligence of either the manufacturer or the dealer.”).

privity. With *Henningsen*, states could also recognize a warranty theory of strict liability for both buyers and ultimate consumers of products.

C. STRICT LIABILITY IN TORT IS DISCOVERED

After negligence and warranty, a strict liability theory in tort became available with the holding in *Greenman v. Yuba Power Prods., Inc.*\(^98\) In *Greenman*, a man received a Shopsmith, a combination power tool for use in the home, from his wife.\(^99\) While he was using the Shopsmith, a rotating piece of wood he was turning (as in a lathe) "flew out of the machine and struck him on the forehead, inflicting serious injuries."\(^100\) Consequently, he sued both the retailer and the manufacturer.\(^101\) At trial, there was evidence of "defective design and construction of the Shopsmith."\(^102\) The court submitted to the jury a cause of action for breach of implied warranty against the retailer, and for negligence and breach of express warranty against the manufacturer.\(^103\)

The Supreme Court of California reviewed California statutes and the common law on warranty, and found that, as a rule, injured customers could not meet certain requirements in order to bring court actions against manufacturers with whom they had not dealt.\(^104\) However, the court found strict liability in tort for the manufacturer "when an article he places on the market,\(^98\) 377 P.2d 897 (Cal. 1963). The California Supreme Court held that the manufacturer’s liability for defective products was “not one governed by the law of contract warranties but by the law of strict liability in tort.” *Id.* at 901. The court held:

> To establish the manufacturer’s liability it was sufficient that plaintiff proved that he was injured while using the Shopsmith in a way it was intended to be used as a result of a defect in design and manufacture of which plaintiff was not aware that made the Shopsmith unsafe for its intended use.

*Id.*

\(^99\) *Id.* at 898.

\(^100\) *Id.*

\(^101\) See *id.*

\(^102\) *Greenman*, 377 P.2d at 899.

\(^103\) “Implicit in the machine’s presence on the market . . . was a representation that it would safely do the jobs for which it was built.” *Id.* at 901.

\(^104\) See *id.*, 377 P.2d at 900 (stating that the notice requirement, while a sound rule as between commercial entities, becomes a booby trap when applied to a consumer dealing with a remote seller). “The injured consumer is seldom ‘steeped in the business practice which justifies the rule,’ and at least until he has had legal advice it will not occur to him to give notice to one with whom he has had no dealings.” *Id.* (citations omitted).
knowing that it is to be used without inspection for defects, proves to have a defect that causes injury to a human being."\(^{105}\)

With these cases, products liability no longer depended on privity, nor was it limited by an express warranty from the manufacturer or dealer. The ultimate consumer was now protected, and theories of negligence, warranty, and strict liability in tort were all available by 1962. The next logical step after Greenman, from the viewpoint of consumers, was the formulation of section 402A of the Restatement (Second) of Torts regarding the special liability of a seller for physical harm caused to the user or consumer.\(^{106}\)

In sum, section 402A establishes strict liability in tort for defective products found to be unreasonably dangerous. After Henningsen and its progeny,\(^{107}\) a plaintiff may have a cause of action for strict liability in warranty. A negligence theory is also available after MacPherson and related cases.\(^{108}\) An aggrieved plaintiff thus has three theories of liability against vendors of defective products: negligence in tort, strict liability in tort, and strict liability in warranty.\(^{109}\)

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\(^{105}\) Id. (noting that there was sufficient precedent in so many cases and varieties of products as to warrant extending the rule to general applicability to all products). Liability should be governed in these cases not by the law of contract warranties, but by the law of strict liability in tort. See id. at 901. "The purpose of such liability is to insure that the costs of injuries resulting from defective products are borne by the manufacturers that put such products on the market rather than by the injured persons who are powerless to protect themselves." Id.

\(^{106}\) See § 402A, supra note 13.

(1) One 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 thereby caused to the ultimate user or consumer, or to his property, if

(a) the seller is engaged in the business of selling such a product, and

(b) it is expected to and does reach the user or consumer without substantial change in the condition in which it is sold.

Id.


\(^{109}\) See PROSSER, supra note 75, §§ 96-98, at 681-94. Of course, products liability law is state law, as is demonstrated by all these cases, and each state’s legislature and courts decide which theories to accept, if any.
IV. PRODUCT DEFECTS

How is a product defective? There are three ways to consider a product as being in a defective condition. There may be a flaw in the product, also known as an abnormality or a condition that was unintended, which makes the product more dangerous. Such a defect is termed a manufacturing defect. The second type of defect, a design defect, is one that makes a product unreasonably dangerous, not because of its unintended manufacturing flaws, but because of its failure to meet the consumer's expectations. Thirdly, a product may be unreasonably dan-

The difference between negligence and strict liability is demonstrated in a case that concerned an electric company lineman burned from an electric arc. See Bigham v. J.C. Penney Co., 268 N.W.2d 892 (Minn. 1978). The lineman claimed that his injuries were aggravated by a "melt and cling" effect from the clothing he wore, a cotton shirt and pants purchased from the defendant retailer. Id. at 895. He claimed he should have been warned that his work clothes were flammable and would produce a "melt and cling" effect if ignited. See id. The trial court found that while he had assumed the risk of flash-over injuries, he had not assumed the risk of having his burns aggravated by the clothes he was wearing. See id.

On appeal, the Supreme Court of Minnesota upheld the jury's dual findings that the work clothes were not in a "defective condition unreasonably dangerous" to the plaintiff, and that while Penney's had not breached a warranty, it was negligent with respect to the flammability of the work clothes. Id. at 896. The court found that the work clothing was not defective because it was not dangerous to the average consumer; thus, there was no strict liability. See id. at 897. At the same time, Penney's could also be found negligent because it sold flammable clothing without warnings about its flammability. Bigham, 268 N.W. 2d at 898. Thus, a manufacturer can be found negligent but not strictly liable in a product liability case.

110 See PROSSER, supra note 75, § 99, at 695 (stating that a flaw "created in the construction or marketing processes makes the product unreasonably dangerous as a matter of law since it causes the product to be more dangerous than it was designed to be").

111 See HENDERSON, supra note 84, at 561 (dividing a chapter on products liability into three categories: manufacturing defects, design defects, and failure to warn—the last now known as a "marketing failure").

112 See PROSSER, supra note 75, § 99, at 698-99. Two tests are noted, the "consumer-contemplation" test and the "danger-utility" test. Id. A product may be unreasonably dangerous by reason of a design defect under the "consumer-contemplation test," if it is "dangerous to an extent beyond that which would be contemplated by the ordinary consumer who purchased it with the ordinary knowledge common to the community as to the product's characteristics." Id. at 698 (citing § 402A, supra note 13, cmt i). Under the "danger-utility test," an item "is defective as designed if, but only if, the magnitude of the danger outweighs the utility of the product." Id. at 699.
gerous if it has no warnings, or inadequate warnings, about a risk or hazard related to the way the product is designed.\textsuperscript{113}

\section*{A. Manufacturing Defect}

The presence of a manufacturing defect is relatively easy to determine. "[A] defective product is one that differs from the manufacturer's intended result or from other ostensibly identical units of the same product line."\textsuperscript{114} A manufacturing defect, then, can be treated by a simple "deviation from the norm" test.\textsuperscript{115} Applying this test to \textit{MacPherson}, the wheel which broke and caused the injury had a manufacturing defect.\textsuperscript{116} In a comparison to other ostensibly identical units of the same product line, the Imperial Wheel Company of Flint, Michigan as Buick's supplier, had furnished 80,000 good wheels prior to this incident.\textsuperscript{117}

An analysis of \textit{MacPherson} also reveals the elements necessary to make a case of negligence. The court found that Buick was under a duty of care,\textsuperscript{118} and that "[i]t was not at liberty to put the finished product on the market without subjecting the com-

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\textsuperscript{113} \textit{See id.} at 697 (stating that "[t]here will be no liability without showing that the defendant designer knew or should have known . . . of the risk[s] or hazard[s] about which he failed to warn.").
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\textsuperscript{114} Barker v. Lull Eng'g Co., Inc., 573 P.2d 443, 454 (Cal. 1978) (stating that "when a product comes off the assembly line in a substandard condition," there is a manufacturing defect). The Supreme Court of California gave, as an example, one machine out of a million, which contains a cracked or broken part. \textit{See id.} at 445. The Restatement (Third) states that a product "contains a manufacturing defect when the product departs from its intended design even though all possible care was exercised in the preparation and marketing of the product." \textit{Restatement (Third) of Torts: Products Liability, supra} note 1, § 2.
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\textsuperscript{115} Barker, 573 P.2d at 454.
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\textsuperscript{116} \textit{See MacPherson}, 111 N.E. at 1051 (stating that "[o]ne of the wheels was made of defective wood, and its spokes crumpled into fragments.").
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\textsuperscript{117} \textit{See id.} at 1055 (Bartlett, C.J., dissenting) (noting that Buick had relied on Imperial Wheel Co., a reputable manufacturer, to "make all necessary tests as to the strength of the material therein, and made no such test itself").
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\textsuperscript{118} \textit{See id.} at 1053 (stating that "[t]he manufacturer of [a] thing of danger is under a duty to make it carefully").
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ponent parts to ordinary and simple tests."\textsuperscript{119} The duty was breached by the failure of the manufacturer to inspect the wheel and by placing a defective product on the market. As a result, the defect caused an injury.\textsuperscript{120} Justice Cardozo made several interesting comments regarding the potential liability of the wheel component manufacturer. To make a case against Imperial, he stated, and its undoubted negligence in furnishing a defective wheel, the company could conceivably claim an intervening, independent cause: the negligence of its customer, Buick.\textsuperscript{121} This view has found some support,\textsuperscript{122} and does not contradict section 402A.\textsuperscript{123} Foreseeability of harm is a part of the causation element under the rule that if a seller is negligent where danger is foreseeable, liability will follow.\textsuperscript{124} The court noted that the manufacturer knew persons other than the buyer would use the car.\textsuperscript{125}

The principles of products liability and negligence announced in \textit{MacPherson} are still good law, as illustrated in the recent Florida case, \textit{Juno Indus., Inc. v. Bielawski}.\textsuperscript{126} As a pipe manufacturer, Juno joined several segments together to form a 200-foot long section to be used as part of its customer's con-

\textsuperscript{119} See \textit{id.} at 1055 (explaining that "[t]he defendant was not absolved from a duty of inspection because it bought the wheels from a reputable manufacturer").

\textsuperscript{120} See \textit{id.} at 1053 (noting that there was "no break in the chain of cause and effect").

\textsuperscript{121} See \textit{id.}

\textsuperscript{122} See, \textit{e.g.}, Goldberg \textit{v. Kollsman Instrument Corp.}, 191 N.E.2d 81, 83 (N.Y. 1963) (holding that it is not necessary to extend rules of liability to component manufacturers in a warranty action).

\textsuperscript{123} The "caveat" immediately following section 402A states that the American Law Institute expresses no opinion as to whether section 402A may apply to the seller of a component part of a product to be assembled. The Restatement (Third) makes it clear that the matter has been resolved to hold liable component manufacturers who furnish defective components. \textit{RESTATEMENT (THIRD) OF Torts: Products Liability, supra} note 1, § 2(b).

\textsuperscript{124} See \textit{MacPherson}, 111 N.E.2d at 1053 (stating that when a manufacturer of a finished product places it on the market to be used by his customers without inspection, and "is negligent where danger is to be foreseen, a liability will follow").

\textsuperscript{125} \textit{Id.} (stating that the automobile had seats for three persons). Dismissing the argument of privity, the court noted that the dealer was the one person certain not to use the car, and that \textit{MacPherson} had purchased the car from a Buick dealer. \textit{Id.} at 1053.

\textsuperscript{126} 701 So. 2d 1186 (Fla. Dist. Ct. App. 1997).
The written contract between the buyer and Juno specified a testing procedure to determine the strength of the pipe and the welds. The buyer did not follow this procedure, and one of the buyer's workers was killed. The trial court found that there was no negligence on the part of the manufacturer, because the defect in the weld, certainly a manufacturing defect, was not the proximate cause of the worker's death.

The Florida appeals court considered whether to uphold the trial court's finding that Juno was 5% liable upon a theory of strict liability. The court found that strict liability is justified only when the purchaser is entitled to expect that a product placed in the stream of commerce has been tested and inspected (or properly labeled) to assure that it is safe for human use. Since the required testing was so well spelled out to the purchaser, the appellate court concluded that this was not a case of strict liability, and reversed in Juno's favor.

B. DESIGN DEFECT

Design defects may be detected by two tests, the "consumer-contemplation" test and the "risk-utility" test. Under the "consumer-contemplation" test, a product is defectively designed if it is "dangerous to an extent beyond that which would be contemplated by the ordinary consumer who purchases it, with the ordinary knowledge common to the community as to that product's characteristics." This test, as articulated by section 402A, contemplates an "ordinary consumer"
with "ordinary knowledge," not a "foreseeable user," which would unreasonably extend liability.\textsuperscript{136} The other test, the "risk-utility" test, arose because critics perceived the consumer-contemplation test as too restrictive on manufacturer's liability.\textsuperscript{137} The risk-utility test for a design defect focuses on whether, in light of the relevant factors, the benefits of the challenged design outweigh the risk of danger inherent in the design.\textsuperscript{138} The tests may be summarized as a dual standard to assure that a plaintiff is protected from "products that either fall below ordinary consumer expectations as to safety, or that, on balance, are not as safely designed as they should be."\textsuperscript{139} The Restatement (Third) of Torts favors the "risk-utility" test when it defines a design defect in terms of the "foreseeable risks of harm posed by the product," and requires a showing of a "reasonable alternative design" whose omission renders the product not reasonably safe.\textsuperscript{140}

The "risk-utility" test debuted in \textit{Barker}, where a worker, who was not accustomed to working with a high-lift loader, at-

\textsuperscript{136} Todd v. Societe Bic, S.A., 21 F.3d 1409 (7th Cir. 1994) (en banc), \textit{cert. denied}, 513 U.S. 947 (1994) (noting that a child is certainly a foreseeable user of dangerous objects, but refusing to make manufacturers absolutely liable, and thus insurers of their products).

\textsuperscript{137} See \textit{Barker}, 573 P.2d at 451.

\textsuperscript{138} See \textit{id.} at 451-52 (stating that the plaintiff must prove that the product's design proximately caused the injury).

\textsuperscript{139} \textit{id.} at 446-47. The court also noted that the product's "reasonably foreseeable" use is part of any defectiveness evaluation, rather than its "intended use." \textit{id.} at n.9. Note the distinction: the manufacturer is responsible for reasonably foreseeable uses, but not foreseeable users. Under the facts of this case, a reasonable and prudent man might characterize the plaintiff's use of the product as "misuse." However, a plaintiff's misuse is not a defense in a strict liability case. See \textit{Jurado} v. Western Gear Works, 619 A.2d 1312, 1317 (N.J. 1993) (applying N.J. law, noting that the absence of misuse is to be part of the plaintiff's case, and that the "plaintiff has the burden of showing that there was no misuse or that the misuse was objectively foreseeable"). The court in \textit{Jurado} goes on to note two kinds of misuse: one is use for an improper purpose, such as using a power saw for clipping one's nails; the other is for use in an improper manner, such as when a high-lift forklift is operated on a steep slope instead of level terrain. See \textit{id.} at 1318.

\textsuperscript{140} A product:

\textsuperscript{b} is defective in design when the foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design by the seller or other distributor, or a predecessor in the commercial chain of distribution, and the omission of the alternative design renders the product not reasonably safe.

\textbf{Restatement (Third) of Torts: Products Liability, supra} note 1, §2(b).
tempted to lift a load of lumber to a height of 18-20 feet above
the ground. The worker used the levelers provided on the
loader because the ground at that location sloped sharply in sev-
eral directions. As the load went above 10 feet high, he felt a
vibration, and his co-workers shouted to him that the load was
beginning to tip and that he should jump. He jumped, and
was injured when struck by a piece of falling lumber. In its
analysis, the court reviewed the consumer-expectation test as un-
satisfactory, since in many instances “a consumer would not
know what to expect because he would have no idea how safe a
product could be made.”

The court noted several factors that could be weighed in evalu-
ating designs:

- the gravity of the danger posed by the challenged design,
- the likelihood that such danger would occur,
- the mechanical feasibility of a safer alternative design,
- the financial cost of an improved design,
- and the adverse consequences to the product and to the
  consumer that would result from an alternative design.

While the loader was equipped with levelers, there were several
other features that would have made it a much safer design.

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141 573 P.2d at 447. The regular user called in sick that day, knowing that the
high-lift loader was not safe for that use, which he believed was more suited to a
crane. See id. at 448, n.2. The supervisor was so informed but had not agreed to
obtain a crane for such lifting. See id.

142 See id. at 447.

143 See id.

144 See id.

145 Id. at 454 (citing John Wade, On the Nature of Strict Tort Liability for Products,
44 Miss. L.J. 825 (1973)).

146 Barker, 573 P.2d at 455. The court also discussed how to allocate the bur-
den of proof, noting that the feasibility and cost of alternative designs are often
“technical matters peculiarly within the knowledge of the manufacturer.” Id. at
455.

Barker has been criticized for shifting the burden of proof for the risk-utility
analysis. See James A. Henderson, Jr. and Aaron D. Twerski, Achieving Consensus
on Defective Product Design, 83 Cornell L. Rev. 867, 900 (1998). The authors note
that “most American legal scholars agree that the general standard for defective
design is the risk-utility analysis together with a requirement of proof of a reason-
able alternative design.” Id. at 901. Henderson and Twerski are the reporters for
the American Law Institute’s Restatement (Third) of Torts: Products Liability
(1998). See id. at 901-2 & n.142. This standard is not “codified.” Restatement
(Third) of Torts: Products Liability, supra note 140, § 2(b).

147 See Barker, 573 P.2d at 447-48. The plaintiff’s expert witness testified that
the loader was unstable because of its “relatively narrow base” and the height to
which loads were expected to reach. Id. The plaintiff’s expert further indicated
that “the loader should have been equipped with ‘outriggers,’ mechanical
arms . . . to lend stability to the loader.” Id. at 448. The loader was also defective
The court thus found that the risk-utility test could be applied to questions of design defect.\textsuperscript{148}

To illustrate the difference in the tests, note that the consumer-expectation test would have failed the plaintiff in \textit{Barker}. The "ordinary consumer" in \textit{Barker} might be the usual operator or the foreman, both of whom were skilled in the operation of the high-load lift.\textsuperscript{149} Their ordinary knowledge, common to the community, was that the loader was entirely unsafe for the attempted task.\textsuperscript{150} The issue was whether the product was defectively designed so as to be "unreasonably dangerous for its intended use."\textsuperscript{151} When this question was submitted to the trial jury, it rendered a 10-2 verdict in favor of the defendants.\textsuperscript{152}

The California Supreme Court looked at other cases and commentary, and decided to relax the requirements so as to include the risk-utility test as well.\textsuperscript{155} As a result, the court remanded the case on the issue of whether the design was defective under the risk-utility test, as well as whether the loader was defective for "reasonably foreseeable uses," rather than its "intended uses."\textsuperscript{154}

Application of these tests requires some discretion. The narrower consumer-contemplation test is generally used "when a simple product which poses an obvious danger is alleged to be defective."\textsuperscript{155} Under Illinois law, for instance, the courts have decided there are limited situations in which the broader risk-utility test can be applied.\textsuperscript{156} It is only incumbent upon to the court, as a matter of law, to decide whether a product is "sim-

\textsuperscript{148} See \textit{Barker}, 573 P.2d at 457-58.
\textsuperscript{149} See \textit{id.} at 451.
\textsuperscript{150} See \textit{id.} at 448 n.2.
\textsuperscript{151} \textit{Id.} at 449 n.4. Note that it was error for the trial court to specify "intended use," rather than "reasonably foreseeable use." \textit{Id.} at 458.
\textsuperscript{152} See \textit{id.} at 449.
\textsuperscript{153} See \textit{Barker}, 573 P.2d at 456.
\textsuperscript{154} \textit{Id.} at 458.
\textsuperscript{155} Haddix v. Playtex Family Prods. Corp., 138 F.3d 681, 684 (7th Cir. 1998).
\textsuperscript{156} See \textit{id.} (quoting Scoby v. Vulcan-Hart Corp., 569 N.E. 2d 1147, 1151 (Ill. App. 1991) for the proposition that "a line must be drawn beyond which the danger-utility (i.e., risk-utility) test cannot be applied").
ple."157 Thus, in a case involving tampon use, that caused toxic shock syndrome to an Illinois user, the court decided it was a simple product; therefore, the consumer-contemplation test applied, and the dangers were obvious to users.158 The court's decision was due at least in part to the warnings on every box of tampons, as required by federal regulations.159 While the danger might not be obvious, the court recognized that the ultimate effects were made obvious by the warnings.160 Components of products may also be defectively designed, as illustrated by a case involving an aircraft speed indicator.161 In Moorhead, the pilot encountered icing conditions, causing the aircraft to lose airspeed, spin out of control and crash.162 The district court found that the plane's airspeed indicator was partially responsible for the accident.163 The indicator had frozen during the flight, causing the indicated speed to increase with altitude.164 The aircraft manufacturer and the National Transportation Safety Board (NTSB), after encountering similar malfunctions, had issued advisory warnings.165 The appellate court noted that there were alternate designs for this airspeed indicator, and therefore left undisturbed the district court's finding of defective design.166

C. DEFECT IN MARKETING OR FAILURE TO WARN

A product can be deemed defective by its failure to warn, or failure to warn adequately, of a risk or hazard related to the product's design.167 Prosser takes the view that in an action against a manufacturer-designer, the proof must include negligence. This flows from the plaintiff's need to show that the manufacturer-designer knew or should have known, in the exer-

157 Id. (citing Scaccianoce v. Hixon Mfg. & Supply Co., 57 F.3d 582, 586 (7th Cir. 1995)).
158 See id. at 686.
159 See id.
160 See id. In agreement, the court here noted that the Ninth Circuit had ruled similarly on the same facts. See id. (citing Papike v. Tämbrands, Inc., 107 F.3d 737 (9th Cir. 1997))
161 See Moorhead v. Mitsubishi Aircraft Int'l, Inc., 828 F.2d 278 (5th Cir. 1987) (applying Texas law).
162 Id. at 281.
163 See id. at 284.
164 See id.
165 See id. at 284 n.27.
166 See id. at 284 (noting that there were modifications which might have corrected problems with the airspeed indicating system).
167 See Prosser, supra note 75, § 99, at 697.
exercise of ordinary care, of the risk or hazard of which he failed to warn.\footnote{168 See id.} When a manufacturer or seller "markets without adequate warnings, [however,] a reseller is subject to liability [even] without negligence in reselling the product without adequate warning."\footnote{169 Id.} A most contentious issue in "failure to warn" cases has been whether a manufacturer is liable for warnings of risks which were unknown or unknowable at the time of manufacture.\footnote{170 See \S 402A, supra note 13, cmt. j (noting that a seller will not be required to warn persons of foods causing common allergies, on the grounds that they will have knowledge of them). Section 402A also notes there will be a duty to warn of dangers not generally known, or which a consumer would not reasonably expect to find in the product, if the seller knows, or should have known, of the danger. See id.}

The chief exception to the duty to warn is the unknown and unknowable risk.\footnote{171 See Anderson v. Owens-Corning Fiberglas Corp., 810 P.2d 549, 556 (Cal. 1991) (citing Brown v. Superior Court, 751 P.2d 470 (Cal. 1988) for the proposition that knowledge or knowability is a component of strict liability for failure to warn, and a defendant in such a case may present evidence of the state of the art, i.e., that the particular risk was neither known or knowable with the scientific knowledge available at the time of manufacture or distribution).} Neither is there a duty to warn of open and obvious dangers.\footnote{172 See Clark v. Boeing Co., 395 So. 2d 1226 (Fla. Dist. Ct. App. 1981). In Clark, a stewardess opened a door on a jet aircraft while its engines were running, causing trauma to herself from the noise and from jet fuel emissions. Id. at 1228. The court found that the aircraft manufacturer had no duty to warn individuals of an obvious danger. See id. at 1228-29. The court found that the aircraft was not defectively designed for lack of a door interlock which would have prevented opening while the engines were running; therefore, there is no duty to consumers to supply materials which could be made safer, when the danger to be avoided is obvious to all. See id.}

However, a defect in a product cannot be
overcome by a mere warning.\textsuperscript{174} Under Comment \textit{j} to section 402A, a seller is entitled to the presumption that his warnings will be read and heeded.\textsuperscript{175} The question may then arise as to the adequacy of a given warning.\textsuperscript{176}

\textsuperscript{174} See Howard Latin, "Good" Warnings, Bad Products, and Cognitive Limitations, 41 UCLA L. Rev. 1193, 1206 (1994) [hereinafter Latin] (citing Skyhook Corp. v. Jasper, 560 P.2d 934 (N.M. 1977), overruled by Klopp v. Wackenhut Corp., 824 P.2d 297 (N.M. 1992)). In \textit{Jasper}, the court found that a crane, which "could have been insulated against electric shock," was sufficiently safe if the manufacturers warned users not to come close to high-voltage power lines. Jasper, 560 P.2d at 938. In \textit{Klopp}, an airline passenger going through a metal detector tripped over its stanchion base and sustained injuries. 824 P.2d at 295. \textit{Klopp} overruled \textit{Jasper}, holding that "[a]n occupier of premises cannot avoid liability . . . for injuries caused by dangers that otherwise may be made safe through reasonable means." Id. at 297.

One rationale for requiring manufacturers to actually mitigate dangers, rather than to depend on warnings, is that warnings often prove ineffective. See Latin, \textit{supra}, at 1206. Latin contends that a manufacturer chooses either to make a product safer or to add warnings which require consumers to protect themselves or others who use the product. See \textit{id}. at 1196. The danger in adding warnings lies in the consumer's failure to read them, his difficulty in understanding these admonitions, and a general failure to follow warning or directions given. See \textit{id}. at 1196, 1207, 1220, 1242. Latin's explanation for the consumer's failure to read the warnings includes functional illiteracy, inattentive or incompetent users, unavailable or misplaced directions, reliance on intermediaries, reliance on general knowledge or experience, and information overload. See \textit{id}. at 1207-15.

\textsuperscript{175} See \S 402A, \textit{supra} note 15 cmt. \textit{j} (stating that a product with such a warning, which is safe for use if followed, is neither defective nor dangerous). This is no longer consistent with case law. See \textit{supra} note 174 and accompanying text. Section 2 of the Restatement (Third) appears to extend this protection, in that a product is deemed to have a design defect "when the foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design . . . and the omission of the alternative design renders the product not reasonably safe." David Owen, \textit{Products Liability Law Restated}, 49 S.C. L. Rev. 273, 281 (1998) (citing American Law Institute, \textit{Restatement (Third) of Torts: Products Liability}, \S 2(b) (Proposed Final Draft 1997)). The section expands to include liability for the seller, the distributor or other predecessors in the commercial chain of distribution. See \textit{id}. A product with a defect carrying a "foreseeable risk of harm" may be one which causes a manufacturer or seller to foresee danger so much as to add a warning. See Latin, \textit{supra} note 174, at 1196 (stating that manufacturers choose either safer designs or "good" warnings). If a manufacturer is able to warn of a danger, it follows that he must have foreseen the danger.

\textsuperscript{176} See \textit{Jaurequi} v. John Deere Co., 971 F. Supp. 416, 419 (E.D. Mo. 1997) (applying Missouri law) (where the plaintiff claimed that the warning on a corn head was inadequate); see also Latin, \textit{supra} note 174, at 1195. Latin notes that "product warnings and other disclosure mechanisms can be effective only when intended recipients are able to receive, comprehend, and act upon the information imparted." \textit{Id}. Latin emphasizes several reasons why consumers do not understand warnings. These include imperfect tradeoffs in a warning among details, the clarity and impact of the warning, textual ambiguity, uncertainty concerning the con-
A seller may still be liable for post-sale warning of his product when defects are discovered at a later time. For example, in cases involving helicopter engines, a duty exists to warn purchasers of a product's defect. It is generally accepted that knowledge or knowability is a necessary component in failure-to-warn cases. Strict liability, on the other hand, would not concern itself with such conduct by the seller, that is, whether the seller knew or should have known. Failure-to-warn cases, then, bounded by the defendant's knowledge or knowability, are much more about negligence than strict liability, but in these cases, the distinction lacks serious difference. Thus, in a failure-to-warn case, the plaintiff must show that the defendant

sequences of misuse, inadequate expertise necessary to evaluate the warning, variations in individual capabilities, and cognitive heuristics and biases (e.g., when an individual uses simplified strategies and biases which lead to mistakes in evaluation). See id. at 1220-40.

177 See Walton v. Avco Corp., 610 A.2d 454, 459 (Pa. 1992) (applying Pennsylvania law in a case wherein Avco sold engines to Hughes Helicopter, Inc. for use in helicopters). When Avco became aware of the defect in the engines, it issued a service instruction to Hughes detailing the defect and corrective action. See id. at 456. Hughes failed to pass the warning on to its helicopter consumers, and thus incurred liability not only for incorporating a defective engine, but also for failing to forward the warning: "Having been informed of [the] defect, Hughes was required to warn its service centers and, more importantly, those who purchased the affected helicopters." Id. at 459. The court further noted the special property of helicopters in that they are not mass-produced objects which may be "swept away" in the stream of commerce, but are sold in specialized markets. Id. The court found it important that Avco, the manufacturer of the defective component, had consistently maintained contact with Hughes for the very purpose of keeping Hughes current on all pertinent information, presumably so that Hughes could fulfill its duty to warn its customers. See id.

178 See Anderson, 810 P.2d at 556. Only Louisiana, Missouri, Pennsylvania and Washington have rejected knowability as a condition of strict liability. See id. at 554 n.100.

179 See id. at 562 (Mosk, J., dissenting). Justice Mosk argues that the principles of strict liability are diluted when a defendant's conduct, and thereby his negligence, are brought into the argument. See id. He contends that California will no longer have strict liability for failure to warn under the "state of the art" rule, but rather only a negligence claim will remain. See id. He also notes that "one characteristic that distinguishes strict liability from negligence is proof of actual or constructive knowledge of risk," and that negligence cases focus on the defendant, while strict liability cases focus on the product. Id. (citing Kearl v. Led- erle Lab., 172 Cal. App. 3d 812, 832 (1985), rev'd on other grounds, Brown, 751 P.2d at 482).

180 See Anderson, 810 P.2d at 563 (Mosk, J., dissenting) (stating the possibility that failure to warn cases may be based solely on negligence); see also James A. Henderson, Jr. and Aaron D. Twerski, Doctrinal Collapse in Products Liability: The Empty Shell of Failure to Warn, 65 N.Y.U. L. Rev. 265 (1990).
knew or should have known that the product was dangerous, yet failed to warn the buyer.\textsuperscript{181}

With the development of all these theories of liability, a plaintiff could now bring suit in any number of ways. One author might have imagined products liability plaintiffs:
as a swarm of flies in vintage time,
About the wine-press where sweet must is poured,
Beat off, returns as oft with humming sound;
Or surging waves against a solid rock,
Though all to shivers dashed, the assault renew,
Vain battery, and in froth or bubbles end.\textsuperscript{182}

V. APPLICATION OF PRODUCTS LIABILITY TO "UPRATED" ELECTRONIC COMPONENTS

A. LIABILITY OF COMPONENTS MANUFACTURERS

The Restatement (Third) itself is possibly the strongest defense against liability of components manufacturers, contending that they should not be liable when their components are not defective.\textsuperscript{183} In other words, liability should limit itself to cases where the components themselves are defective, or where the component manufacturer “substantially participates in the integration of component[s] into the design of [other] prod-


\textsuperscript{182} \textit{JOHN MILTON,} \textit{Paradise Regained,} Book IV in \textit{The Portable Milton} 591-92, ll 15-20 (1671).

\textsuperscript{183} RESTATMENT (THIRD) OF TORTS: PRODUCTS LIABILITY, supra note 1, § 5 cmt. a. Section 5 states:

\begin{quote}
Liability of Commercial Seller or Distributor of Product Components for Harm Caused by Products Into Which Components are Integrated

One engaged in the business of selling or otherwise distributing product components who sells or distributes a component is subject to liability for harm to persons or property caused by a product into which the component is integrated if:

(a) the component is defective in itself, as defined in this Chapter, and the defect causes the harm; or

(b) (1) the seller or distributor of the component substantially participates in the integration of the component into the design of the product; and

(2) the integration of the component causes the product to be defective, as defined in this Chapter; and

(3) the defect in the product causes the harm.
\end{quote}

\textit{Id.}
Comment a of section 5, touching on the rationale for liability of components manufacturers, calls it "unjust and inefficient to impose liability solely on the ground that the manufacturer of the integrated product utilizes the component in a manner that renders the integrated product defective." 185

It is generally recognized that electronic parts manufacturers do not produce the end items, which are either used in industry or purchased by the consumer. A chain of suppliers with accompanying responsibility is usually established, and may include piece part manufacturers,186 intermediaries who furnish avionics equipment to airplane manufacturers,187 equipment integrators or outfitters,188 as well as aircraft manufacturers themselves.189 The supposition is that electrical or electronic parts

184 Id. Comment e states that substantial participation can take many forms, but "[w]hen the component seller substantially participates in the design of the integrated product," it is fair and reasonable to hold the component seller responsible for the harm caused by the defective, integrated product. Id. at § 5 cmt. e. This does not, however, include liability for a component seller whose participation is limited to responsively designing a component to the buyer's expectations. See id.

Comment e further notes that those who merely provide "mechanical or technical services or advice concerning a component part" do not engage in the substantial participation necessary to subject the component supplier to liability. Id. "One who provides a design service alone, as distinct from combining the design function with the sale of a component, generally is liable only for negligence, and is not treated as a product seller." Id.

185 RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY, supra note 1, § 5 cmt. a. Comment f notes that "the mere fact that the component seller participates in the integration of a component into the design of a product," does not subject the seller to liability unless the integration causes the product to be defective and the resulting defect causes the plaintiff's harm. Id. at § 5 cmt. f. The reporters use as an example a valve manufacturer who redesigns a valve so that it can be integrated into a particular kind of tank. If the tank then fails due to reasons unrelated to the valve installation, the component seller of is not liable under § 5(b).

186 See Wright, supra note 34, at 255 (noting that manufacturers are "not willing to take on the legal liability related to subsequent use of [their] components in a temperature regime where [they have] not expended the test resources necessary to ensure the components will perform adequately").

187 See id. (distinguishing between subassembly suppliers, assembly suppliers, and system integrators, and noting that as the level of integration increases, the options available to the supplier increase, such as the option of cooling the parts in question).

188 Recall Colt and Phoenix in Woodling, 813 F.2d at 543.

189 See APEM course, supra note 25, § 8 (stating that air transport avionics is essentially a commercial enterprise centered on plastic-encapsulated-microcircuit, and listing commercial and business aircraft customers who purchase avionics equipment made with such components).
warranted by the manufacturer for 0-70°C operation and storage are being used in conditions where the temperature range may extend below 0°C or above 70°C. A further supposition is that the users test at least some of the parts for their suitability at conditions which exceed the 0-70°C range (such as -40 to +85°C).  


While such methods are useful, most manufacturers and users of electronic and electrical devices who consume piece parts in generating next-higher assemblies have distinct methods of testing and qualifying the pieces they consume and manufacture. "The organization best suited to performing uprating is the component manufacturer. The manufacturer has the design rules, knows the temperature range for which the components are designed, and has the production test vectors and equipment needed for functional and parametric testing to evaluate performance." Wright, supra note 34, at 255.

While the manufacturer may be the party best able to “uprate” components, manufacturers are not often willing to take on legal liability related to the use of components in a temperature regime where they have not expended the test resources necessary to ensure adequate performance. See id. There are greater costs associated with specifying components for use over an extended temperature range, including reduced device performance over the wider temperature range, greater marketing commitment, costlier testing, and increased warranty costs. See id. "A manufacturer who chooses not to sell components in the military temperature range has made a business decision not to incur these costs but rather to direct resources to other areas." Id.

One manufacturer handles the situation this way, as illustrated in its title page for a catalog on Dynamic RAM data devices:

Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. “Typical” parameters can and do vary in different applications. All operating parameters, including “Typicals” must be validated for each customer application by customer’s technical experts . . . . Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or
A manufacturer is liable strictly in tort for a defective product that is unreasonably dangerous. He is also liable for breaching a warranty of suitability for fitness and purpose, and is liable in negligence for a breach of any duty of care to his customers.\textsuperscript{191} Thus, a manufacturer who sells a product with a manufacturing defect, or marketing defect, may be liable under several theories of products liability.\textsuperscript{192}

\textsuperscript{191} See Prosser, supra note 75, §§ 96-98, at 681-94. Because manufacturers are anxious to reduce any liability for their products, and virtually all manufacturers of semiconductor or electrical products have warnings and disclaimers in their literature, if not placed directly on their products. These warnings can be complicated, but may also be as simple as the following two examples:

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\textsuperscript{192} See Prosser, supra note 75, § 99, at 694-702. Of course, the component manufacturer can only be liable under the Restatement (Third) if the products he furnishes are defective, or if after he substantially participates in the integra-
In order to prove a claim for a products liability action in strict liability, a plaintiff must establish that:

1) the defendant sold the product in the course of its business; 2) the product was then in a defective condition unreasonably dangerous when put to a reasonably anticipated use; 3) the product was used in a manner reasonably anticipated; and 4) the plaintiff was injured as a direct result of such defective condition as existed when the product was sold.\textsuperscript{193}

If the claim for strict liability is one for failure to warn, the elements of the cause of action must also allege that the plaintiff was injured as a direct result of the failure to warn.\textsuperscript{194} Causation has two requirements: "1) The product for which there was no warning must have caused plaintiff's injuries; and 2) the plaintiff must show that a warning would have altered the behavior of those involved in the incident."\textsuperscript{195}

The elements of a cause of action in warranty are that the product was subject to an implied warranty of merchantability, the product breached the warranty because it was defective, and the product proximately caused the plaintiff's injury.\textsuperscript{196} For negligence, a plaintiff must show that the defendant owed a duty to the plaintiff, the duty was not performed, and the breach was the proximate cause of the plaintiff's injury.\textsuperscript{197}

\textsuperscript{193} See \textit{Restatement (Third) of Torts: Products Liability}, supra note 1, § 5.

\textsuperscript{194} \textit{Jaurequi}, 971 F. Supp. at 422. \textit{ Cf. Haddix}, 138 F.3d at 683 (applying Illinois law and stating that the elements of the cause of action are that the product was in an unreasonably dangerous condition, the condition existed at the time the product left the manufacturer's control, and that injury resulted from the product's condition). Both states' laws track section 402A language closely.

\textsuperscript{195} \textit{See Jaurequi}, 971 F. Supp. at 427 (listing the elements of the cause of action under Missouri law).

\textsuperscript{196} Id.

\textsuperscript{197} \textit{See Jaurequi}, 971 F. Supp. at 431.
B. DEFENSES TO PRODUCTS LIABILITY BY COMPONENTS MANUFACTURERS.

Defenses to products liability claims include a plaintiff's failure to allege or prove, or a defendant's rebuttal of, any of the required elements of a particular claim, as outlined above. In addition, there are numerous affirmative defenses capable of defeating products liability suits. These affirmative defenses include plaintiff's conduct, especially assumption of the risk\textsuperscript{198} or misuse of a product.\textsuperscript{199} Further, preemption by government regulation may usurp a plaintiff's claim, as will a government contractor defense.\textsuperscript{200} A seller may also be relieved of liability in failure to warn cases by the rule of the learned intermediary, which limits a manufacturer's liability if it warns intermediate parties, rather than the ultimate consumer.\textsuperscript{201} A seller may also take advantage of the "sophisticated user" rule, which limits the

\textsuperscript{198} See Gary D. Spivey, Annotation, Products Liability: Contributory Negligence or Assumption of Risk as Defense Under Doctrine of Strict Liability in Tort, 46 A.L.R.3d 240 (1973) ("[c]ontributory negligence in the sense of a failure to discover or guard against product defects is not a defense to an action based upon strict products liability in tort, but that assumption of risk does constitute a defense.").

\textsuperscript{199} See Randy R. Koenders, Annotation, Products Liability: Product Misuse Defense, 65 A.L.R.4TH (1988) (stating that evidence of misuse or abnormal use of the product by someone other than the individual or entity which manufactured or supplied the product may serve to bar or diminish the recovery of an injured party or claimant in a products liability action).


\textsuperscript{201} See Talley v. Danek Med., Inc., 7 F. Supp. 2d 725, 730 (E.D. Va. 1998) (applying Virginia law) (stating that "manufacturers of prescription medical products have a duty only to warn physicians, rather than patients, of the risks associated with the use of the products"). The Restatement (Third) has a separate section dealing exclusively with these areas entitled "Liability of Commercial Seller or Distributor for Harm Caused by Defective Prescription Drugs and Medical Devices." RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY, supra note 1, § 6 (1998).

While the "learned intermediary" doctrine is mostly applied to manufacturers of pharmaceuticals, case law is developing in other areas. See generally Davis v. Cessna Aircraft Corp., 899 P.2d 26, 38 (Ariz. App. 1994) (aviation); Hayes v. Spartan Chem. Co., Inc., 622 So.2d 1352, 1354 (Fla. Dist. Ct. App. 1993) (chemicals). In Hayes, the Florida Court of Appeals observed that warnings to learned intermedias might be preferable in some situations because it would be easier to establish the adequacy of the warning as read and considered by a trained expert. 622 So. 2d at 1354. Such warnings must be accurate, clear and unambiguous, and on such an occasion, "the adequacy of a warning is a question of law for the judge to decide." \textit{Id}. 
seller's liability to purchasers who are aware of inherent dangers of products purchased for use in their business.\textsuperscript{202} A manufacturer may also plead an intervening cause as an affirmative defense, which, in products liability cases, usually means a substantial alteration of the product after it left the manufacturer's control.\textsuperscript{203}

C. Application to Components Manufacturers

A manufacturer of components or avionics may be sued for any of the causes of action discussed above. If the cause of ac-

\textsuperscript{202} See Bragg v. Hi-Ranger, Inc., 462 S.E.2d 321, 331-32 (S.C. Ct. App. 1995) (holding that a manufacturer has no duty to warn of potential risks or dangers inherent in a product if the product is distributed to either a learned intermediary or a sophisticated user). A learned intermediary or a sophisticated user is an individual who "might be in a position to understand and assess the risks involved, and to inform the ultimate user of the risks, and to, thereby, warn the ultimate user of any alleged inherent dangers involved in the product." \textit{Id.} at 331 (jury instruction).

Connecticut courts have applied the sophisticated user rule to hold that a manufacturer will not be liable if the intermediary knew or should have known of the danger, and knew or should have known of the consequences of failing to take action. \textit{See Gajewski v. Pavelo, 652 A.2d 509, 517 (Conn. Ct. App. 1994).} Thus, a manufacturer is not liable for a failure to warn an intermediary of dangers which the intermediary already knew. \textit{See id.} In \textit{Gajewski}, the Connecticut trial court defined the sophisticated user as "the person best able to take precaution against any potential harm associated with the use of the subject product." \textit{Id.} at 516.

The sophisticated user rule has also been applied to sellers of dangerous products in bulk, where the seller must rely on the buyer to warn his employees of potential dangers. \textit{See Jodway v. Kennametal, Inc., 525 N.W.2d 883, 889 (Mich. Ct. App. 1994) (absolving the seller of liability to the employees of the buyer).} The court held, as a matter of law, that the seller could have reasonably relied on the buyer to warn its employees, and applied the rationale that commercial enterprises using materials in bulk are regarded as sophisticated users. \textit{See id.} at 889. In a different opinion, the Sixth Circuit found that Ohio law did not allow for a "sophisticated user" or "learned intermediary" defense. \textit{See Midwest Specialties, Inc., v. Crown Indus. Prods. Co., 142 F.3d 435 (6th Cir. 1998).}

\textsuperscript{203} See Blizzard v. Motorola, Inc., No. 94-0207, 1995 U.S. Dist. LEXIS 4742, *10 (E.D. Pa. Apr. 10, 1995) (quoting \textit{Davis v. Berwind Corp., 640 A.2d 1289, 1295 (Pa. Super. Ct. 1994) for the proposition that a manufacturer "is not liable for injuries caused by a defective product if the defect was created by a substantial alteration in the product amounting to a supervening or intervening cause of the plaintiff's injuries").} Sued by the Philadelphia Police Department, defendant General Electric Co. claimed that the police had substantially altered a radio retransmission facility by changing the correct frequency. \textit{See id.} at *2 n.1. When General Electric motioned for summary judgment, the court found it a jury question whether a post-delivery modification constitutes substantial change. \textit{See id.} at *10-11. The court further found the question may then become whether the manufacturer could have reasonably foreseen or expected such a change. \textit{See id.}
tion is for a manufacturing defect, the truth or falsity of the allegation will be determined at trial. The court and the trier of fact decide whether the product is defective because of a manufacturing defect. In a similar manner, if a design defect is alleged, the court and the trier of fact determine whether to apply the consumer expectation test or the risk-utility test. If the suit alleges a defect in marketing, the trier of fact may focus on the product's instructions, directions and warnings to determine whether a defect existed.

204 See Michael J. Toke, Note: Restatement (Third) of Torts and Design Defectiveness in American Products Liability Law, 5 CORNELL J.L. & PUB. POL'Y 239, 241 (1996) (hereinafter Toke) (stating that in cases alleging manufacturing defects, courts can evaluate the challenged product against the manufacturer's own standards as manifested by other units in the production line).

205 See PROSSER, supra note 75, § 99, at 695; see also Toke, supra note 204, at 241 n.11 (stating that a product with a manufacturing defect will be readily identifiable because it differs from other ostensibly identical units of the same product line).

206 See PROSSER, supra note 75, § 99, at 698-99; see also Toke, supra note 204, at 246 (stating that a risk-utility balancing test will be the standard for judging defectiveness in product design with the adoption of the Restatement (Third) of Torts).

207 See Latin, supra note 174, on the various warnings and directions, and how manufacturers and consumers use and misuse them.

There is no lack of warnings accompanying electrical and electronic components. In fact, there are even specializations within the warnings. For example, there are limits to which the parts have been tested and disclaimers as to product performance, including actual performance violations of manufacturer's and third party intellectual property rights (patents), and even trademark and copyrights:

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1. Defenses to Component Defects

A supplier's first lines of defense may be that the supplier did not make the product, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective, the product was not defective, the transaction involved a service rather than a part, the product was not defective. See Clements v. Boeing, Weber Aircraft, Inc., No. Civ. A. 92-3034, 1993 WL 45086, *1 (E.D. Pa. Feb. 24, 1993) (stating that Boeing did not manufacture, supply or sell the aircraft seat which caused injury to a stewardess). Summary judgment was granted in favor of Boeing, and it was found that the airline operator had procured the seats independently. See id. at *2.

Jurisdiction may also be challenged, as was exhibited in Roethlisberger v. Tokyo Aircraft Instrument Co. (TKK) of Japan, No. 90-CV-885, 1991 WL 347671, at *1 (W.D. Mich. May 8, 1991). Beech Aircraft Corp. (Beech), one of the named defendants, claimed that the court lacked personal jurisdiction because the company had insufficient "minimum contacts" with the state of Michigan. See id. Beech maintained no office in Michigan, made no deliveries to Michigan, paid no taxes in Michigan, and did not sell the plane at issue to a Michigan purchaser. See id. Nevertheless, the court found "continuous and systematic" business contacts by Beech through its independent dealer in Michigan, visits by Beech representatives to the dealer in Michigan, a million-dollar inventory at the dealer in Michigan, and the use of the Beech trademark and trade name within Michigan. See id. at *2.

In one case, a defendant claimed to have furnished only services, not the product. See Dudley v. Business Express, Inc., 882 F. Supp. 199, 210 (D.N.H. 1994) (stating a successful defense to products liability exists when the defendants furnished transportation services, not products such as aircraft, to customers).

See Momen v. United States, 946 F. Supp. 196, 207 (N.D.N.Y. 1996) (stating that a plaintiff in a products liability case must demonstrate, at a minimum, that the product was dangerous). See also Veale v. Teledyne Indus., Inc., 899 S.W.2d 239, 239-245 (Tex. App-Houston [14th Dist.] 1995, no writ) (holding a connecting rod not defective in the crash of a Cessna aircraft which resulted in the pilot's death).
uct did not proximately cause the injury,211 or no compensable injury exists.212 Along with the "economic loss" doctrine, these defenses are available to components manufacturers, or those who assemble components into circuit boards or higher assemblies, since all those involved are either manufacturers or assemblers. Other defenses, as outlined in Section B above, will also be explored.

Possible defects in the manufacturing of electronic parts are legion.213 However, manufacturers of electronic components go to great lengths to insure the reliability of their parts, not merely for aviation, but for industrial, automotive, and general and consumer use as well.214 In fact, few cases in the products-liability literature focus on electronic or electrical defects involving substantial amounts of misuse,215 assumption of risk,216 or negli-

211 See id. (explaining that defendant successfully moved for summary judgment on the grounds that the defect could not have resulted in injury to the plaintiff). See also Aerospatiale Helicopter Corp. v. Universal Health Servs., Inc., 778 S.W.2d 492, 496-99 (Tex. App.—Dallas 1989, no writ) (observing that pilot error and subsequent conduct caused the helicopter to crash, not a product defect).


213 See, e.g., PECHT, supra note 5, at 235-237 (listing defects, failure mechanisms, failures, and their causes).

214 See id., at 325-60 (stating that the manufacturer usually qualifies products, and that those products should be qualified by the customer for specialized applications). "Qualification is the validation of a product's capability to function in its intended application." Id. at 325. Qualification may consist of many steps, including: goal-setting, determination of environmental and operational stresses, identification of failure mechanisms and modes, the conducting of tests and collection of failure rate data to assess reliability and durability of the products, and the interpretation of data and reports. See id. at 326.


216 See Gibson v. Norfolk Southern Corp., 878 F. Supp. 1455, 1462 (N.D. Ala. 1994) ("[D]ecedent knew that the warning signals often sounded and flashed in the absence of an approaching train ... [but] the decedent still assumed the risk of collision by crossing those tracks without taking the necessary precautions ... .") In Alabama, assumption of risk acts as an affirmative defense, and is a complete defense to a claim brought under the Alabama Extended Manufac-
gence involving uses that go well beyond those which the manufacturer reasonably calculated.\textsuperscript{217}

2. \textit{Product Not Defective}

The most defensible position for components manufacturers in a products liability suit is to make a product that is not defective.\textsuperscript{218} That was the defense assumed by Siemens, a company that supplied airbag components for use in General Motors cars. Sipes, the plaintiff, owned a General Motors car whose airbag did not deploy in a collision, causing serious injuries.\textsuperscript{219} The collision was one involving a side-impact, and the airbag system was only designed for a frontal or near-frontal collision.\textsuperscript{220} It was undisputed that the airbag was designed for deployment only in a frontal or near-frontal collision.\textsuperscript{221}

Siemens, supplier of a sensor used in the airbag, was granted partial summary judgment on allegations of a design defect on the grounds that it did not design the airbag system, but merely supplied parts for the airbag system.\textsuperscript{222} Siemens was also granted summary judgment on the issue of failure to warn, since the sensors were "not conspicuous to the user of the automobile."\textsuperscript{223} The court agreed that if Siemens' products conformed to its specifications there was no manufacturing defect.\textsuperscript{224}

\textsuperscript{217} See Woodling, 813 F.2d at 548 (stating that the aircraft operator was seventy percent liable for negligence).
\textsuperscript{218} See Sipes v. General Motors Corp., 946 S.W.2d 143, 159 (Tex. App. - Texarkana 1997, no writ) ("A component manufacturer who did not design a system and whose finished product conforms to the manufacturer's design standard is not liable for a fabricated defect."). This holding is completely in agreement with the spirit of the Restatement (Third) of Torts.
\textsuperscript{219} See id. at 146.
\textsuperscript{220} See id. at 147.
\textsuperscript{221} See id. at 148.
\textsuperscript{222} See id. at 159.
\textsuperscript{223} Id. at 157.
\textsuperscript{224} See Sipes, 946 S.W.2d at 159. The court did not accept Siemens' testimony as to the quality of the sensors at issue because their expert had not examined them. See id. at 160. That issue was remanded to the trial court. See id. at 161-62. The appellate court also held firm in refusing to grant the joint appellant-defendants' motions for summary judgment on the issues of design defect, implied or
3. Product Misuse

Manufacturers may escape liability if they can show that product misuse was the cause of the plaintiff's injury. An interesting example dealing with misuse of electrical components is *Erickson v. Monarch Indus., Inc.* In *Erickson*, a grain-drying facility hired a contractor to install grain-drying equipment. Later, an electrical transformer failed, causing an explosion which killed an operator. The deceased's estate sued the general contractor, the electrical contractor, and Square D Company and one of its subsidiaries, the manufacturer of the transformer. The plaintiff alleged that Square D was negligent in supplying a defective transformer, failing to test the transformer, and failing to give proper warnings. The trial court returned a verdict against the contractors who had miswired the transformer, but found no liability on the part of Square D.

The transformer was designed to be wired in several different ways. But, because the manufacturer's instructions were included with the transformer, and it was supplied to those who would have special knowledge as to how to install the transformer, the court concluded that the supplier had no additional duty to warn. In affirming the lower court's decision, the Nebraska Supreme Court held it was only because of improper wiring and installation that the transformer could cause any hazard. The court also noted that Square D had supplied an express warranty, negligence, or failure to warn. See *id.* at 156-59. The court held that only Siemens was entitled to partial summary judgment on the issues of warnings and design. See *id.* at 157, 159.

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225 347 N.W.2d at 99.
226 *Id.* at 104.
227 See *id.*
228 See *id.*
229 See *id.*
230 See *id.*
231 See *Erickson*, 347 N.W.2d at 104. The manner in which the defendant electrical contractor wired the transformer caused a 50-percent overload on the transformer, that resulted in overheating, the introduction of flammable gases into the electrical cabinet, and an explosion from an electrical arc when the main disconnect switch was thrown. See *id.* at 104-05.
232 See *id.* at 109. In a variation of the "sophisticated user" defense, the court held that it "was not reasonably foreseeable that a consumer of particular expertise would fail to follow directions." *Id.* (citing Hughes v. Magic Chef, 288 N.W.2d 542 (Iowa 1980)).
233 See *id.* The court cited other jurisdictions on this point. "A manufacturer or supplier is not required to warn about every conceivable danger that might arise from a misuse of the product." *Id.* at 109 (citing Westerberg v. School Dist. No. 792, 148 N.W.2d 312, 315 (Minn. 1967)). "Failure to follow plain and unam-
transformer with instructions and directions, and that if the transformer had been installed, wired and fused in accordance with those instructions and directions, “there would not have been an accident.”

*Erickson* dealt with user misuse, in a manner very similar to that encountered in the first case discussed in this Comment, *Woodling v. Garrett Corp.* The electricians in *Erickson* miswired a transformer, thus causing the operator’s death. In much the same way, it appears the miswiring of the Texasgulf aircraft electrical system in *Garrett* was the cause of the generator tripping, and ultimately, the crash of the aircraft.

Biguous instructions is a misuse of the product.” *Id.* (citing Proctor & Gamble Mfg. Co. v. Langley, *on reh’g*, 422 S.W.2d 773 (Tex. Civ. App. 1967)).

234 *Erickson*, 347 N.W.2d at 109.
235 813 F.2d at 543.
236 347 N.W.2d at 104.

While *Garrett* and *Erickson* are good examples of misuse, the defense is not always honored. In Philadelphia, a fire-house boiler exploded, killing one firefighter and severely injuring two others. *See Dougherty v. Edward J. Meloney, Inc.*, 661 A.2d 375, 378 (Pa. Super. Ct. 1995). This products liability suit joined numerous defendants, including the gas supplier (Philadelphia Gas Works), the fire station architect, the heating system installer, the boiler manufacturer, the controller manufacturer, and the manufacturer of the automatic gas safety shut-off valve, which should have prevented the explosion. *See id.* at 378-80.

There was evidence that the firefighters knew that the boiler’s valve did not work, that it was missing parts, and that it had to be unscrewed and tapped on in order to operate. *See id.* at 379. Further, the valve was known to stick on occasion. *See id.* Two weeks before the explosion, the valve became stuck in the open position twice, causing the boiler to overheat. *See id.* A serviceman from Philadelphia Gas Works fixed the valve once by bending it with pliers. *See id.* The second time, however, the serviceman informed the fire station captain that the valve needed to be replaced, but neglected to mention that the boiler could not be operated safely. *See Dougherty*, 661 A.2d at 379. The cost of replacing the valve was approximately $300. *See id.*

The trial court found the valve manufacturer liable for approximately $8 million, and the Superior Court of Pennsylvania affirmed. *See id.* at 380, 388. The court held “it was unforeseeable that the valve cap would be removed and the armature would be tapped when the valve was stuck.” *Id.* at 386. In other words, the court did not find that the failure of the Philadelphia Gas Works to replace the valve was a superseding and intervening cause because the negligent acts must be “so extraordinary as not to have been reasonably foreseeable.” *Id.* at 387 (quoting Powell v. Drumheller, 653 A.2d 619, 623 (Penn. 1995)). A possible explanation for the court not holding Philadelphia Gas Works liable may be that the city owned the utility. *See Andrew Maykuth, Heat is on Gas Works, Philadelphia Inquirer*, Feb. 18, 1996, at 1 (stating that Philadelphia Gas Works is a municipal utility, and thus city-owned).
Contributory negligence has been rejected as a defense to products liability claims in favor of comparative negligence, or assumption of risk. In California, a drunk-driving case showed how the user's negligence can be a defense to product defects.\footnote{Daly v. General Motors Corp., 575 P.2d 1162 (Cal. 1978).} In Daly, an attorney crashed his car into a metal divider fence on a Los Angeles freeway.\footnote{Id. at 1164.} The force of the impact threw open the car door and ejected the driver, resulting in fatal head injuries.\footnote{See id.} Neither party disputed that the injuries would have been minor had he remained in the car.\footnote{See id.} His estate sued under a strict liability theory for a defectively designed door latch on the grounds that the latch should not have come open during the crash, and that, but for the latch, the decedent would not have died.\footnote{See id.}

The defendant pointed out that the deceased was intoxicated, that the car was equipped with both a seat belt-shoulder harness system and a door lock, and that the operator's manual contained warnings that the seat belts should be worn with the doors locked while the car is in motion. The deceased used neither the harness system nor the door lock.\footnote{See id. at 1165.} The jury returned a verdict for the defendants, and the California Supreme Court affirmed, applying the principles of comparative negligence in strict liability actions.\footnote{See Daly, 575 P.2d at 1175.} The effect was positive, in that comparative negligence does not completely bar a plaintiff's claim, while contributory negligence in a products liability case bars recovery.\footnote{See id. at 1169. In a dissenting opinion, Justice Mosk takes umbrage at the change the majority is invoking in the present case calling the decision a "dark day" for the court. Id. at 1185. Justice Mosk continues to believe, as he did in Greenman, that the tort of negligence is a "foreign object" in that of products liability. See Daly, 575 P.2d at 1181. Moreover, he asserts one assumes the risk if one chooses to use a product that is patently defective when there are other alternatives available, or if one chooses to use a product in a manner in which it was clearly not intended to be used. See id. at 1185. That is, "[o]ne who employs a power saw to trim his fingernails—and thereafter finds the number of his fingers reduced—should not prevail to any extent whatever against the manufacturer even if the saw had a defective blade." Id. at 1185. Hence, Justice Mosk argues...}
Contributory negligence, which consists of voluntarily and unreasonably proceeding to encounter a known danger, and is often referred to as assumption of risk, is a defense under section 402A; but contributory negligence, which consists of a mere failure to discover the defect, or guard against its existence, is not a defense.\textsuperscript{246} Under section 402A, then, contributory principles apply, in that if the user or consumer discovers the defect and nevertheless proceeds unreasonably to make use of the product and is injured by it, the user is barred from recovery.\textsuperscript{247} Comparative negligence provides a better measure of fairness in products liability cases.\textsuperscript{248}

As for electronic components, a component manufacturer will likely argue that a user assumed the risk of product failure by using a component beyond the temperature ranges specified by the manufacturer.

5. Preemption

A preemption defense normally calls for the application of federal over state law,\textsuperscript{249} and there are also cases in which the law of contracts preempts tort law.\textsuperscript{250} The principal law available

\textsuperscript{246} See § 402A, \textit{supra} note 13, cmt. n.

\textsuperscript{247} See id.

\textsuperscript{248} See Daly, 575 P.2d at 1175 (stating that by extending and tailoring the principles of comparative negligence to the doctrine of strict liability, we move closer to the goal of equitable allocation of legal responsibility for personal injuries).

\textsuperscript{249} See \textit{John W. Wade et al., Prosser, Wade and Schwarz's Cases and Materials on Torts}, CH. XV, at 791 (9th ed. 1994) ("State law is preempted by federal law, and as a practical matter, the manufacturer need comply only with the federal statute and the regulations issued under it."). State law is preempted when the federal government, under the supremacy clause, has a unique interest and must complete government work. \textit{See Boyle v. United Techs. Corp.}, 487 U.S. 500, 505 (1988). In \textit{Boyle}, the Court stated that federal control may be justified by the Constitution, the laws of the United States, and even "federal common law" (federal law of a content prescribed by the courts) to replace and preempt state law. \textit{Id.} at 504.

\textsuperscript{250} See Larry D. Scheafer, Annotation, \textit{Pre-Emption of Strict Liability in Tort by Provisions of UCC Article 2}, 15 A.L.R.4th 791 (1982 and Supp. 1998). The annotation collects cases in which courts have at least discussed whether Article 2 of the Uniform Commercial Code (UCC) preempts the doctrine of strict liability in tort for products liability cases. \textit{See id.} The author notes that the doctrine of strict liability in tort developed about the same time as the law relating to the sales provisions of the UCC. \textit{See id.} at 792. The best argument for separate liability may be that strict liability has its foundation in tort, rather than in contract, and therefore, the UCC does not preclude tort actions. \textit{See id.} Proponents of preemption argue that strict liability in tort acts to undermine remedies provided to
to aviation products liability suits is the General Aviation Revitalization Act (GARA) of 1994.\(^{251}\) Both the preemption defense and GARA applied in the case of a helicopter crash involving two fatalities which were caused by an allegedly defective engine compressor vane.\(^{252}\) The engine was delivered in August 1975 and the crash took place in November 1993, after the eighteen-year period prescribed by GARA.\(^{253}\) The court held that GARA applied, and barred the plaintiff's suits against the helicopter and engine manufacturers.\(^{254}\)

The plaintiffs attempted to extend the liability period by claiming that periodic bulletins and manuals issued by the manufacturers extended the period under GARA.\(^{255}\) The court reviewed case law and state preemption statutes throughout the country and concluded that the publications did not extend

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251 48 U.S.C.A. § 40101 et. seq. (1994) Federal law supersedes any state law to the extent that such law permits a civil action to be brought after an eighteen-year period:

No civil action for damages for death or injury to persons or damage to property arising out of an accident involving a general aviation aircraft may be brought against the manufacturer of the aircraft or the manufacturer of any new component, system, subassembly, or other part of the aircraft, in its capacity as manufacturer if the accident occurred—

(1) after the applicable limitation period [18 years] beginning on—

(A) the date of delivery of the aircraft to its first purchaser or lessee, if delivered directly from the manufacturer; or

(B) the date of first delivery of the aircraft to a person engaged in the business of selling or leasing such aircraft; or

(2) with respect to any new component, system, subassembly, or other part which replaced another component, system, subassembly, or other part originally in, or which was added to, the aircraft, and which is alleged to have caused such death, injury, or damage, after the applicable limitation period beginning on the date of completion of the replacement or addition.

Id. (quoting GARA's historical and statutory notes).


253 See id. at 533, 536.

254 See id. at 542.

255 See id. at 537.
GARA. GARA clearly prohibits a lawsuit arising from design or manufacturing defects in an aircraft delivered more than eighteen years before the accident. The court reasoned that a failure to warn or an incorrect statement in a manual is also barred after the eighteen-year period because such a suit would be a "back door to sue for the design [or manufacturing] flaw." The court found plaintiff's argument inconsistent with the spirit and intent of GARA, and granted summary judgment for the defendants.

Perhaps the most subtle preemption defense is one like that was brought by the defendants in *Gregory v. Garrett*, a case related to *Woodling v. Garrett*. In *Gregory*, the workman's compensation issue turned on which entity employed the eight deceased individuals, and, thus, which state's law applied. The court considered whether ostensible employees of Texasgulf Aviation were actually employees of Texasgulf, Inc., the 100% shareholder of Texasgulf Aviation. Of the eight people killed, four were residents of Connecticut who worked in Connecticut, while two were residents of Connecticut who worked in New York. The remaining two were residents of North Carolina who worked in North Carolina. Under both North Carolina and Connecticut workman's compensation laws, Texasgulf, Inc. was immune from direct liability.

In addition to being defenses against direct liability, Connecticut and North Carolina workman’s compensation laws discourage third-party impleading actions. The plaintiffs, therefore, had to be creative in their suits. They wanted New York law to apply because they preferred New York's pro-third-party ap-

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256 See id. at 538-40, 541.
257 Id. at 541.
259 See id. at 542.
260 578 F. Supp. at 871.
261 813 F.2d at 543.
262 578 F. Supp. at 879-80.
263 See id. at 876.
264 See id. at 875. The flight began in New York, went to Toronto, Ontario, Canada, and returned to New York, the site of the crash. See id. at 875.
265 See id. at 876 (citing CONN. GEN. STAT. ANN. § 31-284 (a) (1972), and N.C. GEN. STAT. § 91-10.1 (1979)).
266 See id. at 879. In such an action, the plaintiffs could sue other defendants such as Garrett Corp., who would then implead Texasgulf, Inc. or Texasgulf Aviation, or both. Thus the plaintiffs could achieve indirectly what they could not directly accomplish. See id.
The district court analyzed the conflict of laws issue and decided that New York law applied because the crashed occurred in New York.\(^{268}\)

The preemption defense also applies when there is a federal law that prohibits the states from enacting statutes relating to a particular good. Thus preemption applies in the case of medical devices\(^{269}\), insecticides,\(^{270}\) and automobiles.\(^{271}\) One example is tampon products liability covered by the Medical Device Amendments of 1976 to the Federal Food, Drug, and Cosmetic

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\(^{267}\) See Gregory, 578 F. Supp. at 879.

\(^{268}\) See id. at 881. The “most significant contacts” factors considered in an action for a tort (negligence) include the state in which the injury occurred, the state in which the conduct causing or injury occurred, the domicile or place of business of each party, and the state in which the relationship between the parties is centered. See id. at 881 (citing RESTATEMENT (SECOND) OF CONFLICT OF LAWS § 145 (b)(2) (1971)).

\(^{269}\) See Federal Food Drug and Cosmetic Act, as amended by the Medical Device Amendments of 1976:

Except as provided in subsection (b) of this section, no State or political subdivision of a State may establish or continue in effect with respect to a device intended for human use any requirement—

(1) which is different from, or in addition to, any requirement applicable under this chapter to the device, and

(2) which relates to the safety or effectiveness of the device or to any other matter included in a requirement applicable to the device under this chapter.


\(^{270}\) See Federal Insecticide, Fungicide, Rodenticide Act:

(a) A State may regulate the sale or use of any federally registered pesticide or device in the State, but only if and to the extent the regulation does not permit any sale or use prohibited by this subchapter. (b) Such State shall not impose or continue in effect any requirements for labeling or packaging in addition to or different from those required under this subchapter.


\(^{271}\) See National Highway Traffic Safety Administration Authorization Act:

When a motor vehicle safety standard is in effect under this chapter, a State or a political subdivision of a State may prescribe or continue in effect a standard applicable to the same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this chapter. However, the United States government, a State, or a political subdivision of a State may prescribe a standard for a motor vehicle or motor vehicle equipment obtained for its own use that imposes a higher performance requirement than that required by the otherwise applicable standard under this chapter.

For instance, the Act mandates that particular warnings be placed on each box of tampons, and if the plaintiff reads the warnings and is aware of a risk, the Act preempts any state law claim of failure to warn. In addition, the Act preempts any state law claim regarding a failure under the “consumer contemplation” test. Some federal statutes, however, as is the case with environmental laws, do enable suits rather than preempt them.

While there may not be a specific preemption defense available to the manufacturer of electronic components, a variety of such defenses are applicable as shown in the following section, and diligent products liability advocates should familiarize themselves with these possibilities.

6. Government Contractor Defense

The government contractor defense is a special type of preemption or immunity defense wherein the contractor may claim that government requirements preclude liability in civil court,

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272 See Haddix, 138 F.3d at 683.
273 See id.
274 See id. at 686. A product fails the consumer contemplation test when it is “dangerous to an extent beyond that which would be contemplated by the ordinary consumer who purchases it, with the ordinary knowledge common to the community as to its characteristics.” Id. (quoting Hunt v. Blasius, 384 N.E.2d 368, 372 (Ill. 1978), reh'g denied) (1979)).
275 Citizen suits are specifically allowed under provisions of the Consumer Product Safety Act. Section 2072(a) states the following:
   Any person who shall sustain injury by reason of any knowing (including willful) violation of a consumer product safety rule, or any other rule or order issued by the Commission may sue any person who knowingly (including willfully) violated any such rule or order in any district court of the United States . . . .

Section 2073 states: “[a]ny interested person (including any individual or nonprofit, business, or other entity) may bring an action in any United States district court . . . .” 15 U.S.C. § 2073 (1994).

Section 2074(a) states that “[C]ompliance with consumer product safety rules or other rules or orders under this chapter shall not relieve any person from liability at common law or under State statutory law to any other person.” 15 U.S.C. § 2074(a) (1994).

especially in matters relating to safety. In Boyle, a Marine Corps pilot drowned when his helicopter crashed during a training exercise. He could not escape from the craft because the escape hatch opened outward and was useless under water. His father sued, alleging defective design of the escape system and defective repair of the servo, a device in the automatic flight control system that caused the crash. Sikorsky, the helicopter manufacturer, claimed immunity from tortious liability under the government contractor defense.

The Court held that it was in the government’s interest to carve out federal preemption of state law to complete government work, whether through federal officials or government contractors. The grounds for preemption under this defense must be that unique federal interest exists where the application of state law frustrates the specific objectives of federal policy. That interest may extend to limit the liability of federal officials for acting in the course of their duties and even, as in Boyle, to limit the liability to third persons in tort arising from performing a government contract. The preemption may be authorized by the U.S. Constitution, the laws of the United States, or through federal law prescribed by the courts without explicit statutory authority—the “federal common law.” The Court found a significant conflict between Virginia state law and the needs of the federal government in this situation, and that a state law presenting a significant conflict with federal policy must be displaced.

The Court did not want to limit liability for every stock item that the government ordered but wanted to limit this defense to situations when officials exercised discretion in ordering military equipment. To that end, the Court held that liability for

276 See Boyle, 487 U.S. at 511 (stating that “the selection of the appropriate design for military equipment to be used by [the] Armed forces” involves balancing and tradeoffs, especially between military effectiveness and safety).
277 Id. at 502.
278 See id.
279 See id. at 503.
280 See id.
281 See id. at 504-05.
282 See Boyle, 487 U.S. at 507. The fact that the area in question is one of unique federal concern changes what would otherwise be a conflict that cannot produce preemption into one that can. Id. at 508.
283 Id. at 505.
284 Id. at 504.
285 See id. at 511-12.
286 See id. at 509-11.
design defects in military equipment could not be imposed pursuant to state law "when (1) the United States approved reasonably precise specifications; (2) the equipment conformed to those specifications; and (3) the supplier warned the United States about the dangers in the use of the equipment that were known to the supplier but not to the United States."  

As applied to electronic parts, or "uprated" electronic parts, the government contractor immunity defense is available if the parts are furnished under a military specification. For the defense to apply, the government must do more than "rubber stamp" the designs, and the required warnings must be communicated to the government in a reasonably effective manner. A contractor will not be liable if it communicates everything it knows, but there is no duty to warn of open and obvious dangers. In sum, a successful defense includes both an approved design and a warning to the government.

7. Learned Intermediary Defense

A manufacturer may assert the "learned intermediary" defense on the grounds that the product and the warning are supplied to a specialized class of people who may prescribe or administer the product. Although the defense is usually applied in medical products cases, it has been successfully raised in the aircraft industry, as exemplified by a suit against Cessna and the firm supplying its aircraft's engine.  

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287 Boyle, 487 U.S. at 512.
288 See id. (stating that the defense applied if the government furnished reasonably precise specifications.)
289 See Tate v. Boeing Helicopters, 140 F.3d 654, 657 (6th Cir. 1998).
290 See id. at 660.
292 See id. at 352.
293 See Butler v. Ingalls Shipbuilding, Inc., 89 F.3d 582, 586 (9th Cir. 1996) (applying California law) (stating that the government contractor's defense may be used to trump a design defect claim by proving that the government, not the contractor, is responsible for the defective design; but defendants in a "failure to warn" claim must show that they were acting in compliance with "reasonably precise specifications" imposed by the United States).
294 See Davis, 893 P.2d at 38.
295 See id. at 29. The Restatement (Third) of Torts addresses the liability of a commercial seller or distributor for harm caused by defective prescription drugs and medical devices. The portion which relates to foreseeable harm of a drug or medical device states that a drug or device is not reasonably safe if the risk of harm is sufficiently great, relative to its foreseeable therapeutic benefits, that knowledgeable health care providers would not prescribe the drug or medical
crashed when a defect in the fuel system caused the engine to fail.\textsuperscript{296} The plaintiffs claimed that the engine did not have a proper line for venting vapor, causing vapor lock and flooding the engine.\textsuperscript{297}

In response to plaintiff's claims, the engine maker adopted the learned intermediary defense, claiming that Cessna knew what would happen if the aircraft were refueled at a sufficiently high pressure. As evidence of Cessna's awareness of this danger, the engine maker cited its warning to Cessna about the potential danger of refueling at high pressures.\textsuperscript{298} Cessna also demonstrated awareness of the potential dangers of high-pressure fuel by installing a microswitch to prevent the auxiliary pump from pumping fuel at too high a pressure.\textsuperscript{299} Based on this evidence, the court granted summary judgment in favor of the engine manufacturer.\textsuperscript{300}

As applied to electronics components, no one seriously argues that makers of diodes and transistors should be liable for their applications in aircraft computers or navigation equipment unless for any class of patients. \textit{See} \textit{Restatement (Third) of Torts: Products Liability, supra note} 1, § 6(c).

\textsuperscript{296} \textit{See} \textit{Davis}, 893 P.2d at 30. An auxiliary fuel boost pump was able to exceed the engine's prescribed fuel inlet pressures which could have led to flooding of the engine. \textit{See id. at} 38.

\textsuperscript{297} \textit{See id. at} 37-38 (stating that the engine manufacturer should have foreseen that the aircraft manufacturer might add such a pump and should have warned against it).

\textsuperscript{298} \textit{See id. at} 38.

\textsuperscript{299} \textit{See id.}

\textsuperscript{300} \textit{See id. at} 39. Arizona honored the learned intermediary defense in \textit{Davis}. However, since the doctrine is so firmly rooted in medical and pharmaceutical products, other courts have declined to extend the doctrine beyond those products. For instance, a maker of hydraulic valves was denied the defense under Massachusetts law. \textit{See} \textit{Officer v. Teledyne Republic/Sprague}, 870 F. Supp. 408, 410 (D. Mass. 1994) (stating that the learned intermediary rule presupposes the predictable existence of such an intermediary, and noting that the defendant manufacturer's products were widespread, with the particular intermediary in this case being "a complete fortuity").

Texas also refuses to extend the learned intermediary rule to products other than prescription drugs. \textit{See} \textit{Khan v. Velsicol Chem. Corp.}, 711 S.W.2d 310, 313 (Tex. App.—Dallas 1986). In \textit{Khan}, the defendant Velsicol supplied dangerous chemicals to a maker of termicide, Miss Phoebe's Pest Control, Inc., whose customer was injured by a product made with Velsicol's products. \textit{Id. at} 312. The court recognized that the supplier of a bulk chemical had no practicable method of warning the consumer or giving it instructions concerning the safe use of the product. \textit{See id. at} 314. For these reasons, the court found Velsicol could only escape liability to the consumer if it gave adequate warning or instructions to Miss Phoebe's. \textit{See id.}
less the component manufacturer substantially participated in the design and application to that equipment. Nevertheless, the makers of avionics and similar equipment are learned intermediaries, and can be held liable as such.

8. **Sophisticated User Defense**

The "sophisticated user" defense limits a seller's liability to employers who are aware of the inherent dangers of products purchased for use in the employer's business.\(^{301}\) As applied to components, a component manufacturer has no duty to warn (and no liability) if the user or installer knew or should have known of a dangerous condition and of the consequences of failing to correct the condition.\(^{302}\) The buyer's use of the product may have sufficiently transformed the product into something beyond what the seller furnished,\(^{303}\) and such modification may arguably have changed the product sufficiently to make the seller not liable for defects that did not exist when the product left its possession.\(^{304}\)

In *Gajewski*, a homeowner suffered permanent injury from carbon monoxide poisoning caused by improper ventilation in the furnace flue.\(^{305}\) The court found no duty on the part of the furnace manufacturer to warn the homeowner, reasoning that the installer was best able to prevent harm associated with the use of the product.\(^{306}\) Applying the sophisticated user doctrine, the court also found no manufacturer duty to warn the installer

\(^{301}\) See *Bragg*, 462 S.E.2d at 331-32.


\(^{303}\) See *Torres v. Xomox Corp.*, 56 Cal. Rptr. 2d 455, 468 (Cal. Ct. App. 1996).

\(^{304}\) See *id.* (citing *Daly*, 575 P.2d at 1162 and *Moerer v. Ford Motor Co.*, 129 Cal. Rptr. 112 (Cal. Ct. App. 1976)). Note that section 402A of the Restatement (Third) of Torts limits liability to instances where the product "is expected to and does reach the user or consumer without substantial change in the condition in which it is sold." § 402A(1)(b), *supra* note 13. Comment q to section 402A states that manufacturer liability for component parts assembled into a product terminates when that component is incorporated, especially where there is no change to the part itself.

Such a defense was precluded in the case of a shotgun which discharged accidentally, injuring a hunter. See *Klonowski v. International Armament Corp.*, 17 F.3d 992, 993 (7th Cir. 1994) (applying Wisconsin law). The shotgun fired because a component was defective, allowing the gun to fire even with the safety on. See *id.* at 994. The court held that the defendant was not entitled to the "substantial change" defense because the product was defective and unreasonably dangerous when it left the manufacturer's control. See *id.* at 997.

\(^{305}\) *Gajewski*, 652 A.2d at 511.

\(^{306}\) See *id.* at 516 (echoing a learned intermediary defense).
if the installer or his employees already knew of the danger and the consequences.\textsuperscript{507}

An allegedly defective valve in a chemical line in \textit{Torres} caused two workers to be doused with sulfuric acid sludge, killing one and severely burning the other.\textsuperscript{508} At issue were the design of the valve and the furnishing of a replacement part for the valve.\textsuperscript{509} Among other defenses, Xomox claimed that it would have been impossible for it to communicate directly with the thousands of valve users, and that additional warnings were not required because its users were sophisticated.\textsuperscript{510} The trial jury did not accept this argument because there was no evidence of written warnings concerning the use of the valves and possible dangers with the valves.\textsuperscript{511}

The sophisticated user defense also applies to electronic components. Such components are not normally dangerous to their users (assemblers and installers) but may become dangerous if used inappropriately. A component manufacturer can best preserve this defense by furnishing nondefective products and explicitly noting the temperature or other environmental conditions which are necessary for successful operation of its components.

9. \textit{Intervening Causes}

The intervening cause defense commonly alleges that a part was substantially altered after the product left the manufacturer's control.\textsuperscript{512} In \textit{Torres}, one of the issues was whether the admitted modification was sufficient to constitute a concurrent or superseding cause of the injury.\textsuperscript{513} The record did not indi-

\begin{itemize}
\item \textsuperscript{507} See \textit{id.} at 517 Under Connecticut law, the "sophisticated user" is not so much an affirmative defense as an element of the case to be weighed in the aggregate by the trier of fact. See \textit{id.}
\item \textsuperscript{508} \textit{Torres}, 56 Cal. Rptr. 2d at 459.
\item \textsuperscript{509} See \textit{id.} at 461.
\item \textsuperscript{510} See \textit{id.} at 468.
\item \textsuperscript{511} See \textit{id.}
\item \textsuperscript{512} See Blizzard, 1995 U.S. Dist. LEXIS at *10. While an intervening cause does not absolve a defendant's actions, courts will recognize a limit to a defendant's liability when causes of independent origin bring about the harm to which the defendant's conduct has substantially contributed. See \textit{PROSSER, supra} note 75, at 301. Prosser defines an intervening cause as one that comes into active operation in producing the result after the defendant's negligence. See \textit{id.}
\item \textsuperscript{513} \textit{Torres}, 56 Cal. Rptr. 2d at 465 (arguing that there was no liability for a design defect because the defect, if any, did not exist when the valve left Xomox's possession).
\end{itemize}
cate that there was a modification sufficient to be the sole cause of the accident. 314

One court has held that the alteration of a molding machine, allowing a worker access to pinch points, was an intervening cause. 315 However, another court found no superseding cause in the case of an informal drawing to which strict conformity was not required. 316 In Pasquale, only an informal, unsophisticated drawing was used for the housing of a clutch mechanism on a racing car; when the clutch burst, the housing did not contain the exploding parts, killing a racing spectator. 317

There was no substantial alteration of the product in the case of the Lockheed Jetstar crash. 318 In Woodling, the defendant GCU manufacturer and installer argued that the conduct of the plane operators was a supervening cause sufficient to relieve it of its liability in the airplane crash and the death of eight men. 319 The court cited recent New York law holding that reckless, intentional, and even criminal intervening acts are not superseding causes when they are foreseeable. 320 The court stated that neither Garrett nor Phoenix gave any warnings or provided any protections that the deceased ignored or refused to follow. 321

Almost every electronic component will be used in an assembly of some kind, whether a circuit board, a higher assembly or other application. Component manufacturers should give clear

314 See id. at 466. Comparative fault reduced Xomox's liability to five percent. See id. at 459.


316 See Pasquale v. Speed Prod. Eng'g, 654 N.E.2d 1365, 1375 (Ill. 1995). As to the difference between intervening and superseding causes, Prosser states that the question in a case of an intervening force is whether the defendant is to be relieved of responsibility and the defendant's liability superseded by a subsequent event. See Prosser, supra note 75, at 302.

317 Pasquale, 654 N.E.2d at 1369-70. While design was the issue in Woods and Pasquale, another case involving a farm implement concerned failure to warn in which the defendant claimed a superseding, intervening cause. See Jauréqui, 971 F. Supp. at 422. The court noted that the corn head at issue had been painted over twice, and found that the plaintiff had not raised a factual issue for trial concerning proximate cause of his injuries. See id. at 430-431 (stating that the plaintiff attempted to assert that he was not aware of specific areas of danger within the corn head, but had been verbally warned by his supervisors on several occasions just prior to the accident that he should never go in front of the corn head near the region of the snouts).

318 See Woodling, 813 F.2d at 543.

319 See id. at 554-55.

320 See id. at 556.

321 See id.
warnings and directions for the use of their products. If a component must be used only in certain ways, if a component must not be altered in some particular manner, or if a component must not be used under conditions or temperatures the manufacturer considers inappropriate, the manufacturer should indicate as much in its literature. The defense of supervening cause would then be available for the component manufacturer in a products liability suit.

VI. CONCLUSION

It goes without saying that a component manufacturer can best avoid liability by furnishing parts without defects. There is no liability if a component part is not defective. A component manufacturer who does not design a system into which the parts are assembled and whose finished product conforms to the manufacturer’s own standards is not liable for a defect in that system. To avoid suits over failure to warn, a component manufacturer should give adequate warnings and directions concerning the uses and limitations of his products. If those components are used beyond the manufacturer’s specifications, a variety of defenses are available to the manufacturer. These include product misuse, assumption of risk, preemption, government contractor defense, learned intermediary and sophisticated user defenses, and intervening causes. No defect in the product, however, remains the best defense.

These principles hold in the main case cited in this comment, Woodling v. Garrett Corp. The jury assessed liability against the owner and operator of the aircraft, Texasgulf Aviation, at 70%. Garrett Corp., installer of the generator control units

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322 See § 402A, supra note 13 (stating that a seller is subject to liability only if his products are in a defective condition unreasonably dangerous to the user or consumer); Restatement (Third) of Torts: Products Liability, supra note 1, § 5 cmt. a (stating that component sellers should not be liable when the component itself is not defective).

323 See Sipes, 946 S.W.2d at 159; Restatement (Third) of Torts: Products Liability, supra note 1, § 5 (b) (stating that the seller or distributor of the component is liable only if she substantially participates in the integration of the component into the design of the product, and the integration of the component causes the product to be defective, and the defect in the product causes the harm).

324 See Latin, supra note 174, at 1196. Latin believes that manufacturers could make products safer and that manufacturers sometimes use labels and warnings in lieu of, rather than in addition to, safer products. See id.

325 813 F.2d 543 (2d Cir. 1987).

326 See id. at 548.
on the aircraft, was found 20% liable for negligent installation of the generator control units.327 Phoenix Aerospace, Inc. designed and manufactured the generator control units and was held only 5% liable.328 The systems designer, Colt Electronics Co., was also found liable to the extent of 5%.329

The court noted that Texasgulf Aviation's appeal focused not on issues of fact related to the operation of the aircraft and the crash but rather on whether its liability was muted by worker's compensation immunity and a release signed by Mrs. Woodling.330 Phoenix Aerospace and Garrett pinned their appeal hopes on the allegedly supervening conduct of Texasgulf Aviation.331 However, the court found that neither Garrett nor Phoenix had warned Texasgulf Aviation, and when Texasgulf Aviation continued to operate the aircraft under such conditions, Garrett should have known that the operator would be unable to determine whether the problem was solved.332 Colt did not appeal the finding of its negligence with respect to the preparation of the installation drawings.333

Woodling is a cautionary tale in many ways. Ambiguity in the installation drawings or defects in adaptation of the units for the aircraft provided sufficient evidence upon which the court found Colt negligent. This negligence may have consisted of failure to warn, a failure that also applied to both Garrett and Phoenix. The court found liability for all three defendants in spite of a common-sense feeling that Texasgulf Aviation assumed an extraordinary risk of flying under the following conditions: bad weather, multiple failures of necessary equipment and a procession of skilled aviation personnel who refused to fly the aircraft. Courts will not hesitate to find liability even for small components, if those components are defective and they cause harm.

327 See id.
328 See id.
329 See id.
330 See id. at 549.
331 See Woodling, 813 F.2d at 554.
332 See id. at 555-56.
333 See id. at 549.