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Injuries From Electronic Power Sources

Charles H. Grace and Sheila M. Kahoe***

IN 1969, THE MANUFACTURING of electronic products for home use alone, was estimated to be a five billion dollar a year business. This figure is more than double the amount of five years ago. Economists predict that before 1975 this figure will be close to ten billion dollars.¹ New electronic devices will give rise to litigation just as X-ray machines and radios did in their early days.

The principles of law applicable to electronic product liability cases are basically the same as those applicable to other types of products, but characteristics of these new devices will give the electronics cases some unique features.

In order to understand how the existing products liability law applies to electronic products, it is necessary to examine the methods by which such products are distributed, and the manufacturers' attitude toward the inclusion of safety devices in the production of these products. The four characteristics of electronic products that most affect their legal treatment will be identified and discussed, and the three principal theories most often used for the prosecution of products liability cases will be described herein, with emphasis on the features most likely to be involved in electronic cases.

Electronic Products and Their Hazards

In the last few years the consumer has been introduced to a variety of new electronic appliances and devices. Microwave ovens which cook food in a fraction of the time required by conventional ovens are one typical example. Electrostatic air cleaners which eliminate the need for dusting the house and also remove some allergens from the air are growing more popular as they become less expensive. Electronic garage door openers are already commonplace, and electronic headlight dimmers which detect the approach of oncoming traffic by the light from oncoming headlights and automatically switch their own vehicle's headlights to low beam have been available for several years as an optional accessory for automobiles.

In the field of recreational electronics such items as color television and electronic recording equipment are now in general use. Another popular electronic product is the depth finder used by fishermen as a

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¹ Furniture That Does Everything, 99 *Forbes Magazine* 30 (March 15, 1967).

fishing aid and to safeguard their boats against running aground. A great surge is expected in the recreational and communications area in the next few years as products such as three-dimensional television, TV-videotape recording equipment and picture phones are introduced.

A vitally important product field is that of medical electronics. Electronic pacemakers for the heart are now widely used. These tiny instruments, surgically implanted in the body, supply electronic signals to the heart to regulate the heart beat. Laser beams are now used to perform operations on the retina of the eye by the burning of the retina in a controlled manner, and hypersonic generators (sometimes called ultrasonic) for the treatment of bursitis and other ailments are used in hospitals, doctors' offices and some homes.

Hypersonic generators have also found use in cleaning small articles such as spectacles, false teeth, surgical tools and tableware. High voltage is required for the transducer which is used to convert electronic power to sound power. The hypersound itself can injure a hand held inside the generator tank for a few seconds.

Still in the experimental stage are several psychological electronic devices. Scientists have found that a person's mood may be affected by the nature and extent of atmospheric ionization. The polarity and concentration of ions in the air can be controlled by ion generators. High voltages are required for their operation. Experiments are also being conducted with a small electronic device which is intended to be worn by mental patients. The device transmits electronic signals to the patient's brain and dramatically eliminates feelings of depression, although the signals are not consciously felt by the patient.

Some Recognized Dangers

With advanced technology spewing new electronic products onto the market at an increasing rate, there has been a growing concern for public safety in light of possible dangers inherent in the new devices. Like electrical products, electronic power sources are dangerous instruments and a high degree of care is required in handling them.² Shock hazards are already rather familiar because many electronic devices are similar to electrical appliances.

Two common household items have recently been officially cited as possibly dangerous to health because of radiation. Color television is one; some sets emit X-rays.³ The other is the microwave oven, which is rapidly coming within the reach of the average consumer.

The microwave oven was introduced several years ago. Unlike conventional cooking appliances which cook food by heat which penetrates

² *White Sewing Machine Co. v. Feisel*, 28 Ohio App. 152, 162 N.E. 633 (1927).

³ Blatz, *Are There Hidden Radiation Hazards in Your Home*, 194 *Popular Science* 90 (May 1969).

from the outside, the microwave oven uses a high frequency radio wave which penetrates the food, creating internal heat within the mass being cooked. When first introduced microwave ovens were priced too high to be practical for most homeowners, but, by the beginning of 1969, the ovens were retailing for between 400 and 900 dollars. Hanson Blatz, Director of Radiation Control of New York City Health Department, estimates that over one thousand microwave ovens are now being sold every month.⁴

The microwave oven is generally thought to be safe if operating instructions are followed and it is serviced by a qualified serviceman. However, an alarming survey made by Public Health Services units in three states revealed that a high percentage of these ovens showed significant microwave leakage.⁵ This microwave leakage may cause radiation sickness, the effects of which will be discussed in detail later.

The public may be in greater danger from the use of electronic devices in another area—medical electronics. At a Reliability Symposium held in Chicago in January, 1969, Dr. Carl Walter, a surgeon at Peter Bent Brigham Hospital in Boston, reported that approximately 1200 patients are electrocuted each year in hospitals in the United States.⁶ The electrocutions usually occur during “routine diagnostic tests.”⁷ In March of 1969, Dr. Walter’s figure was corroborated in an address given by Seymour Ben-Zvi at the New York Academy of Sciences.⁸ On April 18, 1969, *Time* Magazine made these findings available to the general public. Numerous newspaper articles have subsequently appeared concerning electronic products safety, some of them calling for protective legislation.

Complicated medico-legal problems may arise from accidents caused by faulty hospital electronic equipment. It is difficult to prove that internal electric shock was the cause of death. There is an added complication when several different pieces of equipment are used to treat a single patient, and their interaction causes the injury. A patient undergoing surgery in a well-equipped modern hospital may be wired for as many as sixteen different purposes.⁹ Doctors and nurses who use the sophisticated equipment, usually without any special training, are also subject to possibly lethal shocks.

⁴ *Ibid.*

⁵ *Id.* at 93.

⁶ Accidental Electrocutions Claim 1200 Patients a Year, 14 *Electronic News* 29 (January 27, 1969).

⁷ *Id.* at 30.

⁸ Field, Would You Put That Probe on Your Sick Grandmother, 43 *Electronic Engineer* 35 (July, 1969).

⁹ *Op. cit. supra* n. 6, at 30.

Physics of Injuries from Electronic Products

Electric shock may cause unconsciousness, muscular contraction, respiratory paralysis, ventricular fibrillation, severe burns, and death.¹⁰ Electric shock also sometimes kills by paralyzing the body's nervous system. Although the system might recover later if life is sustained in the meantime, the cessation of vital functions may kill before the nervous system can resume its functioning.

There is also a danger in electric shock of injuries not caused directly by the electric current, but by the subject's involuntary reaction. A victim of electric shock will "jump back" without regard to the safety of this reaction, and may be injured thereby, or may be hurt by falling, as a fainting victim often is, even in the absence of any lasting injury from the shock itself.

Unfortunately, no medical agreement is possible as to the maximum amount of current or voltage that a particular human body can withstand safely. States that use electrocution as a form of capital punishment generally employ a current of three to four amperes under a pressure of 1,800 to 2,200 volts.¹¹ The amount of electric voltage or current that is lethal depends upon many variables, including the exact path of the current, the physical condition of the person, moisture content of the skin, and whether the current is introduced above or below the skin. Because there are so many factors, legal cause of a death may be difficult to determine.

The same difficulty is experienced with analysis of radiation effects from electronic products as with electric shock. Safe exposure limits are not well defined, except in the case of X-rays.

Radiation is believed to cause a disturbance in cellular activity resulting from chemical changes caused by ionization.¹² Radiation sickness may be acute and immediate, or delayed. Excessive exposure may result in amenorrhea, cataract formation, tissue damage, hemorrhage, severe skin burns and even death.¹³

In testimony given before Congress on May 13, 1968, Dr. Herman P. Schwan of the University of Pennsylvania suggested that any or all of these injuries could be caused by microwaves, especially those found in the microwave oven.¹⁴ A home user or restaurant worker might be exposed gradually and be completely unaware that a danger of radiation was present.¹⁵

¹⁰ Merck, *The Merck Manual of Diagnosis and Therapy* 1231 (10th ed. 1961).

¹¹ Wood, *Electrocution*, 5 *World Book Encyclopedia* 2271 (1961).

¹² Merck, *op. cit. supra* n. 10, at 1219.

¹³ *Id.* at 1221.

¹⁴ 114 *Cong. Rec.* 1988 (1968).

¹⁵ Blatz, *op. cit. supra* n. 3, at 92.

Another danger present in some electronic products is hypersonic waves. These waves are produced by high voltage hypersonic generators, for medical treatments and for cleaning.¹⁶ As with radiation and electric shock, the exact nature of its potential danger is not clear. It is known that these high frequency sound vibrations can be painful and harmful.

Distribution of Electronic Products

Electronic devices used in homes are ordinarily distributed from the manufacturer to wholesalers, thence to retailers, and ultimately to consumers. Some wholesale distribution outlets are owned and operated by the manufacturers; some manufacturers operate their own retail stores.

Electronic products for home use may be repaired by manufacturer-authorized service companies, by the manufacturer directly, or by independent repair companies which are often sole proprietorships.

Medical electronic equipment is sold to hospitals and private doctors directly by the manufacturers, by hospital supply houses, or through manufacturers' representatives.

It is not practical to require the dealer to inspect thoroughly the electronic devices that he sells. Ordinarily he is not technically qualified to undertake such inspection. Yet courts recently have held that lack of skill on the part of the seller, leading to failure to discover defects, does not discharge his liability.¹⁷ There is support under a negligence theory for the argument that retail dealers cannot be expected to have the scientific competence necessary to understand, or recognize defects in the product, and therefore should not be held strictly liable for injuries sustained. However, recent cases have more often held dealers and wholesalers strictly liable for injuries to the consumer and his family.¹⁸

Many electronic products are advertised by the manufacturer in direct appeals to the consumer. This provides a substantial basis for holding the manufacturer directly liable to the ultimate consumer, irrespective of the number of intervening merchants.

Manufacturers' Rationale as to Product Safety

The question of whether to include safety devices in a product is not generally one of technical feasibility. Every electronic product that is on the market could be made more safe, at some additional cost. Rather, product safety is a question of economic feasibility. The con-

¹⁶ Field, *op. cit. supra* n. 8, at 36.

¹⁷ *Vlases v. Montgomery Ward & Co.*, 377 F. 2d 846 (3rd Cir. 1967).

¹⁸ *McKisson v. Sales Affiliates Inc.*, 416 S.W. 2d 787 (Tex. 1967); *State Stove Mfg. Co. v. Hodges*, 189 So. 2d 113 (Miss. 1966); *Read v. Safeway Stores, Inc.*, 70 Cal. Rptr. 454 (Cal. App. 1968).

sumer wants both safety and a reasonable price. The equipment designer attempts to balance several conflicting interests of the ultimate consumer and of himself.

In addition to low price, other considerations weigh against the inclusion of safety devices by the designer. These include lighter weight, smaller size, greater convenience, and better appearance. Consumers, further, may prefer to do without the safety device, and pay less for the product. If two competitive products sit side-by-side on a display shelf in a retail store, one costing \$10 and the other, because of inclusion of an additional safety device, costing \$13, the consumer may select the first. Conceivably, an enlightened consumer might prefer a slightly more dangerous product, with the design savings spent (by the manufacturer) for liability insurance. The consumer would then be protected by the manufacturer's insurance. Warning plates and labels, if included by the manufacturer, increase the cost slightly and also tend to make a buyer fearful and therefore less likely to buy the product, and are therefore unattractive to the manufacturer.

Safety in product design is expensive even if the safer product does not cost any more to build than the unsafe one, because safety requires engineering thought. The engineering cost may be \$50,000 or more to design a consumer electronic product that sells for \$100. The amount of detailed work required to design even a simple product would astound most laymen.

A manufacturer's quality control personnel also must make compromises between cost and safety. Individual piece-part defects are the cause of an appreciable percentage of the defects found in assembled products¹⁹ and are considered manufacturing faults as contrasted with design faults. Many individual electronic circuit components such as resistors, capacitors and transistors (called piece-parts in the trade) are not tested before they are installed in the equipment as in over-all test of the equipment performance is usually considered sufficient to reveal component failures.²⁰ Certain piece-parts and sub-assemblies whose values must be precisely correct in order to function may be pre-tested before assembly, and other components are sometimes spot-checked by statistical quality control. The decision whether or not to test piece-part components ordinarily depends on the costs of testing and frequency of occurrence of a defect.

Components sold for incorporation in electronic equipment are usually sold with a "standard Electronics Industry Association (EIA) warranty." It provides for free replacement of unaltered components whose defect was present when shipped by the component seller, if the seller is notified promptly. Component sellers, however, are almost

¹⁹ Millard v. Binkley Co., 280 N.Y.S. 2d 21, 28 A. 2d 620 (1967).

²⁰ *Ibid.*

invariably willing to disregard the time limitation and replace indisputably defective parts as long as eight months after a sale. Thus the component's warranty time limitation does not provide any incentive to the assembler to test even expensive components when first received. Again, the tests that are performed on the completed equipment will be relied on to reveal component defects.²¹

The equipment manufacturer may be able to protect himself against claims of inadequate quality control by good documentation of routine product test procedures and by making a conformity record, written at the time of inspection, for each individual unit of the product. Such evidence may cast doubt upon allegations that an article was defective when it left the manufacturer's hands.

A great (anticipated) volume of sales permits the manufacturer to test his designs more thoroughly, because the engineering cost can be amortized over more sales. When manufacturing greater quantities, the manufacturer has a greater opportunity to discover and correct defects in product design or in methods of fabrication. But as a product becomes more popular, less specialized retailers may begin to distribute it. With more consumers purchasing and using the product there is a greater probability of one of the consumers misusing the product and thereby injuring himself or someone else.²²

The greater the complexity of an electronic product, the lower, generally speaking, is its reliability. Also, the greater the complexity of the product, the greater is the reliance placed upon the seller's skill and judgment by the consumer.²³ This problem of reliance on a technically complicated product by unskilled users is especially important in the area of medical electronic products. In an emergency situation, medical personnel may have no time to study an instrument before using it.

The chances of successfully employing a defense of assumption of risk defense are thus decreased as the product becomes more technical. The homeowner who buys an electrostatic air cleaner cannot be expected to judge competently the safety of the product.²⁴

Under a negligence theory, the standard of care owed by a reasonable manufacturer cannot be expected to include knowing the unknowable. Where the dangers of a product are unknowable the manufacturer has no duty to the consumer to know them. However, under the concept of strict liability, (either warranty or strict tort liability) the standard-of-care criteria of negligence do not apply. Hence even in the absence of negligence (because of the unknowability of the defect) there

²¹ *Barfield v. Atlantic Coast Line R. R. Co.*, 197 So. 2d 545 (Fla. App. 1967).

²² *McClish v. Niagara Machine and Tool Works*, 266 F. Supp. 987 (S.D. Ind. 1967).

²³ *Kopet v. Klein*, 275 Minn. 525, 148 N.W. 2d 385 (1967).

²⁴ *Ibid.*

may be liability imposed upon the manufacturer.²⁵ The character of the goods may be misrepresented by the seller; this is more easily done when products are new, unusual, or technically complex.²⁶

Vouchers for injuries from electronic products may be intangible. Since the medical consequences of electronic shock, radiation injuries, and hypersound injuries are not well known, it may be difficult to prove the damages. However, the existence of a *defect* in an electronic product is perhaps as easy to prove as for any other type of product. Defects that cause injury are likely to remain for subsequent inspection and analysis. The nature of most electronic products makes them less likely to be altered by the customer or tampered with internally, than are other products. By their enclosure design, many electronic products are in mechanically somewhat "sealed" containers of their own, so there is less likelihood of consumer changes. Thus an allegation that a defect or latent defect was in the product when it left the hands of the supplier, a necessary element of liability, is more easily proved.²⁷ There is also little likelihood of an electronic product's being totally destroyed by a defect, as in the case of foods, drugs or chemicals.

Three Theories of Liability for Product Defects

When someone is injured by a defective product, he may look to the law to shift his loss to the supplier. The law will shift the loss if any of three interests have been violated. These interests are protected by the following three legal policies.

- (a) The policy of protecting a person from harm caused by the fault of others.
- (b) The policy of enforcing promises.
- (c) The policy of placing risks where they can be easily distributed among the users of the product.

Each of these theories has resulted in a body of law upon which an action to recover damages may be based. They are, respectively,²⁸

- (a) Negligence. A tort action.
- (b) Warranty. A hybrid tort and contract action.
- (c) Strict liability. A tort action.

The three theories may be contrasted as to their most distinguishing characteristics as follows: (a) Negligence requires proof that a

²⁵ *Davis v. Wyeth Laboratories, Inc.*, 399 F. 2d 121 (9th Cir. 1968).

²⁶ *McKisson v. Sales Affiliates Inc.*, *op. cit. supra* n. 18; *Read v. Safeway Stores, Inc.*, 70 Cal. Rptr. 454 (1st Dist. 1968); *O. S. Stapley Co. v. Miller*, 103 Ariz. 556, 447 P. 2d 248 (1968).

²⁷ *Williams v. Ford Motor Co.*, 411 S.W. 2d 443 (Mo. App. 1966).

²⁸ *Lonzrick v. Republic Steel Corp.*, 6 Ohio St. 2d 227, 218 N.E. 2d 185 (1966).

supplier of the defective product failed to fulfill a duty of reasonable care. (b) Warranty depends upon an express or implied requirement upon the supplier that the goods are merchantable and fit for the intended use, but does not require proof of negligence. The existence of a contract of sale, not necessarily involving the plaintiff, is required. (c) Strict liability requires that the product be potentially dangerously defective when it leaves the supplier, and that the supplier be engaged in the business of supplying products of that description. No negligence or privity of contract between victim and supplier is required.

The law does not hold a manufacturer responsible to others solely because the manufacturer exists and may be able to pay, but because of his affirmative actions.²⁹ These actions may include, however, non-feasance as well as misfeasance. If his affirmative actions may affect the interests of another, the law may hold him liable for them.³⁰ A seller is responsible for the dangers which are injected into society by his initiative.

The plaintiff's choice of cause of action depends upon two factors—(a) which of the three interests he can prove was violated and (b) which theory provides the particular remedies that he most desires.

If no negligence can be shown even with the help of *res ipsa loquitur*, he must choose between the warranty and strict tort theories. If there is no warranty either express or implied, either negligence or strict liability is indicated. If the state in which the injury occurred has not yet accepted strict liability, either negligence or warranty must be depended upon. If the fault was due to an improper recommendation by the retailer for the use of the product, negligence or warranty may be more promising than strict tort liability. If all three interests were violated the plaintiff may wish to select negligence because the consequent damage award may be greater.

Defect Depends Upon Reasonability Test

If the product has no defect and was properly sold there is no cause of action under any theory.³¹ The defect, however can be merely absence of adequate warning, in an otherwise safe product.³² Thus the instructions that should accompany the product are part of the product in a broad sense. Sale to an incompetent,³³ child or for an improper purpose is in the nature of defects in the sale, in a broad sense.

The standard of safety of a product is the same regardless of whether negligence, warranty, or strict liability is pursued.³⁴ Many

²⁹ Fitzgerald v. Ludwig, 41 Wis. 2d 635, 165 N.W. 2d 158 (1969).

³⁰ Terry, Negligence, 29 Harv. L. Rev. 40 (1918).

³¹ Telak v. Maszczanski, 248 Md. 476, 237 A. 2d 434 (1968).

³² Littlehale v. E. I. du Pont de Nemours & Co., 268 F. Supp. 791 (S.D. N.Y. 1966).

³³ Snowwhite v. State, 243 Md. 291, 221 A. 2d 342 (1966).

³⁴ Schneider v. Chrysler Motors Corp., 401 F. 2d 549 (8th Cir. 1968).

definitions of a defect have been devised by the courts. A defect in a product is a characteristic that creates a risk such that a reasonable man would not sell it if he knew the risk.³⁵ This definition employs the terminology of negligence, but is distinguished from fault concepts by the word "if."

Other attempts at definition of a defect are: "A defect is an unnecessary characteristic whose presence may cause the product to be unreasonably dangerous."³⁶ "A defective product may be defined as one that fails to match the average quality of like products, and the manufacturer is then liable for injuries resulting from deviation from the norm."³⁷ A product is not deemed to be defective merely because it can be harmful. A product need not be accident-proof nor totally harmless.³⁸

A defect can exist in a product without anyone's having been negligent. The product may have been designed, fabricated, inspected and tested with reasonable care, but possess nevertheless a dangerous concealed defect. For example a transistor, which may be a component of a safety device, may contain a latent defect that causes failure under normal voltage conditions. The state of the art in design and manufacture are taken into account in determining negligence.³⁹ The manufacturer is held to the standard of knowledge of an expert in his business. He must keep abreast of developments, and know his business.⁴⁰

Deterioration or wearing out is something for which the manufacturer is not liable if injuries result.⁴¹ Moreover, long use before failure is evidence of absence of any initial defect.⁴² But where evidence of an initial defect is clear, changes of ownership or long delays do not prevent recovery.⁴³

Conclusion

Growing concern for public safety led to the passage by Congress of the Radiation Control for Health and Safety Act of 1968. The stated purpose of this Act is to protect the public health from

³⁵ *Olsen v. Royal Metals Corp.*, 393 F. 2d 116 (5th Cir. 1968); *Juenger v. Bucyrus-Erie Co.*, 286 F. Supp. 286 (E.D. Ill. 1968).

³⁶ *Ibid.* See also *Heaton v. Ford Motor Co.*, 248 Or. 467, 435 P. 2d 806 (1967).

³⁷ Traynor, *The Ways and Meanings of Defective Products and Strict Liability*, 32 *Tenn. L. R.* 363 (1965).

³⁸ *Oropesa v. Huffman Mfg. Co.*, 9 Ohio App. 2d 337, 224 N.E. 2d 530 (1965).

³⁹ *Schneider v. Chrysler Motors Corp.*, *supra* n. 34.

⁴⁰ *Kallen v. Samuel M. Langston Co.*, 96 Ill. App. 133, 237 N.E. 2d 759 (1968); *Minot Hooper Co. v. Crowley Indus. Bag Co.*, 217 So. 2d 653 (Miss. 1968).

⁴¹ *McNally v. Chrysler Motors Corp.*, 55 N.Y. Misc. 2d 128, 284 N.Y.S. 2d 761 (1967).

⁴² *Melanson Co. v. Hupp Corp.*, 282 F. Supp. 859 (D. N.J. 1966).

⁴³ *Minkle v. Blackmon*, 166 S.E. 2d 173 (S.C. 1969).

the dangers of electronic product radiation. Thus, it is the purpose of this subpart to provide for the establishment by the Secretary of an electronic product radiation control program which shall include the development and administration of performance standards to control the emission of electronic product radiation from electronic products and the undertaking by public and private organizations of research and investigation into the effects and control of such radiation emissions.⁴⁴

The primary purpose of the legislation is to protect the consumer as electronic products become more common, not only for performing old services better, but for performing entirely new services. These products are destined to become a sizable percentage of the products which are subjects of injury liability litigation.

Electronic products cases are expected to differ from electrical liability cases of the past because, in the days when electrical house wiring, electric motors, and electric appliances were introduced, product liability was not strict liability. It was then policy to encourage innovation and enterprise by protecting the manufacturer. The majority of electronic products injury cases in the future may face the application of strict liability for defects.

⁴⁴ Radiation Control for Health and Safety Act of 1968, Pub. L. No. 90-602, § 354, 82 Stat. 1173.