

## CONSUMER PRODUCT SAFETY COMMISSION

### 16 CFR Part 1245

RIN 3041-AC31

[Docket No. CPSC-2011-0074]

### Safety Standard Addressing Blade-Contact Injuries on Table Saws

**AGENCY:** Consumer Product Safety Commission.

**ACTION:** Notice of proposed rulemaking.

**SUMMARY:** The U.S. Consumer Product Safety Commission has determined preliminarily that there may be an unreasonable risk of blade-contact injuries associated with table saws. In 2015, there were an estimated 33,400 table saw, emergency department-treated injuries. Of these, CPSC staff estimates that 30,800 (92 percent) are likely related to the victim making contact with the saw blade. CPSC staff's review of the existing data indicates that currently available safety devices, such as the modular blade guard and riving knife, do not adequately address the unreasonable risk of blade-contact injuries on table saws. To address this risk, the Commission proposes a rule that is based, in part, on work conducted by Underwriters Laboratories Inc. The proposed rule would establish a performance standard that requires table saws, when powered on, to limit the depth of cut to 3.5 millimeters when a test probe, acting as surrogate for a human body/finger, contacts the spinning blade at a radial approach rate of 1 meter per second (m/s). The proposed rule would address an estimated 54,800 medically treated blade-contact injuries annually. The Commission estimates that the proposed rule's aggregate net benefits on an annual basis could range from about \$625 million to about \$2,300 million.

**DATES:** Submit comments by July 26, 2017.

**ADDRESSES:** You may submit comments, identified by Docket No. CPSC-2011-0074, by any of the following methods:

*Electronic Submissions:* Submit electronic comments to the Federal eRulemaking Portal at: <http://www.regulations.gov>. Follow the instructions for submitting comments. The Commission does not accept comments submitted by electronic mail (email), except through [www.regulations.gov](http://www.regulations.gov). The Commission encourages you to submit electronic comments by using the Federal eRulemaking Portal, as described above.

*Written Submissions:* Submit written submissions by mail/hand delivery/

courier to: Office of the Secretary, Consumer Product Safety Commission, Room 820, 4330 East West Highway, Bethesda, MD 20814; telephone (301) 504-7923.

*Instructions:* All submissions received must include the agency name and docket number for this notice. All comments received may be posted without change, including any personal identifiers, contact information, or other personal information provided, to: <http://www.regulations.gov>. Do not submit confidential business information, trade secret information, or other sensitive or protected information that you do not want to be available to the public. If furnished at all, such information should be submitted in writing.

*Docket:* For access to the docket to read background documents or comments received, go to: <http://www.regulations.gov>, and insert the docket number CPSC-2011-0074, into the "Search" box, and follow the prompts.

**FOR FURTHER INFORMATION CONTACT:** Caroleene Paul, Directorate for Engineering Sciences, U.S. Consumer Product Safety Commission, 5 Research Place, Rockville, MD 20850; telephone (301) 987-2225; fax (978) 367-9122; email [cpaul@cpsc.gov](mailto:cpaul@cpsc.gov).

#### SUPPLEMENTARY INFORMATION:

##### I. Background

On April 15, 2003, Stephen Gass, David Fanning, and James Fulmer, *et al.* (petitioners) requested that the CPSC require performance standards for a system to reduce or prevent injuries from contact with the blade of a table saw. The petitioners are members of SawStop, LLC, and its parent company, SD3, LLC (collectively, SawStop). On October 11, 2011, the Commission published an advance notice of proposed rulemaking (ANPR) to consider whether there may be an unreasonable risk of blade-contact injuries associated with table saws. 76 FR 62678. The ANPR began a rulemaking proceeding under the Consumer Product Safety Act (CPSA). The Commission received approximately 1,600 public comments. The Commission is now issuing a notice of proposed rulemaking (NPR) to address an unreasonable risk of blade-contact injuries associated with table saws that would limit the depth of cut to 3.5 mm or less when a test probe, acting as surrogate for a human body/finger, contacts the spinning blade at a radial approach rate of 1 meter per

second (m/s).<sup>1</sup> The information discussed in this preamble is derived from CPSC staff's briefing package for the NPR, which is available on CPSC's Web site at: <https://www.cpsc.gov/s3fs-public/Proposed%20Rule%20-%20Safety%20Standard%20for%20Blade-Contact%20Injuries%20on%20Table%20Saws%20-%20January%2017%202017.pdf>.

##### II. Statutory Authority

Table saws are "consumer products" that can be regulated by the Commission under the authority of the CPSA. *See* 15 U.S.C. 2052(a). Section 7 of the CPSA authorizes the Commission to promulgate a mandatory consumer product safety standard that sets forth performance requirements for a consumer product or that sets forth requirements that a product be marked or accompanied by clear and adequate warnings or instructions. A performance, warning, or instruction standard must be reasonably necessary to prevent or reduce an unreasonable risk or injury. *Id.*

Section 9 of the CPSA specifies the procedure that the Commission must follow to issue a consumer product safety standard under section 7. In accordance with section 9, the Commission may commence rulemaking by issuing an ANPR; as noted, the Commission issued an ANPR on table saws in October 2011. (76 FR 62678 (October 11, 2011)). Section 9 authorizes the Commission to issue an NPR, including the proposed rule and a preliminary regulatory analysis, in accordance with section 9(c) of the CPSA and request comments regarding the risk of injury identified by the Commission, the regulatory alternatives being considered, and other possible alternatives for addressing the risk. *Id.* 2058(c). Next, the Commission will consider the comments received in response to the proposed rule and decide whether to issue a final rule, along with a final regulatory analysis. *Id.* 2058(c)-(f). The Commission also must provide an opportunity for interested persons to make oral presentations of their data, views, or arguments, in accordance with section 9(d)(2) of the CPSA. *Id.* 2058(d)(2).

According to section 9(f)(1) of the CPSA, before promulgating a consumer

<sup>1</sup> The Commission voted 3-2 to publish this notice in the *Federal Register*. Commissioner Robert S. Adler, Commissioner Elliot F. Kaye, and Commissioner Marietta S. Robinson voted to approve publication of the proposed rule. Acting Chair Ann Marie Buerkle and Commissioner Joseph P. Mohorovic voted against publication of the proposed rule. The Commissioners' individual statements are available at <https://www.cpsc.gov/About-CPSC>.

product safety rule, the Commission must consider, and make appropriate findings to be included in the rule, on the following issues:

- The degree and nature of the risk of injury that the rule is designed to eliminate or reduce;
- the approximate number of consumer products subject to the rule;
- the need of the public for the products subject to the rule and the probable effect the rule will have on utility, cost, or availability of such products; and
- the means to achieve the objective of the rule while minimizing adverse effects on competition, manufacturing, and commercial practices. *Id.* 2058(f)(1). Under section 9(f)(3) of the CPSA, to

issue a final rule, the Commission must find that the rule is “reasonably necessary to eliminate or reduce an unreasonable risk of injury associated with such product” and that issuing the rule is in the public interest. *Id.* 2058(f)(3)(A)&(B). Additionally, if a voluntary standard addressing the risk of injury has been adopted and implemented, the Commission must find that:

- The voluntary standard is not likely to eliminate or adequately reduce the risk of injury, or that
- substantial compliance with the voluntary standard is unlikely. *Id.* 2058(f)(3)(D).

The Commission also must find that expected benefits of the rule bear a

reasonable relationship to its costs and that the rule imposes the least burdensome requirements which prevent or adequately reduce the risk of injury for which the rule is being promulgated. *Id.* 2058(f)(3)(E)&(F).

### III. The Product

#### A. Types of Table Saws

Table saws are stationary power tools used for the straight sawing of wood and other materials. The basic design of a table saw consists of a motor-driven saw blade that protrudes through a flat table surface. To make a cut, the operator places the workpiece on the table and, using a rip fence or miter gauge as a guide, pushes the workpiece into the blade (see Figure 1.)

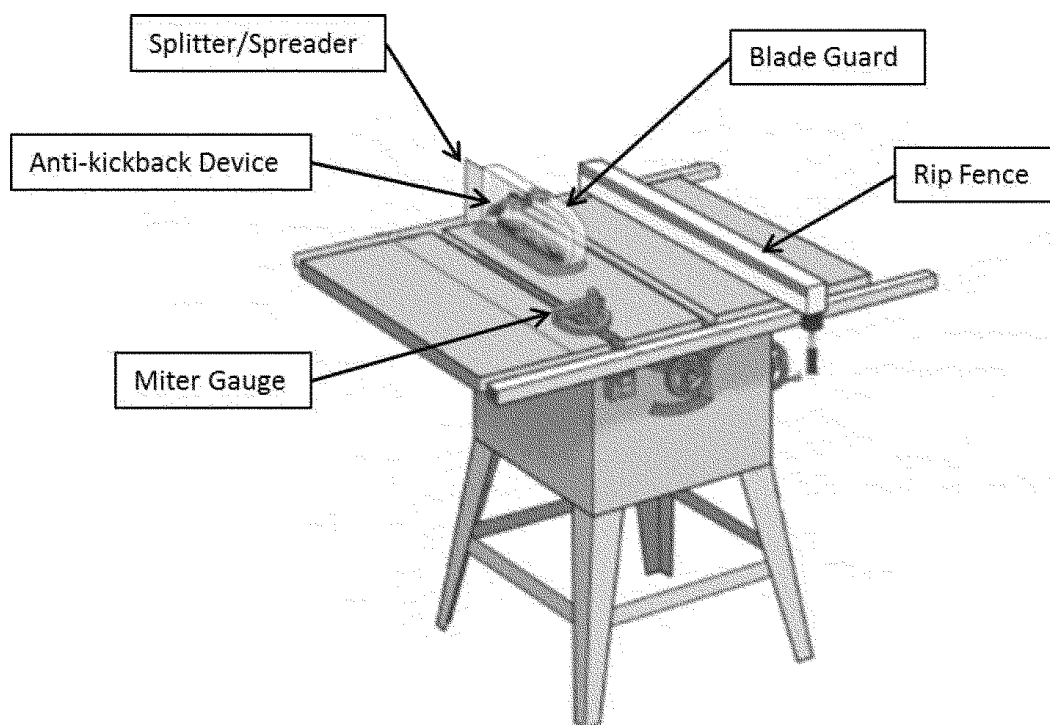


Figure 1. Typical table saw components

Table saws generally fall into three product types: Bench saws, contractor saws, and cabinet saws.<sup>2</sup> Although there is no exact dividing line, the distinction among these types of saws is generally based on size, weight, portability, power transmission, and price.<sup>3</sup>

<sup>2</sup> Cabinet saws also are referred to as stationary saws because they are not portable.

<sup>3</sup> In addition to these three primary product types, there are also several hybrid saws in the market. This product type blends components of both contractor and cabinet saws. Specifically, hybrid saws have the energy requirements, weight, and mobility of contractor saws with the structure, accuracy, and dust control features of cabinet saws.

Bench saws are intended to be transportable, so they tend to be small, lightweight, and relatively inexpensive. In recent years, bench saw designs have

This product type typically operates in single phase with a voltage range of 110–240 volts, generating 1.75 to two horsepower, depending on the model. There are also sliding saws that are similar to cabinet saws in that they are belt driven, but they are typically equipped with an extension and greater rip- and cross-cutting capacity that allows for cutting large panels. This type of saw can be wired for either single-phase or three-phase operation; however, three-phase wiring is a more common feature for sliding table saws. Sliding saws operate in the 220–440 volt range.

evolved to include saws with larger and heavier-duty table surfaces, with some attached to a folding stand with wheels to maintain mobility. These larger portable saws on wheeled stands are called “jobsite” saws because they are capable of heavier-duty work, but they are still portable enough to move to work sites.

Bench saws generally run on standard house voltage (110–120 volts), use universal motors,<sup>4</sup> drive the saw blade

<sup>4</sup> A universal motor runs on AC or DC power, has high starting torque, can run at high speed, and is

through gears, and range in weight from 34 pounds to 133 pounds. The universal motor and gear drive produce the high decibel noise and vibration that are distinctive characteristics of bench saws. Prices for bench saws range from \$129 per model, to as much as \$1,499 for a high-end model.

Contractor saws used to be considered portable table saws, but designs have progressed with larger motors and heavier table tops to the point that most contractor saws are considered non-portable. Although a mobile base can be added to the frame to make contractor saws mobile, they are often found in home workshops as non-portable saws that are a less expensive alternative to cabinet saws. Contractor saws generally run on standard house voltage, use induction motors, are belt driven, and range in weight from around 200 pounds to 400 pounds. The induction motor and belt drive result in a table saw that produces less vibration, is quieter, is more accurate, is able to cut thicker pieces of wood, and is more durable than a bench saw. Prices for contractor saws range from around \$500 to \$2,000.

Cabinet saws are larger, heavier, and more powerful than contractor saws, and their motors are enclosed in a solid base. These saws are typically the highest grade saw found in the home woodworking shop. Cabinet saws generally run on 220–240 volts, use a 1.75–5 hp or stronger motor, are belt driven, and weigh from around 300 pounds to 1,000 pounds. Components in cabinet saws are designed for heavy use and durability, and the greater weight further reduces vibration so that cuts are smoother and more accurate. Cabinet saws are expected to last a lifetime (with an average product life of 24 years), and prices range from around \$1,200 to \$5,000.

### B. Standard Safety Devices

Common safety devices on table saws are designed to reduce contact between the saw blade and the operator and to reduce kickback, a phenomenon in which the saw blade imparts its kinetic energy to the workpiece and ejects the workpiece back towards the operator. The configuration and specific design of these safety devices vary from manufacturer to manufacturer, but the safety devices generally fall into two basic categories: (1) Blade guards, and (2) kickback-prevention devices.

Blade guards surround the exposed blade and function as a physical barrier

between the blade and the operator. Blade guards generally are designed either as a single-piece unit that covers the saw blade, as shown in Figure 1, or as a modular system with a fixed-top barrier and independent side barriers.

Kickback-prevention devices include splitters, riving knives, and anti-kickback pawls. A splitter, also commonly called a “spreader,” is typically a flat piece of metal, aligned directly behind the saw blade that rides within the cut, or kerf, of a workpiece already fed through the blade. This prevents the workpiece from closing up on itself after it passes the blade and pinching the blade, which can cause the workpiece to be thrown upwards and back toward the operator. Before 2009, most table saws were designed with a splitter located behind the blade that was attached to the blade guard. If a cut required removal of the splitter or guard, they were removed together.

Riving knives are curved metal plates that are similar to, and perform the same function as, splitters, but are often located closer to the blade, rise no higher than the top of the blade, and attach to the arbor assembly so that they are raised and lowered with the blade.<sup>5</sup> Like splitters, riving knives physically prevent the two halves of the cut workpiece from moving back towards each other and pinching the spinning blade. However, unlike splitters, the riving knife can be left on for non-through cuts.

Anti-kickback pawls are another device designed to help reduce kickback. The pawls are mounted on both sides of the splitter and consist of a pair of spring-loaded pieces of metal with barbed teeth on the bottom edge that allow passage of the workpiece but will dig into it if it begins to move back toward the operator.

The riving knife and modular blade guard represent the latest progression in table saw safety design that have been incorporated into the voluntary standards for table saws. As discussed in section VI of the preamble, under *UL 987 Stationary and Fixed Electric Tools*, the voluntary standard effective dates for riving knives and modular blade guards were January 31, 2014, and January 31, 2010, respectively. However, the industry accelerated compliance with the voluntary standard, and the new guarding system with modular blade guards and riving knives became widely available on table saws in 2008. By 2012, table saw manufacturers introduced more than

900,000 table saws with riving knives and modular blade guards.

### C. AIM Technology

An active injury mitigation (AIM) system uses technology to actively mitigate or prevent injury of a human body part resulting from contact with a rotating saw blade (e.g. by braking, removing, and/or retracting the blade). Thus, any device that detects imminent or actual human contact with the table saw blade and then performs an action that mitigates the severity of the injury is considered to be an AIM system. An AIM system is *active* because it reacts to a blade contact in a way that minimizes the injury. A blade guard is a *passive* system because the guard does not react to a blade contact, but rather, provides a passive barrier between the blade and the user.

CPSC staff considers AIM to be a viable approach to address blade-contact injury in conjunction with existing passive safety strategies (blade guard and riving knife) to prevent blade contact on table saws. AIM systems can provide a layer of safety that can mitigate a blade-contact injury if the blade guard or riving knife are removed or fail to function properly. AIM systems can also protect against blade-contact injuries that can occur when a blade guard and riving knife are in place and functioning properly, but blade contact occurs nonetheless.

An AIM system performs two functions: (1) *Detects* contact between the rotating table saw blade and a human body part, and (2) *reacts* to mitigate injury. In a research report issued in March 2015, UL researched developing performance requirements for table saw safety standards to help address finger injuries due to contact with the blade.<sup>6</sup> The report examined performance requirements that consisted of a defined relationship between approach velocity (speed of finger at a specified angle relative to saw blade) and depth of cut to the finger/hand. In addition, the report focused on the use of a surrogate finger. The report determined that, in addition to the proper trigger attributes, the surrogate finger must possess physical properties that allow it to be cut such that representative, repeatable and reliable measurements of the depth of cut can be recorded.

<sup>6</sup> Jiang, H., Tabaddor, M., and He, F. (2015). General Characteristics of a Surrogate Finger for Table Saw Safety Testing. *UL Research Report*. Available at: <http://library.ul.com/wp-content/uploads/sites/40/2015/12/UL-Research-Report-on-Finger-Surrogate-Characteristics-for-Table-Saw-Testing-2015.pdf>.

lightweight and compact. For these reasons, universal motors are commonly used in portable power tools and equipment.

<sup>5</sup> The arbor assembly includes the arbor, which is the metal shaft that holds the saw blade.

CPSC staff's review of UL's literature research indicates that detection can be achieved by: (1) Sensing electrical properties of the human body/finger; (2) sensing thermal properties of the human body/finger; (3) visual sensing and tracking of the human body/finger; or (4) other methods. Current AIM technologies on the market rely on the first type of detection: Electrical sensing of the human body. CPSC staff based its testing of the AIM system on existing technology.

Reaction systems must perform some type of action to limit the severity of injury upon human body/finger contact

with the table saw blade. Removing either the spinning blade or the human body/finger from the point of contact is the most logical method to achieve this goal. Current AIM technologies on the market remove the spinning blade from the point of contact quickly enough, within milliseconds, to reduce significantly the severity of injury.

#### 1. Electrical Detection of Human Body

Current AIM technologies available on table saws in the U.S. market rely on electrical detection of contact between a table saw operator and the rotating saw blade to activate the AIM system. One means of detecting body contact is with

circuitry that generates a detection signal with defined electrical characteristics (see Figure 2). The signal can then be coupled onto the saw blade through various means, such as conductive, magnetic, or capacitive coupling devices. Additional circuitry continuously monitors the characteristics of the detection signal. The detection signal changes when a human body part comes into contact with the saw blade and the monitoring circuit senses the change in the signal. If the change is beyond a certain limit, the monitoring circuit then activates a reaction mechanism.

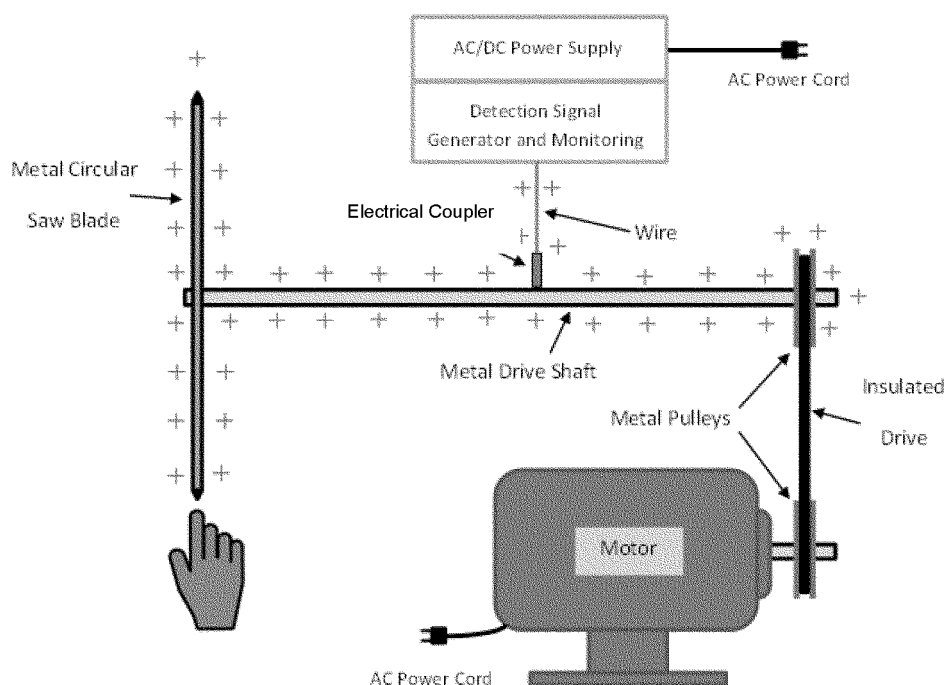


Figure 2. Example of electrical detection of human body

#### 2. Current Products in the Market With AIM Technology

In 2004, SawStop released an industrial table saw featuring AIM technology based on electrical detection of the human body, and a mechanical brake reaction that stops the blade from spinning and moves the saw blade assembly beneath the table top surface. Typically, the reaction occurs in less than 5 milliseconds after contact is detected. Subsequently, SawStop introduced to the market a professional cabinet saw, a contractor saw, and a bench (jobsite) saw with the same AIM technology. The SawStop AIM technology works in three steps:

##### 1. Monitor and Detect

- The blade carries a small electrical signal.
  - When a person contacts the blade, the signal changes because the human body is conductive.
  - The change to the signal activates the safety system.
- #### 2. Brake Activation
- An aluminum brake block is forced into the spinning blade by a spring released by an electric signal.
  - The blade's angular momentum drives the blade assembly beneath the table top, removing the risk of further contact.
  - Power to the motor is shut off.
- #### 3. The AIM system must then be reset by:
- Shutting off the saw.

- Removing the brake cartridge and embedded blade.
- Installing a new blade (if necessary) and brake cartridge.

In 2016, Robert Bosch, LLC (Bosch) released a jobsite table saw featuring AIM technology based on electrical detection of the human body and a combustion-based mechanical reaction that forces the saw blade assembly beneath the table top surface. The Bosch REAXX™ with Active Response Technology™ system (Bosch REAXX™) also works in three steps:

##### 1. Monitor and Detect

- The blade carries a small low-voltage signal.

- When a person contacts the blade, the signal changes because the human body is conductive.

- The change to the signal activates the safety system.

#### 2. Blade Retraction

- A combustion reaction is triggered in a cylindrical cartridge, which fires a piston at a high rate of speed (this action is similar to the deployment of an air bag in an automobile).

- The piston pushes against a linkage to rapidly rotate the saw blade assembly below the table surface away from the operator.

- The blade assembly remains locked under the table after activation, while the blade coasts to a stop after power to the motor is cut off automatically.

#### 3. The AIM system must then be reset by:

- Shutting off the saw.

- Inserting a fresh/new activation cartridge (two cartridges are paired together, so the unactivated side of the same dual-action cartridge may be used).

- Unlocking the blade assembly and raising it back into place.

Neither the SawStop, nor Bosch AIM technologies, can be used when cutting conductive materials (that allow the flow of an electrical current) because both systems rely on electrical detection of the human body. A person touching the conductive material being cut would allow the detection signal to pass through the conductive material and into the person, activating the system as soon as the material touches the saw blade. For this reason, each product has a bypass mode to allow the user to cut conductive materials. In addition, cutting wet wood that is moist enough to conduct enough electricity to activate the AIM system can cause tripping of the safety system. Accordingly, the AIM system generally must be deactivated while cutting wet wood. The table saw automatically exits the bypass mode and resets to normal mode after the saw is turned off and the blade comes to a complete stop.

The Bosch REAXX™ has been the only non-SawStop model with AIM technology available in the United States. Both the SawStop bench model and the Bosch model with the AIM technology are at the upper end of the bench saw price range. The SawStop bench saw model (which was first marketed in 2015) retails for about \$1,300 to \$1,400 per unit. The Bosch REAXX™ model has a retail price of \$1,300 to 1,500. However, the future of the Bosch model is unclear. On July 16, 2015, SawStop filed a complaint against Bosch for patent infringement and requested that the U.S. International

Trade Commission (ITC) order U.S. Customs to exclude the Bosch REAXX™ saws from entering the U.S. market.<sup>7</sup> On September 9, 2016, an administrative law judge (ALJ) made an initial determination that the Bosch model does infringe on several SawStop patents.<sup>8</sup> Subsequently, on November 10, 2016, the ITC decided not to review the ALJ's initial determination and requested that the interested parties provide written submissions on the issues related to remedies, the public interest, and bonding. On January 27, 2017, the ITC issued remedial orders including a limited exclusion order and cease and desist order against Bosch effective March 29, 2017. On April 6, 2017, Bosch filed an appeal of the ITC determination in the U.S. Court of Appeals for the Federal Circuit.<sup>9</sup>

#### IV. Incident Data

CPSC staff's incident data are based on data from the National Electronic Injury Surveillance System (NEISS). NEISS is a national stratified probability sample of approximately 100 U.S. hospitals having 24-hour emergency departments (EDs) and more than six beds. Coders in each hospital code data from the ED record for consumer product-related records, and then the data are transmitted electronically to the CPSC. Because NEISS is a probability sample, each case collected represents a number of injuries (the case's weight) in the total estimate of injuries in the United States. Different hospitals carry different weights.

There are five strata in the NEISS: Children's hospitals, small hospitals, medium hospitals, large hospitals, and very large hospitals. Within each stratum is a sample of hospitals that make up the primary sampling units of the NEISS. For each hospital in the sample, every first-time emergency department visit for an injury associated with a consumer product is recorded.<sup>10</sup> To facilitate injury estimates associated

<sup>7</sup> In the Matter of Certain Table Saws Incorporating Active Injury Mitigation Technology and Components Thereof, Investigation No. 337-TA-965.

<sup>8</sup> Specially, infringement was found in U.S. Patent No. 7,895,927 ('927 Patent), titled, "Power Equipment with Detection and Reaction Systems"; and U.S. Patent No. 8,011,279 ('279 Patent) titled, "Power Equipment with Systems to Mitigate or Prevent Injury."

<sup>9</sup> On July 16, 2015, SawStop also filed a complaint against Robert Bosch Tool Corporation in the U.S. District Court for the District of Oregon (*Sawstop, LLC v. Bosch*, CV No. 3:15-cv-1320) (D. Or. filed on July 16, 2015). On September 28, 2015, the Oregon District Court stayed the proceeding in federal court pending final resolution of the ITC's investigation.

<sup>10</sup> NEISS does not record return visits to the emergency department or other follow-up medical visits for the same injury.

with a product or product group, each injury has a product code that identifies the type of product involved. Other product-specific information, such as the product manufacturer or events leading to the incident, is not recorded in the NEISS. However, information that is recorded for each injury includes sex, age, diagnosis, disposition, and body part. Additional information about the NEISS can be found online at: <http://www.cpsc.gov/en/Research--Statistics/NEISS-Injury-Data>.

For the injury estimates in the proposed rule, CPSC staff reviewed all the incident data abstracted from NEISS hospital records for injuries related to product code 0841 (table or bench saws) for 2015. CPSC staff compared the distributions of table saw injury characteristics against all other workshop product-related injuries and consumer product-related injuries for 2015. Staff performed an injury trend analysis, as well as a risk trend analysis for blade-contact injuries from 2004 to 2015. In addition, CPSC staff reviewed all of the incidents in the CPSC's Consumer Product Safety Risk Management System (CPSRMS) database between January 1, 2004 and December 31, 2015. Finally, in addition to reviewing incident data, to obtain additional information regarding consumer modular blade guard use, in 2015, CPSC conducted a survey of consumers who own table saws with a modular blade guard system (modular blade guard survey).<sup>11</sup>

#### A. NEISS Data Methodology

The NEISS provides product information associated with each case, by recording up to two product codes associated with a case. CPSC staff's methodology and NEISS estimates are detailed in TAB B of the staff briefing package. Starting with all the NEISS cases associated with product code 0841 (this is, all injuries recorded in the NEISS as associated with a table or bench saw), CPSC staff reviewed and categorized the data, removing any cases that were not related to an operational table saw, and also classified whether the injury could have been due to blade contact. This analysis was completed on every case associated with the product code 0841, with date of treatments recorded as January 1, 2004 through December 31, 2015, resulting in a review of 9,300 NEISS cases.

<sup>11</sup> Sherehly, B. and Nooraddini, I. (2016). Table Saw Blade Guard Survey. Available at: [http://www.cpsc.gov/Global/Regulations-Laws-and-Standards/Voluntary-Standards/Voluntary-Standards-Reports/EurekaFactsTableSawBladeGuardSurveyReport\(Final6bcleared\)updatedcoverpage.pdf](http://www.cpsc.gov/Global/Regulations-Laws-and-Standards/Voluntary-Standards/Voluntary-Standards-Reports/EurekaFactsTableSawBladeGuardSurveyReport(Final6bcleared)updatedcoverpage.pdf).

For each of the 9,300 cases associated with the table saw product code (0841), with treatment years 2004 through 2015, the first level of review involved removing any cases where the injuries were not related to an operational table saw. Thus, cases not saying “table saw” were excluded (e.g., cases that only use the word “saw” not “table saw,” cases where the injury was related to a park bench, or cases where the saw was a homemade table saw). Cases indicating a “circular table saw” were removed. Cases where it was unclear that the injury was from a table saw were removed (e.g., cases using wording like “table saw vs. chain saw,” where it is not absolutely certain that the saw was a table saw). Cases were removed when a victim tripped over, fell into, or ran into a table saw and the table saw was not operational. Cases were removed when the injury was related to the table saw being transported, such as the table saw being carried or lifted. Finally, cases were omitted that were related to using the product for an extended period of time (overuse injuries), such as sore knees, elbows, backs, and shoulders. There are cases where it is possible that although “table saw” was used to describe the type of saw, narratives also included descriptions such as “table saw which slipped,” which might indicate a circular saw, instead of a table saw; however, because “table saw” is used to identify the saw type, these are included in the table saw category.

Different types of injuries can occur when using a table saw, some of which

do not include blade contact, such as injuries related to only kickback of the stock. Thus, the next level of review for each case was to determine whether the case involved blade contact or not. First, diagnoses of lacerations, fractures, amputations, and avulsions<sup>12</sup> that were for body parts below the elbow (not including the elbow), were all classified as blade contact, then staff reviewed the NEISS narratives to determine if any were described as not blade contact. Unless otherwise stated in the NEISS narrative, staff considered these combinations of diagnosis and body part to involve blade contact. CPSC staff reviewed the cases for the remaining combinations of diagnosis and body part for any that could be blade contact. Cases were included from this group only if the NEISS narrative indicated a hazard pattern of blade contact while using a table saw.

Given the limited amount of descriptive information related to the incidents available within the NEISS, staff believes that some cases could have been included that did not involve blade contact within the 0841 product code, leading to overestimates in blade-contact injuries. On the other hand, staff also believes that table saw blade contact cases may have been excluded within product codes 0845 (saws, not specified) and 0895 (power saws, other or not specified), leading to an underestimate of table saw blade-contact injuries. CPSC staff does not know to what extent either of these caveats affects the results. However, these caveats have been applied to CPSC

staff’s analysis for both the 2015 injury data and trend analysis results from 2004 through 2015.

*B. Emergency Department-Treated, Table Saw Blade-Contact Injury Analysis Results for 2015*

In 2015, there were an estimated 33,400 table saw, emergency department-treated injuries. Of these, CPSC staff estimates that 30,800 (92 percent) are likely related to the victim making contact with the saw blade. Of the 30,800 emergency department-treated, blade-contact injuries, an estimated 28,900 injuries (93.8 percent) involved the finger. The most common diagnoses in blade-contact injuries in 2015, are as follows:

- An estimated 18,100 laceration injuries (58.8 percent),
- an estimated 5,900 fractures (19.0 percent),
- an estimated 4,700 amputations (15.2 percent), and
- an estimated 2,000 avulsions (6.5 percent).

An estimated 3,800 (12.3 percent) of the blade-contact injury victims were hospitalized. Table 1 provides the emergency department-treated, blade-contact injury estimates for the NEISS variables for age (provided in age groups in the table), sex, body part injured, diagnosis, disposition, and locale. Males represent the majority of victims with blade-contact injuries (96.4 percent); and an estimated 45 percent of injuries occurred to victims over age 61.

TABLE 1—VICTIM AND INJURY CHARACTERISTICS OF TABLE SAW BLADE-CONTACT INJURIES, 2015

	n	Injury estimate			Percent of total
		Estimate	CV †	95% confidence interval	Estimate
Total .....	642	30,800	0.09	25,400–36,200	100%
Age Group:					
≤20 .....	16	*	*	*	*
21–30 .....	51	2,200	0.16	1,500–2,800	7.0
31–40 .....	76	3,800	0.18	2,500–5,200	12.5
41–50 .....	96	4,100	0.15	2,900–5,300	13.2
51–60 .....	133	6,400	0.14	4,600–8,100	20.7
61–70 .....	153	8,200	0.14	5,900–10,400	26.6
71–80 .....	88	4,300	0.16	3,000–5,600	14.0
81+ .....	29	1,300	0.20	800–1,800	4.1
Sex:					
Male .....	622	29,700	0.09	24,400–34,900	96.4
Female .....	20	*	*	*	*
Body Part:					
Finger .....	592	28,900	0.10	23,200–34,500	93.8
Hand .....	46	1,600	0.18	1,100–2,200	5.3
Other .....	4	*	*	*	*
Diagnosis:					

<sup>12</sup> Merriam Webster Dictionary defines “avulsion” as “a tearing away of a body part

accidentally or surgically.” <https://www.merriam-webster.com/dictionary/avulsion>.

TABLE 1—VICTIM AND INJURY CHARACTERISTICS OF TABLE SAW BLADE-CONTACT INJURIES, 2015—Continued

	n	Injury estimate			Percent of total
		Estimate	CV †	95% confidence interval	Estimate
Laceration .....	372	18,100	0.11	14,200–22,000	58.8
Fracture .....	112	5,900	0.17	3,900–7,800	19.0
Amputation .....	119	4,700	0.18	3,000–6,300	15.2
Avulsion .....	37	2,000	0.24	1,100–2,900	6.5
Other .....	2	*	*	*	*
Disposition:					
Treated and Released .....	537	26,800	0.10	21,600–32,100	87.1
Hospitalized ** .....	98	3,800	0.20	2,300–5,300	12.3
Other .....	7	*	*	*	*
Locale Where Injury Occurred:					
Home .....	416	20,600	0.11	16,200–25,100	67.0
Unknown .....	223	10,100	0.19	6,400–13,900	32.9
Other .....	3	*	*	*	*

Cells marked by “\*” indicate an estimate that does not meet CPSC reporting limits.

\*\* Hospitalization refers to the combination of two dispositions: Treated and transferred, treated and admitted.

† Coefficient of variation (CV) is a measure of the dispersion of the data as a ratio of the standard deviation to the estimate. The higher the CV, the larger the dispersion; for estimates derived from the NEISS, a CV over 0.33 is high.

C. Table Saw Blade-Contact Injuries Versus Other Product-Related Injuries for 2015

CPSC staff compared emergency department-treated injuries from table saw blade- contact against all other consumer product-related emergency department-treated injuries, to identify demographic groups and hazard

patterns that are specific to table saw blade-contact, emergency department-treated injuries.

CPSC staff’s review showed that table saw blade-contact injuries have a much larger proportion of injuries to fingers (compared to all other types of consumer products) and have significantly larger proportions of diagnoses for lacerations and

amputations. An estimated 18.6 percent of all amputations in the NEISS are related to table saws. Table 2 compares emergency department-treated injuries from table saw blade contact identified in the 2015 NEISS to all other consumer product-related, emergency department-treated injuries in the same timeframe (January 1, 2015 through December 31, 2015).

TABLE 2—COMPARISON OF VICTIM CHARACTERISTICS FOR TABLE SAW BLADE-CONTACT INJURIES VERSUS ALL OTHER CONSUMER PRODUCT-RELATED INJURIES, 2015

	Domain						Rao-Scott $\chi^2$ p-value
	Table saws			All consumer products (excluding table saws)			
	n	Estimate *	% of 30,800	n †	Estimate *	% of 14,098,700 ‡	
Total .....	642	30,800	100%	358,425	14,098,700	100%	N/A
Age Group ***:							
≤20 .....	16	*	*	168,496	5,513,200	39.1	<0.0001
21–30 .....	51	2,200	7.0	40,098	1,709,000	12.1	.....
31–40 .....	76	3,800	12.5	30,973	1,384,500	9.8	.....
41–50 .....	96	4,100	13.2	27,878	1,257,700	8.9	.....
51–60 .....	133	6,400	20.7	29,082	1,290,600	9.2	.....
61–70 .....	153	8,200	26.6	22,123	1,039,900	7.4	.....
71–80 .....	88	4,300	14.0	17,817	860,200	6.1	.....
81+ .....	29	1,300	4.1	21,923	1,042,900	7.4	.....
Sex **:							
Male .....	622	29,700	96.4	195,134	7,438,000	52.8	<0.0001
Female .....	20	*	*	163,291	6,660,800	47.2	.....
Locale:							
Home .....	416	20,600	67.0	161,190	6,564,100	46.6	<0.0001
Unknown .....	223	10,100	32.9	98,418	3,820,100	27.1	.....
Other .....	3	*	*	98,817	3,714,600	26.3	.....
Body Part:							
Finger .....	592	28,900	93.8	29,987	1,209,800	8.6	<0.0001
Hand .....	46	1,600	5.3	17,089	732,000	5.2	.....
Other .....	4	*	*	311,349	12,157,000	86.2	.....
Diagnosis:							
Laceration .....	372	18,100	58.8	63,727	2,510,600	17.8	<0.0001
Fracture .....	112	5,900	19.0	54,210	2,037,500	14.5	.....
Amputation .....	119	4,700	15.2	584	20,400	0.1	.....

TABLE 2—COMPARISON OF VICTIM CHARACTERISTICS FOR TABLE SAW BLADE-CONTACT INJURIES VERSUS ALL OTHER CONSUMER PRODUCT-RELATED INJURIES, 2015—Continued

	Domain						Rao-Scott $\chi^2$ p-value
	Table saws			All consumer products (excluding table saws)			
	n	Estimate *	% of 30,800	n †	Estimate *	% of 14,098,700 ‡	
<i>Other</i> .....	39	2,200	7.0	239,904	9,530,200	67.6	.....
Disposition:							
<i>Treated and Released</i> .....	537	26,800	87.1	323,369	12,768,300	90.6	0.0095
<i>Hospitalized#</i> .....	98	3,800	12.3	29,203	1,120,300	7.9	.....
<i>Other</i> .....	7	*	*	5,853	210,100	1.5	.....

\* CVs for the table saws for reported estimates range from 0.09 to 0.24. CVs for estimates for the other products range from 0.07 to 0.25.  
 \*\* Two observations are classified as “unknown sex” in the NEISS in the timeframe. These two observations were omitted to facilitate comparisons. This does not affect any conclusions or comparisons.  
 \*\*\* To facilitate comparisons, 35 observations with unknown ages are not used in the age group analysis; thus, the statistics provided for age group do not necessarily sum exactly to totals. This does not affect any conclusions.  
 † This “n” is smaller than all of the NEISS, due to cases omitted from the product code 0841 (see Methodology section) as not related to a table saw or blade contact.  
 ‡ Percentages are calculated prior to rounding.  
 # Hospitalization refers to the combination of two dispositions: Treated and transferred, treated and admitted.

CPSC staff’s review showed differences in the injury distributions of age groups when comparing table saw blade-contact injuries to all other consumer product-related injuries. Older age groups represent larger proportions in table saw injuries than with all other products. Approximately 75 percent of the estimated table saw blade-contact injuries occur to people within the age range of 41 through 80. The proportion of all other consumer product-related injuries for the 41 through 80 age groups is approximately 30 percent. Almost all injuries involving table saw blade contact involve males; whereas, with all consumer products,

there is only a slightly larger male proportion. CPSC staff also compared table saw blade-contact injuries and all other woodworking workshop, product-related injury estimates to identify any demographic groups and hazard patterns that are specific to table saw blade-contact injuries within groups that are more likely to have been exposed to table saws. Table saws, in particular, table saw blade-contact injuries, represented a larger proportion of injuries to fingers than all other workshop products (which include tools such as radial arm saws, miter saws, circular saws, band saws, and routers, along with other power and manual

woodworking tools). In addition, table saw blade-contact injuries have significantly larger proportions of diagnoses for lacerations, fractures, and amputations, than injuries associated with all other workshop products. CPSC staff’s review showed that table saws account for an estimated 52.4 percent of all amputations related to workshop products.

Table 3 compares table saw blade-contact, emergency department-treated injuries from the 2015 NEISS to all other workshop product-related, emergency department-treated injuries in the same timeframe (January 1, 2015 through December 31, 2015).

TABLE 3—COMPARISON OF VICTIM CHARACTERISTICS FOR TABLE SAW BLADE-CONTACT INJURIES VERSUS ALL OTHER WORKSHOP PRODUCT-RELATED INJURIES, 2015

	Domain						Rao-Scott $\chi^2$ p-value
	Table saws			All workshop products (excluding table saws)			
	n	Estimate *	% of 30,800 †	n	Estimate *	% of 270,500 ‡	
Total .....	642	30,800	100%	5,313	270,500	100%	
Age Group:							
≤20 .....	16	*	*	702	29,500	10.9	<0.0001
21–30 .....	51	2,200	7.0	943	46,300	17.1	.....
31–40 .....	76	3,800	12.5	952	50,400	18.6	.....
41–50 .....	96	4,100	13.2	979	50,400	18.6	.....
51–60 .....	133	6,400	20.7	887	46,000	17.0	.....
61–70 .....	153	8,200	26.6	536	30,000	11.1	.....
71–80 .....	88	4,300	14.0	243	13,800	5.1	.....
81+ .....	29	1,300	4.1	71	4,100	1.5	.....
Sex:							
Male .....	622	29,700	96.4	4,582	234,600	86.7	<0.0001
Female .....	20	*	*	731	35,900	13.3	.....
Locale:							
Home .....	416	20,600	67.0	2,976	158,900	58.8	0.0049
Unknown .....	223	10,100	32.9	2,152	103,300	38.2	.....
Other .....	3	*	*	185	8,300	3.1	.....
Body Part:							



TABLE 3—COMPARISON OF VICTIM CHARACTERISTICS FOR TABLE SAW BLADE-CONTACT INJURIES VERSUS ALL OTHER WORKSHOP PRODUCT-RELATED INJURIES, 2015—Continued

	Domain						Rao-Scott $\chi^2$ p-value
	Table saws			All workshop products (excluding table saws)			
	n	Estimate *	% of 30,800 †	n	Estimate *	% of 270,500 †	
<i>Finger</i> .....	592	28,900	93.8	2,022	101,800	37.6	<0.0001
<i>Hand</i> .....	46	1,600	5.3	838	44,400	16.4	.....
<i>Other</i> .....	4	*	*	2,453	124,300	46.0	.....
Diagnosis:							
<i>Laceration</i> .....	372	18,100	58.8	2,562	132,100	48.8	<0.0001
<i>Fracture</i> .....	112	5,900	19.0	378	18,600	6.9	.....
<i>Amputation</i> .....	119	4,700	15.2	108	4,200	1.6	.....
<i>Other</i> .....	39	2,200	7.0	2,265	115,600	42.8	.....
Disposition:							
<i>Treated and Released</i> .....	537	26,800	87.1	5,027	258,400	95.5	<0.0001
<i>Hospitalized‡</i> .....	98	3,800	12.3	219	8,700	3.2	.....
<i>Other</i> .....	7	*	*	67	3,300	1.2	.....

\* CVs for the table saws for reported estimates range from 0.09 to 0.24. CV's for estimates for the all other workshop products range from 0.08 to 0.20.

† Percentages are calculated prior to rounding.

‡ Hospitalization refers to the combination of two dispositions: Treated and transferred, treated and admitted.

When table saw blade-contact injuries were compared to all other workshop product-related injuries, CPSC staff identified differences in the distributions of age groups. Older age groups represented larger proportions of table saw blade-contact injuries than for other workshop products. Approximately 45 percent of the estimated table saw blade-contact injuries occurred to people within the age range of 61 through 80. In comparison, the proportion of all other workshop product-related injuries for the 61 through 80 age groups was approximately 18 percent. Accordingly, the mean age for table saw blade-contact injuries was 55.6 years, in comparison to 42.7 years for all other workshop product-related injuries. This approximate 13-year difference in the mean age of people sustaining injuries is a statistically significant difference (p-value < 0.0001), indicating that table saw blade-contact injuries involve older victims compared to injuries related to all other workshop products.

*D. Trend Analysis for Table Saw Injuries*

CPSC staff estimated the yearly injuries associated with table saw blade-

contact injuries from 2004 to 2015, using estimates from NEISS. As mentioned in section III.B. of the preamble, *UL 987 Stationary and Fixed Electric Tools* includes provisions requiring a riving knife and modular blade guard. The voluntary standard effective dates for riving knives and modular blade guards was January 31, 2014, and January 31, 2010, respectively. The date range for the trend analysis includes a timespan before the voluntary standard required table saws to be equipped with a riving knife and modular blade guard (2004 to 2009) and a timespan after the voluntary standard requirements became effective on most table saws (2010 to 2015). Table saws manufactured before the current voluntary standard remain in use throughout this entire period. However, in more recent years, after the current voluntary standard became effective, an increasing proportion of table saws in use conform to the current voluntary standard. Thus, if the voluntary standard was having an impact on the number or severity of injuries, there would be a steady decrease in the number of injuries or severity of injuries as the proportion of table saws

compliant with the new standard increased. However, CPSC staff's analysis shows that the addition of the riving knife and modular blade guard in the voluntary standard has not reduced the number or severity of blade-contact injuries.

CPSC staff performed trend analyses for blade-contact injuries, as well as blade contact amputations, hospitalizations, and finger/hand injuries. CPSC staff concludes that there is no discernible change in the number of blade-contact injuries or types of injuries related to table saw blade contact from 2004 to 2015. Furthermore, CPSC staff concludes that there is no discernible change in the number of blade-contact injuries or types of injuries related to table saw blade contact from the timespan before the voluntary standard was implemented (2004–2009) to the time span after the implementation of the voluntary standard requiring the riving knife and modular blade guard on all table saws (2010–2015). The estimated number of table saw blade-contact, emergency department-treated injuries from 2004 through 2015 is in Table 4.

TABLE 4—NEISS ESTIMATES FOR TABLE SAW BLADE-CONTACT INJURIES, 2004–2015

Year	Table saw blade-contact injury estimates			
	N	Estimate	CV	95% confidence interval
2015 .....	642	30,800	0.09	25,100–36,500
2014 .....	631	30,300	0.08	25,300–35,300
2013 .....	662	29,500	0.09	24,500–34,500
2012 .....	648	29,500	0.09	24,100–34,900
2011 .....	632	29,600	0.09	24,300–35,000

TABLE 4—NEISS ESTIMATES FOR TABLE SAW BLADE-CONTACT INJURIES, 2004–2015—Continued

Year	Table saw blade-contact injury estimates			
	N	Estimate	CV	95% confidence interval
2010	657	30,100	0.10	24,000–36,200
2009	714	33,000	0.10	26,500–39,500
2008	723	34,600	0.09	28,700–40,500
2007	694	31,100	0.09	25,400–36,700
2006	766	34,200	0.09	27,900–40,400
2005	812	34,500	0.09	28,300–40,700
2004	773	36,300	0.09	29,600–43,100

To assess any changes across time in the severity of table saw blade-contact injuries, CPSC staff performed trend analyses for blade-contact amputations, hospitalizations (includes two dispositions: Treated with admission and treated with transfer), and finger/

hand injuries. No trend was detected in any of these analyses (p-values = 0.44, 0.53, and 0.17 for amputations, hospitalizations, and finger/hand injuries, respectively). Table 5 provides the estimated number of blade-contact injuries from 2004 through 2015, for

amputations, hospitalizations, and finger/hand injuries from blade contact, with the percentage of each to the total number of estimated blade-contact injuries (Table 4).

TABLE 5—NEISS INJURY ESTIMATES FOR TABLE SAW BLADE-CONTACT AMPUTATIONS, HOSPITALIZATIONS, AND FINGER/HAND INJURIES, 2004–2015

Year	Amputations		Hospitalizations		Finger/hand injuries	
	Estimate (95% CI)	% of blade-contact injuries	Estimate (95% CI)	% of blade-contact injuries	Estimate (95% CI)	% of blade-contact injuries
2015	4,700 (3,100–6,300)	15.2	3,800 (2,300–5,300)	12.3	30,500 (24,900–36,100)	99.1
2014	4,000 (2,400–5,500)	13.1	3,100 (1,700–4,400)	10.1	29,400 (24,600–34,300)	97.2
2013	3,400 (2,300–4,600)	11.7	3,000 (1,800–4,200)	10.2	29,200 (24,300–34,200)	99.2
2012	4,100 (2,700–5,600)	13.9	2,900 (1,300–4,400)	9.8	29,100 (23,700–34,400)	98.7
2011	3,900 (2,700–5,100)	13.2	2,900 (1,900–3,900)	9.9	29,400 (24,200–34,700)	99.3
2010	3,500 (2,500–4,500)	11.6	2,800 (2,000–3,600)	9.2	29,800 (23,700–36,000)	99.2
2009	4,100 (3,000–5,200)	12.5	3,000 (2,000–3,900)	9.0	32,500 (26,100–38,900)	98.5
2008	3,700 (2,700–4,600)	10.6	2,600 (1,700–3,400)	7.4	34,200 (28,300–40,100)	98.7
2007	3,900 (2,600–5,200)	12.6	3,000 (1,800–4,100)	9.5	30,700 (25,100–36,200)	98.7
2006	4,300 (3,100–5,500)	12.5	2,700 (1,600–3,800)	7.9	33,700 (27,500–39,900)	98.7
2005	4,600 (3,100–6,200)	13.5	2,800 (2,000–3,600)	8.2	34,100 (28,000–40,200)	98.9
2004	5,100 (3,600–6,700)	14.1	2,900 (1,900–3,900)	8.0	36,000 (29,300–42,800)	99.2

CPSC staff also conducted a trend analysis to include the rate of injury (that is, the rate of injury, measured by the numerator as the estimated number of injuries and the denominator as the exposure estimate). Based on the

information available, CPSC staff analyzed the risk of blade-contact injury using the estimated number of table saws in use for each year from 2004 to 2015. Table 6 provides the risk of blade-contact injury per 10,000 table saws in

use for each year in the analysis. The estimated numbers of table saws in use yearly is provided in TAB C of the staff briefing package.

<sup>13</sup>No estimates of variance or covariance associated with the number of table saws in use were calculated. CPSC staff determined that the ability to detect trend is increased by omission of the variance-covariance associated with the denominator variable (thus, creating a more

conservative approach). Variance for will increase if using both numerator and denominator variance and covariance structures; this makes it harder to detect trend mathematically. However, CPSC staff determined that there is minimal impact on the

analyses performed, and conclusions are unlikely to change if another method was chosen.

<sup>14</sup>CVs for estimates are equivalent to the CVs for injury estimates, due to no variance estimates being used for the denominator estimates.

TABLE 6—ESTIMATED TABLE SAW BLADE-CONTACT INJURIES PER 10,000 TABLE SAWS IN USE, 2004–2015

Year	Table saw blade-contact injury estimates		Estimated number of table saws in use (in 10,000s) *	Estimates ** of table saw blade-contact injury per 10,000 table saws in use	
	Blade-contact injury estimate	95% Confidence interval		Estimate <sup>14</sup>	95% Confidence interval
			Table saws in use estimate <sup>13</sup>		
2015	30,800	25,100–36,500	813.8	37.8	30.9–44.8
2014	30,300	25,300–35,300	818.6	37.0	30.8–43.2
2013	29,500	24,500–34,500	824.0	35.8	29.8–41.8
2012	29,500	24,100–34,900	832.5	35.4	28.9–41.9
2011	29,600	24,300–35,000	838.9	35.3	29.0–41.7
2010	30,100	24,000–36,200	847.7	35.5	28.3–42.7
2009	33,000	26,500–39,500	873.1	37.8	30.3–45.3
2008	34,600	28,700–40,500	881.5	39.3	32.6–45.9
2007	31,100	25,400–36,700	882.5	35.2	28.8–41.5
2006	34,200	27,900–40,400	865.0	39.5	32.2–46.7
2005	34,500	28,300–40,700	846.3	40.8	33.5–48.0
2004	36,300	29,600–43,100	829.4	43.8	35.7–51.9

\* CPSC’s Directorate for Economics provided the estimated numbers of table saws in use for this analysis.  
 \*\* Estimates are calculated from the exact number of injuries point estimate, not the rounded estimate.

CPSC staff’s analysis shows that there was no discernible change in the risk of injury associated with blade contact related to table saws from 2004 to 2015. Furthermore, staff concludes that there is no discernible change in the risk of injury associated with blade contact related to table saws from the timespan before the voluntary standard was implemented (2004–2009) to the time span after the voluntary standard’s implementation (2010–2015), which required the riving knife and modular blade guard on all table saws.

*E. Other Table Saw-Related Injuries*

Table saw-related incidents are not commonly reported to CPSC through means other than the NEISS. However, the CPSC received a small number of reports of table saw-related injuries through other means, such as news articles, consumer-submitted reports, attorney-submitted reports, and manufacturer and retailer reports. Reported incidents through means other than the NEISS are entered into the

CPSC’s CPSRMS database. The CPSRMS database is not a representative sample of all blade-contact injuries, and only injury estimates from the NEISS are used for nationally representative estimates of table saw and/or blade-contact injuries. These are anecdotal reports of blade-contact injuries, and the reports are not intended to be used to understand trends or the magnitude of the number of blade-contact injuries.

CPSC staff reviewed this data to understand the scenarios and the injuries associated with table saw blade-contact injuries, information not typically captured within a NEISS report. CPSC staff reviewed all reports in the CPSRMS associated with the product code 0841 (table saws) with incident dates from January 1, 2004 through December 31, 2015. The incident dates chosen match the trend analysis performed on the NEISS for table saws.

CPSC staff identified 53 incidents in the CPSRMS database that involved blade-contact injury on table saws that

occurred between January 1, 2004 and December 31, 2015, and the injuries were reported to CPSC by March 1, 2016. The data collection is ongoing for the years 2013, 2014, and 2015, and it is possible for CPSC staff to receive additional reports of blade-contact injuries that occurred during this timeframe. Of the 53 reported blade-contact injuries, 26 were attributable to bench saws, 22 to contractor saws, 2 to cabinet saws, and 3 were unknown.

CPSC staff reviewed whether there were any incidents with unexpected workpiece movement, such as kickback of the workpiece. Table 7 summarizes incidents by unexpected workpiece movement. For the majority of incidents, it is unknown whether unexpected workpiece movement was involved in the blade contact, thus making conclusions difficult. However, of the incidents where information about the contribution of workpiece movement was known, most blade-contact injuries involved some type of unexpected workpiece movement.

TABLE 7—UNEXPECTED STOCK MOVEMENT FOR REPORTED TABLE SAW BLADE-CONTACT INJURIES, 2004–2015

Unexpected workpiece movement	Frequency	Percent
Yes	20	37.7
No	4	7.5
N/A <sup>15</sup>	1	1.9
Unknown	28	52.8
Total	53	* 100.0

\* Due to rounding errors, totals may not exactly equal 100.

<sup>15</sup> Stock movement is “N/A” in one incident, where the victim was not performing a cut at the

time of blade contact. Reportedly, the victim started

the saw accidentally, and a nearby object pulled the victim’s hand into the blade.

CPSC staff also reviewed all 53 reported incidents to assess the type of blade guard that came with the saw, as well as information on whether the blade guard was in use at the time of the incident. Table 8 provides the frequency of the type of blade guard, by the use of the blade guard.

TABLE 8—TYPE OF BLADE GUARD BY BLADE GUARD USE FOR REPORTED TABLE SAW BLADE-CONTACT INJURIES, 2004–2015

Frequency (row percent)	Blade guard in use				Total
	Yes	No	Unknown	N/A <sup>16</sup>	
Type of blade guard					
<i>Modular</i> .....	1 9.1%	1 9.1%	9 81.8%	0 0.0%	11
<i>Traditional</i> .....	7 19.4%	7 19.4%	19 52.8%	3 8.3%	36
<i>Other/Unknown</i> <sup>17</sup> .....	1 16.7%	2 33.3%	3 50.0%	0 0.0%	6
<b>Total</b> .....	<b>9</b>	<b>10</b>	<b>31</b>	<b>3</b>	<b>53</b>

CPSC staff noted that although there are large proportions of unknowns for the blade guard use, making conclusions difficult, out of the 53 reported blade-contact injuries, 36 are associated with a traditional blade guard. Of those 36, seven were reported to be using the blade guard at the time of injury, seven

were reported to not be using the blade guard, 19 had an unknown guard use status, and three were not able to use the blade guard. Of the 53 reported blade-contact injuries, 11 are associated with a modular blade guard as part of the original equipment on the table saw. Of those 11, one was reported to be

using the blade guard at the time of injury, one was reported to not be using the blade guard, and nine have unknown guard use status. Table 9 shows the frequency of the scenarios for the type of blade guard by injury type.

TABLE 9—INJURY DESCRIPTION FOR REPORTED TABLE SAW BLADE-CONTACT INJURIES, 2004–2015

Injury	Type of blade guard *			Total
	Modular	Traditional	Other/ unknown/NA	
<i>Amputation</i> .....	4	21	4	29
<i>Amputation and Laceration</i> .....	0	3	1	4
<i>Fatal Laceration</i> .....	0	1	0	1
<i>Laceration</i> .....	2	4	1	7
<i>Laceration and Fracture</i> .....	1	0	0	1
<i>No Details Provided</i> .....	4	7	0	11
<b>Total</b> .....	<b>11</b>	<b>36</b>	<b>6</b>	<b>53</b>

\* Table 8 shows that it is often unknown whether a blade guard was in use at the time of the incident. This table does not break down the type of injury and type of guard according to whether the blade guard was in use or not.

Although for many of these injuries it is unknown whether the blade guard was in use at the time of the injury, CPSC staff’s review of the reports indicates that the incident scenarios for table saws with modular blade guards are similar to the incidents for table saws with traditional blade guards, in terms of incidents (amputations and lacerations) occurring with and without the use of blade guards, and incidents occurring with and without unexpected stock movement from kickback of the material.

*F. Modular Blade Guard Survey*

To obtain additional information regarding modular blade guard use, in 2015, CPSC contracted EurekaFacts, LLC (EurekaFacts) to conduct a survey of consumers who own table saws with a modular blade guard system.<sup>18</sup> The survey instrument was designed to identify the potential reasons that may affect how a consumer uses the blade guard. EurekaFacts completed 200 surveys of respondents who owned a table saw manufactured after 2009, or later, that included a modular blade guard. The survey was based on a

convenience sample of participants recruited by various advertisement strategies; therefore, no results from the survey are generalized to the population.

Results of the survey indicate that, of the 200 respondents, a majority of respondents (80%) reported that there are circumstances that require the blade guard to be removed, and a majority of respondents did not use the blade guard “sometimes” (28%), “often” (17%) or “always” (14%). The results of the survey demonstrate that for woodworkers who participated in the survey, removal of the blade guard,

<sup>16</sup> Blade guard use is recorded as “N/A” in three incidents, when blade guard use was either impossible (Dado cut, molding attachment on a saw from the 1950s), or the victim started the saw accidentally, and his hand was pulled into the blade by a nearby object.

<sup>17</sup> For the six incidents in the blade guard type of “Other/Unknown,” one incident is in the “other” category, where the blade guard description did not fully meet the traditional description, but the saw was manufactured in the time span of traditional blade guards; the remaining five incidents in this

category were classified as “unknown” blade guard type, due to the limited information provided.

<sup>18</sup> Sherehiy, B. and Nooraddini, I. (2016), *supra* note 11.

traditional or modular, is a necessary and proper action when making certain cuts on table saws. In addition, many respondents in the survey stated that they chose not to use the modular blade guard at all or only some of the time. CPSC staff believes that any situation in which the blade guard is not used eliminates the effectiveness of the blade guard in preventing blade-contact injuries. Accordingly, use of the blade guard cannot be relied upon to prevent injury.

### G. Summary of Incident Data

Based on CPSC staff's review of the existing data, the Commission does not believe that currently available safety devices, such as the modular blade guard and riving knife, will adequately address the unreasonable risk of blade-contact injuries on table saws. In 2015, there were an estimated 33,400 table saw, emergency department-treated injuries. Of these, staff estimates that 30,800 (92 percent) are likely related to the victim making contact with the saw blade. Of the 30,800 emergency department-treated blade-contact injuries in 2015, an estimated 28,900 (93.8 percent) involved the finger. The most common diagnoses in blade-contact injuries are: an estimated 18,100 laceration injuries (58.8 percent); an estimated 5,900 fractures (19.0 percent); an estimated 4,700 amputations (15.2 percent); and an estimated 2,000 avulsions (6.5 percent). An estimated 3,800 (12.3 percent) of the blade-contact injury victims in 2015 were hospitalized.

Thousands of amputations occur each year on table saws; an estimated 4,700 amputation injuries occurred in 2015, alone. Compared to all other types of consumer products, table saw-related amputations are estimated to account for 18.6 percent of all amputations in the NEISS in 2015. When compared to all other workshop products, table saws accounted for an estimated 52.4 percent of all amputations related to workshop products in 2015. The estimated mean age for table saw blade-contact injuries is 55.6; whereas, all other workshop product-related injuries have an estimated mean age of 42.7. This approximate 13-year difference in the mean age of injuries is a statistically significant difference ( $p$ -value < 0.0001), indicating that table saw blade-contact injuries involve older victims in comparison to injuries related to all other workshop products.

CPSC staff also reviewed table saw-related reported incidents in the CPSRMS database. Staff identified 53 incidents in the CPSRMS database that involve blade-contact injury on a table

saw that occurred between January 1, 2004 and December 31, 2015, and were reported to CPSC by March 1, 2016. Of the 53 reported incidents related to table saw blade contact, 36 incidents involved table saws that came equipped with a traditional blade guard, and 11 incidents involved table saws that came equipped with a modular blade guard. Laceration and amputation injuries occurred on table saws equipped with traditional guards and on table saws equipped with modular blade guards. In addition, CPSC staff's review of the reports indicates that the incident scenarios for table saws with modular blade guards are similar to table saws with traditional blade guards in terms of incidents occurring with and without the use of blade guards and incidents occurring with and without unexpected workpiece movement from kickback of the material.

Finally, CPSC staff's review of the modular blade guard survey shows that, for woodworkers who responded to the survey, removal of the blade guard, traditional or modular, is a necessary and proper action when making certain cuts on table saws. In addition, many woodworkers selected in the survey chose not to use the modular blade guard at all or only some of the time.

Based on CPSC staff's review of the incident data, the Commission believes that operator finger/hand contact with the table saw blade is a dominant hazard pattern that presents an unreasonable risk of injury that can be addressed by a performance requirement to reduce the frequency and severity of blade-contact injuries on table saws. The proposed performance requirement is discussed in section VII of the preamble.

### H. Special Studies

As discussed in the ANPR, in 2001, CPSC performed a NEISS special study for stationary power saw-related injuries.<sup>19</sup> The purpose of the survey was to collect more specific and accurate information about the type of table saw involved and also to collect more in-depth information about the hazard pattern and contributing factors to the injuries. The results were published in a memorandum, "Injuries Associated with Stationary Power Saws, 2001."<sup>20</sup> In 2007, CPSC staff conducted, through a contractor, another stationary power saw special study, running through 2008. The report, "Survey of Injuries Involving Stationary Saws: Table and Bench Saws, 2007–2008,"

presented estimates of the numbers and types of emergency department-treated injuries related to table saws in this 2-year study, which was published in March 2011.<sup>21</sup> In October 2011, the ANPR used the 2007–2008 special study estimates as the analytical support for the discussion of table saw-related injuries.<sup>22</sup>

However, the public comments submitted to the CPSC in response to the ANPR called attention to a contradiction between the estimated numbers for each type of table saw and the estimated injuries of direct-drive and indirect-drive table saws in the 2007–2008 special study.<sup>23</sup> As a result of these comments, CPSC staff reanalyzed the saw-type and drive-type responses provided by the injury victims in the 2007–2008 special study. CPSC published the results of the reanalysis in June 2014.<sup>24</sup> CPSC staff found that the estimated number of injuries based on the type of saw were inconsistent with the estimated injuries associated with respondent-declared drive type, which indicated that bench saws may be associated with a much larger proportion of the estimated injuries than initially reported.

To address the inconsistencies about the distribution of type of table saw in table saw-related injuries in the 2007–2008 special study, CPSC staff conducted a second special study on table saws in 2014–2015. This study, performed by contractors, collected computer-aided telephone interview (CATI) responses from 275 individuals treated for injuries related to stationary saws (this category includes table saws) and to unidentified types of saws in emergency departments of NEISS member hospitals between July 2014 and December 2015. For injuries determined to be table saw-related, interviewers read definitions to the participants regarding each table saw type, and interviewers asked additional questions when the participant identified a saw and drive type that were not compatible.

As explained in TAB F of the staff briefing package, after the contractors completed the 2014–2015 special study,

<sup>21</sup> <http://www.cpsc.gov/PageFiles/118311/statsaws.pdf>.

<sup>22</sup> 76 FR 62681.

<sup>23</sup> Staff's economic analysis in the ANPR briefing package first noted that there was an apparent inconsistency between some study participants' responses to the type of saw used and their responses about the type of drive system used in the saw.

<sup>24</sup> <http://www.cpsc.gov/Global/Research-and-Statistics/Injury-Statistics/Home%20Maintenance%20and%20Construction/CoverpageandMemoofStaffAnalysisofTableSawTypeinNEISSSpecialStudy.pdf>.

<sup>19</sup> 76 FR 62680–81.

<sup>20</sup> <https://www.cpsc.gov/s3fs-public/pdfs/powersaw.pdf>.

CPSC staff identified patterns in participant response data across the 275 completed survey responses that indicated that the interviewer may have affected the participants' responses, a phenomenon known as "interviewer effect." Ninety-four percent (259) of the completed surveys were conducted by two interviewers from one company. Statistically significant differences between responses collected by the two interviewers existed for critical questions, such as the type of table saw involved in the injury, use of safety features, and activities preceding the injury. Because the integrity of the responses was indeterminable, CPSC staff did not use the 2014–2015 special study results as a basis for the proposed rule.

In addition, contractor interviewer information from the 2007 to 2008 special study was not available, so CPSC staff was unable to prove or disprove whether interviewer effect impacted that study's responses. Accordingly, CPSC staff did not use the data from either of the prior special studies to inform recommendations in the proposed rule for a performance requirement to address table saw blade-contact injuries.

## V. Risk of Injury

### A. Description of Hazard

CPSC staff reviewed analyses of finger injuries on table saws conducted by researchers at the University of Michigan in a study titled, "*Table Saw Injuries: Epidemiology and a proposal for preventive measures*," which was commissioned by UL.<sup>25</sup> UL extracted sections from that study, with some modifications, for its report, "*Table Saw Hazard Study on Finger Injuries Due to Blade Contact*."<sup>26</sup> The UL report indicated that lacerations to the finger or hand of varying severity are the most common injury associated with table saw operator blade contact. The severity of injury ranges from minor cuts to severe cuts and injuries resulting in amputation. Finger lacerations can be classified into two categories by the extent of damage to the structures of the finger:

(1) Simple lacerations involving damage only from the skin surface to a depth of approximately 2 mm to 4 mm, and

(2) complex lacerations involving cuts deeper than 4 mm that cause damage to tendons, nerves, and blood vessels.

Simple lacerations can be managed at emergency departments with little expertise or by simple at-home care because these cuts generally heal without complications. Conversely, complex lacerations may require skilled microsurgery to repair damaged tendons, nerves, and vessels, and such care often requires hospital stays, transfer to a hospital with the required expertise, and extensive occupational therapy.

According to the UL report, magnetic resonance imaging (MRI) scans show that critical tissues are deepest at the proximal phalanx of the long finger (base of the middle finger) and most shallow at the distal phalanx of the little finger. The neurovascular bundle, which contains the nerves and arteries, is the structure closest to the skin's surface. The mean distance from the surface of the skin to the neurovascular bundle on the tip of the little finger is 4.3 mm.<sup>27</sup> Therefore, UL determined that, based on measurements from the study, a depth of 4 mm is the maximum depth of cut to a finger before serious injury is sustained.<sup>28</sup>

### B. Analysis of Operator Behavior in Blade-Contact Injuries

CPSC staff reviewed operator behavior in blade-contact injuries (TAB E of the staff briefing package). The most basic and common cutting operations performed on a table saw are ripping, which involves narrowing the width of a piece of wood or other "workpiece" by sawing along its length, and crosscutting, which involves shortening the length of a workpiece by sawing across its width. Anecdotally, ripping appears to be the more common of these two operations in the context of table saw use.

#### 1. Ripping Scenarios

Blade contact may be more likely to occur while the consumer is ripping a workpiece, rather than crosscutting, because consumers often use just their hands to feed the workpiece into the blade while ripping, except when ripping narrow workpieces. Additionally, ripping has greater potential to result in kickback, compared to crosscutting. "Kickback" can be defined as the binding of a workpiece in the blade and the consequent thrusting of that workpiece

back toward the consumer. Ripping involves the cut workpiece passing between the spinning blade and a rip fence, which forms a fixed boundary that constrains the movement of the workpiece. Thus, any lateral movements or rotation of the workpiece (or misalignment of the fence) may cause the workpiece to bind and be thrown or propelled at the consumer. The sudden movement of the workpiece from kickback can cause the consumer to lose control of the workpiece and lead to blade contact in a number of ways. For example:

- The consumer's hand or push stick can slip off the workpiece, causing the hand to move into the blade.
- The workpiece can strike the consumer's arm or hand, sending the hand into the blade.
- The consumer can reflexively reach for the workpiece to regain control and inadvertently move the hand into the blade.
- The consumer's hand, if positioned behind the blade to hold, support, or remove the workpiece or cutoff, can be "pulled" into the blade with the workpiece.

Many of the scenarios may be possible even when a blade guard is in use, because blade guard systems generally are designed to allow free passage of the workpiece into the blade from the front; therefore, other objects, such as hands and fingers also can move into the blade from this direction. Thus, although blade guard systems can reduce the likelihood of blade contact from certain angles and certain approaches, the potential for contact remains. In addition, hand or finger contact with the blade can occur even without kickback. Possible blade contact scenarios during ripping, unrelated to kickback, include the following:

- The consumer's hand gets too close to the blade while feeding the workpiece, particularly small workpieces, and the fingers contact the blade. In some cases, the consumer may be wearing gloves for protection, or because of cool temperatures, and the blade catches the glove and pulls the hand into the blade.<sup>29</sup>
- The consumer reaches near or past the blade to regain control of a workpiece that is slipping, lifting up, falling off the table, or otherwise moving in an unexpected way, and the hand contacts the blade.<sup>30</sup>
- The consumer reaches for a cutoff or brushes debris from the table while

<sup>25</sup> Chung, K. and Shauver, M. 2014. Table saw injuries: Epidemiology and a proposal for preventive measures. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4154236/>.

<sup>26</sup> Table Saw Hazard Study on Finger Injuries Due to Blade Contact, *UL Research Report*, Jan. 2014. Available at: [http://library.ul.com/wp-content/uploads/sites/40/2015/02/UL\\_WhitePapers\\_Tablesaw\\_V11.pdf](http://library.ul.com/wp-content/uploads/sites/40/2015/02/UL_WhitePapers_Tablesaw_V11.pdf).

<sup>27</sup> Staff's analysis of cadaverous tissue data indicates that the measurements presented in UL's research report are relative to the volar (palmar) surface of the skin.

<sup>28</sup> UL Research Report, 2014, *supra* note 26 at 18.

<sup>29</sup> For example, IDI nos. 121018CNE1304.

<sup>30</sup> For example, IDI nos. 080415CCC2550 and 141120CNE0001. Note that in IDI no. 141120CNE0001, a blade guard was in use.

the blade is still spinning and the hand contacts the blade. Saw blades can continue spinning for some time after a table saw has been switched off. Accordingly, some consumers might contact the blade after having already switched off the table saw but before the blade has come to a complete stop. Furthermore, consumers who are aware of the potential for kickback might be motivated to remove a cutoff immediately to prevent a cut piece from kicking back or being thrown in some other way.

- The consumer gets distracted and turns or looks away, causing his or her hand to move into the blade. Such a distraction may not be merely daydreaming, but can include cases in which someone enters the room and the operator diverts their attention to make sure the other person is not placing themselves in a hazardous situation. This may be especially likely if the other person is someone for whom the consumer is responsible, such as a child.
- The consumer slips, stumbles, or otherwise loses balance and inadvertently moves a hand into the blade, possibly as a natural motor response to regain balance. Similarly, if a consumer is startled by something or someone, the consumer may move reflexively or jerk a hand toward the blade.
- The consumer's hand or push stick slips off the workpiece, causing the hand to move into the blade. This scenario is similar to the one cited earlier in the context of kickback, but it is not necessarily preceded by a sudden movement of the workpiece.

Many of these scenarios may be more likely to occur if the consumer is tired, or if the view of the blade or cut is impaired somehow. Working with a table saw for long periods likely would contribute to fatigue, which in turn, can degrade a consumer's decision-making abilities, judgment, reaction time, and vigilance.<sup>31</sup> Even devices and equipment that are intended to protect consumers may adversely affect consumers' ability to monitor a cutting operation with a table saw, and

<sup>31</sup> See Sharit, J. (2006). Human Error. In G. Salvendy (Ed.), *Handbook of Human Factors and Ergonomics*, 3rd ed. at 708–760. Hoboken, NJ: Wiley. Staff also notes that, when ripping, consumers must make sure the workpiece maintains contact with the rip fence for the entire cut. Thus, a consumer's attention is likely to be where the workpiece meets the fence, rather than the blade, for at least part of the cut. This necessarily means that adequate attention cannot be given to the position of the hands relative to the blade. If attention is focused, instead, on the fingers relative to the blade, the workpiece may move off the rip fence and lead to kickback, which also can cause the fingers to contact the blade.

potentially increase the risk of injury. Blade guard systems might contribute to difficulties in seeing where a cut is being made, and consumers sometimes report this as a reason for removing blade guard systems. Staff also notes that consumers typically are instructed to wear eye protection when operating a table saw.<sup>32</sup> Although proper eye gear can provide important protection from projectiles striking the eye, the eye protection may affect one's ability to see a cut clearly, particularly if the eyewear is scratched or partially covered in debris, such as sawdust.

## 2. Crosscutting Scenarios

Blade contact scenarios involving crosscutting are likely similar to those involving ripping because many of the same potential issues can arise, such as the consumer feeding the workpiece with their hand too close to the blade, reaching past the blade for a cutoff, or becoming distracted. Although the potential for kickback seems less likely for crosscutting than for ripping, kickback still occurs, and the consequent loss of workpiece control can result in the hand contacting the blade. In addition, during a crosscut, the workpiece may become "jammed" in the blade guard or anti-kickback device. This may be more likely if the workpiece shifts position or rotates from against the miter gauge. In such a scenario, the consumer may reach toward the blade to adjust the workpiece position or attempt to move the offending portion of the guard system, and inadvertently contact the blade with the fingers.

## 3. Adult Aging Issues

As discussed in section IV of the preamble and TAB B of the staff briefing package, approximately 45 percent of all estimated table saw-related, emergency department-treated injuries that likely related to the victim making contact with the blade involved consumers older than 60 years of age. Although CPSC staff does not know if older consumers have greater exposure to these products, adult aging is associated with declines in many perceptual, cognitive, and physical abilities, as discussed in TAB E of the staff briefing package. Some of these age-related deficits likely contribute to blade contact incidents with table saws.

<sup>32</sup> For example, general safety instructions for all power tools, published by the Power Tool Institute (PTI), states that one should "[a]llways wear eye protection," and the section of the document that is specific to table saws states, in part: "Always wear safety goggles or safety glasses with side shields." See, <http://www.powertoolinstitute.com/pti-includes/pdfs/Tool-Specific-Files/Table-Saws.pdf>.

CPSC staff identified differences in the distribution of age groups when comparing table saw blade-contact injuries to all other workshop product-related injuries. Staff analysis of injuries in 2015 indicates that the mean age for table saw blade-contact injuries is 55.6 years, compared to 42.7 years for all other workshop product-related injuries. This approximately 13-year difference in the mean age of victims of table saw blade-contact injuries is a statistically significant difference and indicates that table saw blade-contact injuries involve older victims compared to victims of injuries from all other workshop products.

## VI. Relevant Existing Standards

### A. Voluntary Standards

#### 1. History

In 1971, Underwriters Laboratories Inc. (UL) published the first edition of UL 987, *Stationary and Fixed Electric Tools*. UL 987 included requirements for table saws that specified the following safety devices: A single-piece blade guard, a spreader, and anti-kickback pawls. In 2005, UL published the sixth edition of UL 987, which added riving knives to the general requirements for table saws. The effective date for the riving knife requirements for products already listed with UL was January 2014. In 2007, UL published the seventh edition of UL 987, which expanded the table saw guarding requirements to include a new modular blade guard design developed by a joint venture of the leading table saw manufacturers. The effective date for the modular blade guard requirements was January 2010. The revised standard specified that the blade guard shall not consist of a hood, but comprise a top-barrier guarding element and two side-barrier guarding elements. The new modular guard design was intended to be an improvement over traditional hood guard designs by providing better visibility, offering easier methods to remove and install the guard, and incorporating a permanent riving knife design. In 2011, UL published the eighth edition of UL 987, which clarified requirements for table saws. The eighth edition remains the current edition of UL 987.

In February 2016, UL balloted a proposal to adopt the first edition of International Electrotechnical Commission (IEC) 62841–3–1, *Standard for Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery—Safety—Part 3–1: Particular Requirements for Transportable Table Saws* as the first edition of UL 62841–3–1. This effort is

part of UL's international harmonization goal to adopt international standards, such as one published by the IEC (International Electrotechnical Commission) or ISO (International Organization for Standardization), into one UL standard that is based on the IEC/ISO standard, with appropriate national differences.<sup>33</sup> The proposal passed, and in August 2016, UL published the first edition of UL 62841-3-1, *Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery Part 3-1: Particular Requirements for Transportable Table Saws*. UL 62841-3-1 is recognized as an American National Standards Institute (ANSI) standard and includes requirements for a modular blade guard, riving knife, and anti-kickback pawls. The effective date for UL 62841-3-1 is August 29, 2019. Until that date, UL 987 remains in effect, and table saw manufacturers can list their products to UL 987 or UL 62841-3-1.

Currently, UL 987 (Section 43.2.2) and UL 62841-3-1 (Section 19.101) specify that table saws shall be provided with a modular blade guard. UL 987 (Section 43.2.3) and UL 62841-3-1 (Section 19.103) specify that table saws shall be equipped with a riving knife. Both voluntary standards include: (1) Similar performance requirements to ensure that the modular blade guard prevents incidental contact from the top and from both sides of the saw blade; and (2) similar specifications for the location and rigidity of the riving knife.

## 2. Recent Developments

In June 2011, UL announced its intention to create a standard that addresses the performance characteristics needed to reduce blade-contact injuries associated with table saws, and UL invited CPSC staff to participate in developing blade-to-skin performance requirements for UL 987. UL formed a working group that met regularly during 2011 to 2015 to develop performance requirements for table saws to address flesh-to-blade-contact injuries. The UL working group developed the term "active injury mitigation" (AIM) to describe any type of safety system that detects an imminent or actual human contact with the table saw blade and then performs an action that mitigates the severity of the injury.

In January 2014, UL published a report titled, *Table Saw Hazard Study on Finger Injuries Due to Blade Contact*.<sup>34</sup> The report provides an in-

depth study with hazard analyses, injury classification, and approach speed experiments. The intent of the research was to understand the circumstances that lead to hand/finger contact injuries for table saw operators and to help identify critical parameters to define the hazard level. The report identified the quantitative threshold between a simple and complex laceration of a finger at about 4 mm from the surface of the skin.

In February 2015, UL balloted a proposal to add AIM requirements for table saws to the *Standard for Stationary and Fixed Electric Tools*, UL 987. The performance requirements were based on a defined relationship between approach velocity of a finger to a rotating table saw blade and the depth of cut to the finger once contact has been made. The ballot proposed a performance requirement that introduced a surrogate test finger that demonstrates the proper triggering characteristics particular to the AIM technology to the table saw blade, at an approach rate of 1 m/s, and that limits the depth of cut to 4 mm or less, upon contact with the blade.

CPSC staff sent a letter to UL dated March 24, 2015, expressing staff's support of AIM requirements in the voluntary standard.<sup>35</sup> Staff also provided in-depth investigations (IDIs) of five incidents that occurred on table saws that met the UL standard for table saws at the time (and had a riving knife and modular blade guard). In April 2015, the ballot failed to reach consensus; the ballot received 14 votes against (versus 7 votes for) the proposal.

In March 2015, UL published a report titled, *General Characteristics of a Surrogate Finger for Table Saw Safety Testing*.<sup>36</sup> The report discusses the attributes of a human finger that could be used as the basis for triggering an AIM system and identified three primary methods to detect a human finger: Visual, electrical, and thermal.

In February 2016, UL balloted two proposals: (1) To adopt the first edition of International Electrotechnical Commission (IEC) 62841-3-1, *Standard for Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery—Safety—Part 3-1: Particular Requirements for Transportable Table Saws* as the first edition of UL 62841-3-1; and (2) to add AIM system requirements for table saws as part of the adoption of IEC or as part

of UL 987 (since UL 987 will be merged with IEC 62841-3-1).

Under the proposal, manufacturers were allowed the maximum latitude to design table saws to meet the requirements. The ballot proposed a performance requirement that introduces a conductive test probe, connected to a circuit, which mimics the electrical properties of a human body, to the table saw blade, at an approach rate of 1 m/s, and limited the depth of cut upon contact with the blade to 4 mm or less. The performance requirement also permitted other test probes to be used for AIM technology that depend on visual or thermal detection of finger contact to the blade.

CPSC staff sent a letter of comment to UL, dated March 11, 2016, expressing staff's support of AIM requirements in the voluntary standard for table saws.<sup>37</sup> In April 2016, the UL proposal for adoption of IEC 62841-3-1 reached consensus when the ballot received 15 votes in favor of (versus 2 votes against) the proposal. However, the proposal to add an AIM requirement did not reach consensus; the ballot received 12 votes against (versus 5 votes in favor of) the proposal. The ballots failed, in part, because the table saw industry objected to making AIM requirements part of the UL standard, and because they believed that the proposed requirements were not sufficiently developed.

## B. Voluntary Standards and Patent Policy

The American National Standards Institute (ANSI) has a patent policy<sup>38</sup> that is included in the *ANSI Essential Requirements: Due process requirements for American National Standards* (ANSI Requirements). This policy sets forth requirements that apply to situations in which a proposed voluntary standard may require the use of an essential patent claim. UL's Standards Patent Policy<sup>39</sup> contains requirements that are consistent with ANSI's policy.

Section 3.1 of the ANSI Requirements states that if an ANSI-Accredited

<sup>37</sup> Letter from Caroleene Paul, CPSC, to John Stimitz, UL, dated March 11, 2016. Available at: <https://www.cpsc.gov/s3fs-public/CPSClettertoULcommenttoAIMS.pdf>.

<sup>38</sup> See Section 3.1, *ANSI Patent Policy—Inclusion of Patents in American National Standards of the ANSI Essential Requirements: Due process requirements for American National Standards* (January 2017) available at: [https://share.ansi.org/shared%20documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/2017\\_ANSI\\_Essential\\_Requirements.pdf](https://share.ansi.org/shared%20documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/2017_ANSI_Essential_Requirements.pdf).

<sup>39</sup> See *UL Patent Policy* (March 1, 2017) available at: <http://ulstandards.ul.com/develop-standards/stps/ul-patentpolicy/?ga=l.154860536.1359786552.1492183496>.

<sup>33</sup> See <http://ulstandards.ul.com/about/harmonizing-standards/>.

<sup>34</sup> UL Research Report, 2014, *supra* note 26.

<sup>35</sup> Letter from Caroleene Paul, CPSC, to John Stimitz, UL, dated March 24, 2015. Available at: <https://www.cpsc.gov/s3fs-public/CPSClettertoULcommenttoAIMSproposalwenclosures.pdf>.

<sup>36</sup> UL Research Report, 2015, *supra* note 6.



Standards Developer (ASD) of a proposed American National Standard is informed that the standard may require the use of an essential patent claim, the ASD shall receive from the patent holder (or its authorized representative) written or electronic:

(a) Assurance in the form of a general disclaimer to the effect that such party does not hold and does not currently intend holding any essential patent claim(s); or

(b) assurance that a license to such essential patent claim(s) will be made available to applicants desiring to utilize the license for the purpose of implementing the standard either:<sup>40</sup>

(i) Under reasonable terms and conditions that are demonstrably free of any unfair discrimination; or

(ii) without compensation and under reasonable terms and conditions that are demonstrably free of any unfair discrimination.

According to these policies, it appears that a voluntary standard on table saws that may require the use of an essential patent claim might not be adopted if the ASD did not obtain one of the listed assurances from any essential patent holders.

### C. Adequacy of the Voluntary Standards in Addressing Injuries

Currently, no voluntary standard contains any requirements for AIM technology. CPSC staff does not believe the existing requirements for a riving knife and modular blade guard will adequately reduce the number or severity of blade-contact injuries on table saws because table saws have been equipped with these safety devices since 2009, and these safety devices have not been effective in reducing or mitigating blade-contact injuries. In 2011, staff evaluated the modular blade guard system and concluded that it is an improvement over the single hood guard design, but its effectiveness is still limited by users' willingness to use the guard.<sup>41</sup>

As discussed in section IV of the preamble, since the ANPR, CPSC staff has conducted a modular blade guard survey among owners of table saws with modular blade guards in 2015, reviewed incidents from the CPSRMS database to identify incidents involving table saws equipped with modular blade guard systems, and performed a trend analysis of the annual estimated number of emergency department-treated injuries associated with table saws from 2004 to 2015.

The modular blade guard survey assessed table saw users who own, or are familiar with, a table saw with the modular guard system.<sup>42</sup> Results of the survey indicate that a majority of respondents (80%) reported that there are circumstances that require the blade guard to be removed, and a majority of respondents did not use the blade guard "sometimes" (28%), "often" (17%), or "always" (14%). The results of the survey demonstrate that removal of the blade guard, traditional or modular, is a necessary and proper action when making certain cuts on table saws. In addition, many users choose not to use the modular blade guard at all. CPSC staff believes that any situation where the blade guard is not used eliminates the effectiveness of the blade guard in preventing blade-contact injuries. Accordingly, staff's review shows that reliance on the blade guard for injury prevention is insufficient because consumers have legitimate reasons for removing the guard or do not use it at all or only some of the time.

CPSC staff is also aware of at least 11 incidents from the CPSRMS database that involve table saws that meet the current voluntary standard requirements for riving knives and modular blade guards. Of those 11 incidents, four incidents involved amputation, two incidents involved laceration, and one incident involved laceration and fracture. These incidents show that blade-contact injuries continue to occur on table saws equipped with riving knives and modular blade guards, with and without the blade guard in use.

Moreover, as discussed above in section IV of the preamble and in TAB B of the staff briefing package, CPSC staff performed a trend analysis of the annual estimated number of emergency department-treated injuries associated with table saws from 2004 to 2015. This trend analysis includes the timespan before the voluntary standard implemented the requirement for riving knives and modular blade guards on table saws (2004 to 2009) and the timespan after the requirements were implemented (2010 to 2015). Staff concludes that there is no discernible change in the number of injuries or types of injuries related to table saw blade contact from 2004 to 2015. CPSC staff also performed a trend analysis for the risk of blade-contact injury per 10,000 table saws and concludes that there is no discernible change in the risk of injury associated with table saw blade contact from 2004 to 2015. Accordingly, the implementation of the riving knives

and modular blade guards requirements in the voluntary standards does not appear to have had an impact on the number or extent of blade-contact injuries on table saws.

Based on CPSC staff's evaluation of the data, the Commission concludes that the existing voluntary standard requirements for riving knives or modular blade guards will not prevent or adequately mitigate blade-contact injuries on table saws.

### D. OSHA Regulations

In addition to the voluntary standard, several Occupational Safety and Health Act of 1970 (OSHA) regulations apply to table saws that are used in the workplace. Under section 3(a)(5) of the CPSA, 15 U.S.C. 2052, a "consumer product" means, with certain exceptions, any article or component part thereof, produced or distributed for sale to, or use or consumption by, or enjoyment of, a consumer for use in or around a permanent or temporary household or residence, a school, in recreation, or otherwise. Section 31 of the CPSA, 15 U.S.C. 2080, provides that the Commission shall have no authority to regulate any risk of injury associated with a consumer product if such risk could be eliminated or reduced to a sufficient extent by action taken under OSHA. However, if the risk to consumers cannot be sufficiently reduced or eliminated by OSHA's actions, the CPSC has the authority to address that risk of injury associated with the consumer product.

OSHA currently has regulations on table saws used in the workplace, which are codified at 29 CFR 1910.213, Woodworking Machinery Requirements. The OSHA regulations require that table saws in the workplace include a blade guard, a spreader, and an anti-kickback device. 29 CFR 1910.213(c)&(d). The OSHA regulations require the saw be guarded by a hood with certain performance standards including, among other things, requirements that the hood be strong enough to withstand certain pressures, be adjustable to the thickness of the material being cut, and be constructed in a way to protect the operator from flying splinters and broken saw teeth. 29 CFR 1910.213(c)(1). The OSHA regulations also require inspection and maintenance of woodworking machinery. 29 CFR 1910.213(s). The existing OSHA regulations for table saws do not reflect the latest revisions to 8th edition of UL 987, which require riving knives and modular blade guards.

As discussed in the ANPR, CPSC staff found that the primary differences between consumer and professional

<sup>40</sup> The assurances under subsection (b) above are commonly referred to as FRAND Commitments (or fair, reasonable and non-discriminatory).

<sup>41</sup> 76 FR 62683.

<sup>42</sup> Sherehiy, B. and Nooraddini, I. (2016), *supra* note 11.

users of table saws are environment and training/experience.<sup>43</sup> In many work production environments where a specific cut is performed continuously, guards and safety cut-off switches are custom designed for that operation. The area is specifically designed to be as safe as possible, and safety is a continuous focus through warning/instruction signs and posters that are often displayed throughout the work area. The workplace is also subject to spontaneous inspection by OSHA inspectors; therefore, the prospect of being fined for safety violations increases the likelihood that workers or supervisors will help ensure safety codes are followed. In addition, professional woodworkers are in an industrial setting where employees often receive training on safety practices and in the proper use of the tool. Professional woodworkers are more likely to have had training and to be experienced in performing any special or complex operations with the saw and are more likely to recognize situations and set-ups that may be dangerous or require extra care and caution.

Conversely, as the ANPR further discussed, amateur woodworkers generally have little or no safety training, nor training in the proper use of the table saw.<sup>44</sup> They may take woodworking classes or obtain a training video, but there is no mechanism to encourage the home woodworker to use a table saw as safely as possible. The home users typically have far less experience than professional woodworkers and may discover dangerous or difficult operations only by actually experiencing near accidents or problems. The consumer woodworker also does not have the same OSHA-regulated protections in the home wood shop. The focus on a safe environment in a consumer setting depends on the knowledge and initiative of the home woodworker. For example, in a workplace, regulations require that unsafe saws be removed from service immediately, push sticks or push blocks be provided at the work place for guiding or pushing material past the blade, and emphasis be placed on the cleanliness around woodworking machinery and, in particular, the effective functioning of guards and prevention of fire hazards. 29 CFR 1910.213(s).

We continue to believe that OSHA regulations may not adequately reduce the risk of operator blade-contact injuries to consumers because OSHA's

regulations are intended primarily to ensure a safer work environment in the professional workplace setting, rather than the home woodworking environment. OSHA regulations rely on a comprehensive approach to promote safe practices in the workplace, including training and outreach, as well as mandatory safety standards and enforcement. These safeguards are not available to consumers operating table saws in a home woodworking environment.

Although the safety requirements provided in OSHA regulations would not address the home woodworking environment, we note that there is no clear dividing line between consumer and professional saws, except at the very highest levels of price and performance. We have little information on the proportion of occupational purchasers for contractor saws and cabinet saws. However, CPSC staff's review shows that, based on discussions with industry representatives, electrical requirements and power appear to provide the best distinction between table saws typically used by consumers and those used most often in industrial settings. Tables saws operating at 1.75 horsepower or greater likely cannot be run on typical household wiring. Most consumers do not have the necessary electrical wiring, specifically the specialized outlets and adapters, to accommodate power tools with horsepower ratings greater than 1.75 or requiring 220–240 volt power. Sliding table saws and many other cabinet saws require such electrical capabilities and, therefore, are less likely to be used by consumers. However, CPSC staff is aware of the development of a sliding saw aimed at the high-end do-it-yourself (DIY) market, and some serious woodworking hobbyists may wire their home workshops to accommodate the more powerful saws.

Although some of the more expensive, high voltage table saws are used in construction work or by professional wood workers, many of these same saws may also be used in the home, in schools, and in recreation (woodworking workshops and clubs). Therefore, the CPSC staff believes that these types of saws may be used more than occasionally by consumers. We note that the incident data reviewed by staff, as discussed in TAB B of the staff briefing package, excludes occupational injuries from the NEISS data, and are not included in the injury data estimates.

Based on CPSC staff's review, the Commission concludes that current OSHA regulations do not adequately address the unreasonable risk of blade-

contact injuries associated with table saws used by consumers, which include cabinet and contractor saws. However, the Commission seeks comment regarding whether the scope of the rule should be modified to exclude certain types of table saws that are primarily used for commercial or industrial use.

## VII. Overview and Basis for Proposed Requirements

As discussed in section V of the preamble, CPSC staff reviewed data analyses of finger injuries on table saws conducted by researchers at the University of Michigan in a study titled, "*Table saw injuries: epidemiology and a proposal for preventive measures*,"<sup>45</sup> and by UL in a report titled, "*Table Saw Hazard Study on Finger Injuries Due to Blade Contact*,"<sup>46</sup> to assess the extent and severity of lacerations to the finger or hand from table saw operator blade contact. UL determined that, based on measurements from the study, a depth of 4 mm is the maximum depth of cut to a finger before serious injury is sustained.<sup>47</sup>

After conducting a range of tests on sample table saws with AIM technology, CPSC staff developed a proposed performance requirement to reduce the severity of operator blade-contact injuries on table saws. The proposed requirement would require table saws to limit the depth of cut to 3.5 mm or less when a test probe, acting as surrogate for a human finger, contacts the spinning blade at a radial approach rate of 1 meter per second (m/s).

### A. CPSC Test Results on Existing AIM Technology

CPSC staff purchased samples of table saws with AIM technology and developed test protocols to evaluate the performance of the existing technology. UL report "*Table Saw Hazard Study on Finger Injuries Due to Blade Contact*" identified critical parameters that would define the hazard associated with a human finger/hand coming into contact with a spinning table saw blade.<sup>48</sup> The two critical parameters identified are:

(1) Approach velocity of the hand/finger when making contact with the table saw blade.

(2) Maximum depth of cut to the hand/finger that would distinguish between simple and complex lacerations.

Due to ethical considerations which prohibit the use of human subjects to

<sup>45</sup> Chung, K. and Shauver, M., 2014, *supra* note 25.

<sup>46</sup> UL Research Report, 2014, *supra* note 26.

<sup>47</sup> *Id.* at 18.

<sup>48</sup> *Id.* at 3.

<sup>43</sup> 76 FR 62682.

<sup>44</sup> *Id.*

test the AIM capability of a table saw to mitigate blade-contact injury, CPSC staff developed a performance test using a suitable test probe to serve as a surrogate for the human finger/hand. In the case of an AIM system that relies on electrical detection, staff developed an electric circuit mimicking human contact to trigger the AIM system. CPSC staff determined that effective injury mitigation can be defined by a maximum depth of cut to the test probe when it is introduced to the table saw blade at a prescribed approach rate. The allowable depth of cut in the probe represents the quantitative threshold between a simple and complex laceration, which is the difference between a minor injury and a severe injury to arteries, nerves, or tendons that requires microsurgery to repair. This threshold is 4 mm from the surface of the skin.

CPSC staff focused on test protocols that introduced a probe, as a substitute for a human finger, into the rotating saw blade and measured the resulting depth

of cut on the probe after activation of the table saw's AIM system. Staff determined that an AIM system based on electrical detection can be triggered by a conductive test probe that is coupled to an electric circuit that mimics the human body, hereafter referred to as the human body network (HBN).

The test probe requires two properties: (1) Electrical conductivity, and (2) volumetric and mechanical properties that allow depth of cut to be measured. The probe is electrically coupled to the HBN, which is a network of resistors and capacitors that approximate how the body would respond to an electrical signal. The body's response is the result of two physical properties of the human body: (1) Body resistance, which is a physical property of the human body that limits the flow of electrical current into the body when a voltage source is contacted, and (2) body capacitance, which is a physical property of the human body that allows the body to

store electrical charge from a voltage source. A detailed description of staff's development of the HBN for these tests is available in TAB A of the staff briefing package.

CPSC staff used a cuboid-shaped test probe made of conductive silicone rubber because the probe had already been developed by UL in its own testing of AIM technology and the probe was readily available. The test probe, shown in Figure 3, is made of low resistance, conductive silicone rubber measuring 12.5 mm x 12.5 mm x 60 mm. Staff determined that a layer of less conductive material to represent the epidermis (outer layer of skin) of a human finger is not necessary for AIM testing because the system is triggered by contact with conductive "flesh" once the epidermal layer has been broken. Therefore, for test triggering purposes, staff used a test probe that represents the conductive layer of human flesh once the epidermis has been cut by a table saw blade.

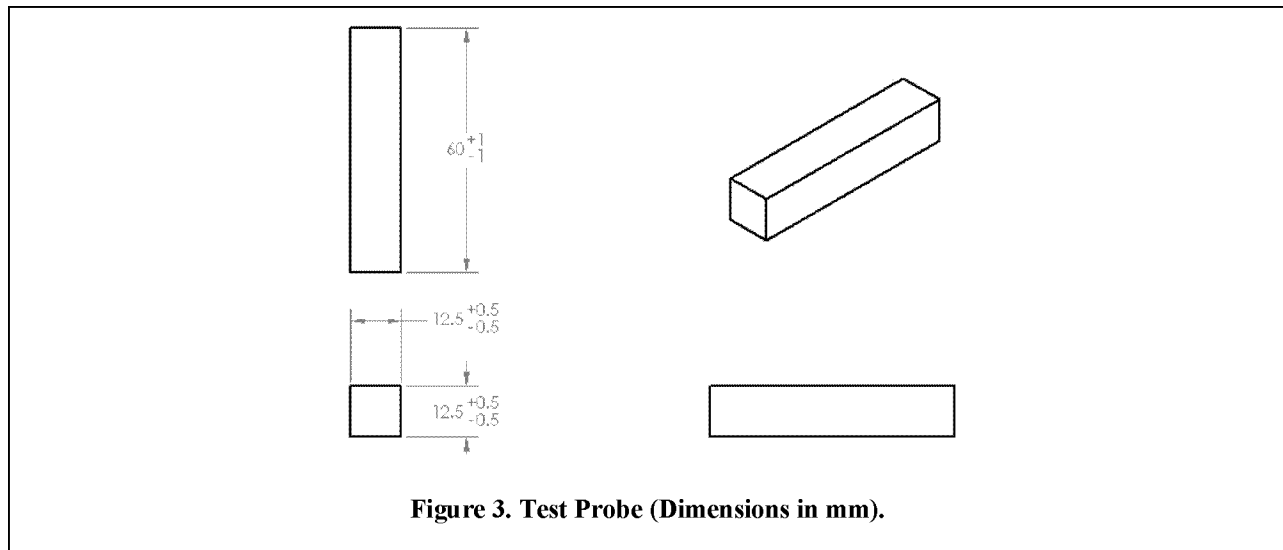


Figure 3. Test Probe (Dimensions in mm).

The quantitative threshold between a simple and complex laceration of a human finger is a 4.0 mm cut from the surface of the skin, and the mean epidermal thickness for a fingertip is  $0.369 \text{ mm} \pm 0.112 \text{ mm}$ , or a maximum thickness of approximately 0.5 mm.<sup>49</sup> Because the test probe represents human flesh beneath the epidermis, staff subtracted the 0.5 mm thickness of the epidermal layer of skin from the 4.0 mm threshold value to arrive at a 3.5 mm value for the maximum allowable depth of cut to the test probe. This 3.5

mm value represents the quantitative threshold between a simple and complex laceration of a human finger, as measured by the test probe.

Staff coupled the test probe to the HBN with a wire lead, fixed the probe in a holder attached to a computer-controlled linear actuator, and fastened the actuator to the table saw surface. This test protocol allowed staff to control the approach of the test probe to a rotating saw blade and to measure the depth of cut to the test probe after activation of the table saw's AIM system.

The approach rate of the test probe to the saw blade represents the rate of

speed at which a human finger moves toward the saw blade during a blade contact incident on a table saw. However, there is no standard body of data that quantifies finger/hand approach rate to the saw blade in a table saw incident, and CPSC staff analysis of blade contact incidents indicates that there are many scenarios in which an operator's finger/hand can contact a table saw blade. These scenarios are described in detail in TAB E of the staff briefing package. Sudden movement from kickback can cause the operator to lose control of the workpiece and cause his/her hand to fall into or be "pulled" into the blade. Hand/finger contact is

<sup>49</sup>Judi Whitton and J.D. Everall, "The Thickness of the Epidermis," *British Journal of Dermatology*, Vol. 89, Issue 5 (Nov. 1973) at 467-476.

also possible without kickback in situations where the operator's hand gets too close to the blade while feeding the workpiece or the operator is distracted and inadvertently contacts the saw blade.

In comments to the table saw ANPR published on October 11, 2011, SawStop presented analysis of the company's incident data (over 1,316 table saw incidents), which indicates approach rates to the blade occurred

between 3.6 in/s (91 mm/s) and 14.5 in/s (368 mm/s), and 14 percent of the incidents involved kickback of the workpiece.<sup>50</sup> In 2014, UL conducted its own analysis of approach rates and noted the difficulty of taking laboratory measurements of human subjects and translating that information to estimate the approach velocity of an operator's hand or finger toward the center of the saw blade, or radial component of the approach velocity, in an actual blade

contact incident (see Figure 4.)<sup>51</sup> UL considered its own analysis of SawStop's incident data, literature searches, and human subject experiments and determined that 39.4 in/s (1000 mm/s or 1 m/s) is a reasonable first-order estimate of a typical case in which a table saw operator accidentally contacts the saw blade.<sup>52</sup>

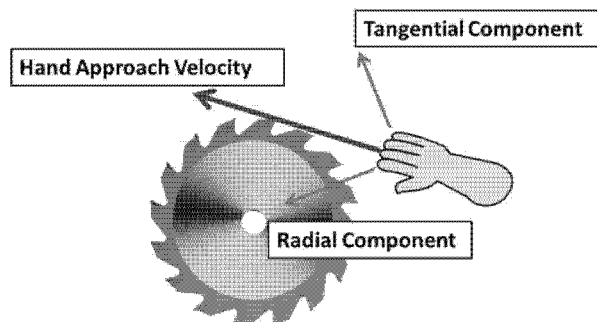


Figure 4. Components of Approach Velocity.

CPSC staff's analysis of operator behavior in table saw blade-contact injuries indicates that blade-contact injuries occur at approach rates that range from slow feeding of the workpiece when the operator's hand is close to the blade and inadvertent contact is made, to faster approach rates that occur when kickback of the workpiece causes the operator's hand to make contact with the blade. Staff concludes that a radial approach rate of 1 m/s is appropriate for a performance test because this is a high rate of speed for the radial component of the hand's approach rate to the saw blade. In addition, this radial approach rate is more than twice as fast as the highest radial approach rate calculated by SawStop in more than a thousand blade-contact injuries that activated their AIM system. Therefore, staff conducted all tests at an approach rate of 1 m/s.

CPSC staff developed a test method to evaluate various existing AIM systems to compare them to the performance standard limiting the depth of cut after triggering, using a test probe that can be used to evaluate the depth of cut when the probe makes contact with the rotating saw blade while approaching the blade at 1 m/s. Staff has used this test method on currently available AIM systems that use electrical sensing to

detect finger contact and injury mitigation after contact. The test method may work if a system were designed using visual tracking, or other means of detection, to mitigate injury after detection. However, the test probe used to test AIM systems based on other methods of detection should have the appropriate properties to trigger the system.

CPSC staff tested a SawStop JSS-MCA jobsite table saw and a Bosch REAXX™ jobsite table saw for AIM technology performance in accordance with the above test protocol. Both saws have 10-inch diameter blades, and the manufacturer's blades were used in all test runs. Staff ran tests with the probe connected to the HBN which was connected to the table saw's ground wire. Staff tested 11 HBN settings/configurations to represent the effect of mutual capacitance between the human body and its surroundings that increases the capacitance of the human body beyond its minimum self-capacitance of 50 pF in 50 pF steps up to 500 pF plus an additional short circuit test.<sup>53</sup> The HBN settings reflect a stepped increase in increments of 50 pF to cover a reasonable range of body capacitance. CPSC staff tested both table saws with 11 test probe activations at an approach rate of 1 m/s, and determined the probe

depth of cut for each test run. For all capacitance values, both the SawStop and Bosch table saws produced cuts that were under the 3.5 mm threshold for allowable depth of cut into the probe. The depth of cut for the SawStop table saw tests ranged from 1.5 mm to 2.8 mm and the depth of cut for the Bosch table saw tests ranged from 1.9 mm to 2.5 mm.

CPSC staff's test results indicate that table saws with AIM systems that rely on electrical detection were able to mitigate injury to a test probe, approaching toward the center of the rotating saw blade at a rate of 1 m/s, upon contact with the blade by limiting the depth of cut to 1.5 mm to 2.8 mm. These table saws limited the depth of cut well below the 3.5 mm threshold between a simple and complex laceration in a human finger, as measured by the test probe.

#### B. Proposed Requirement

CPSC staff's testing of the current AIM technology available on table saws in the U.S. market demonstrates that blade-contact injuries on table saws would be reduced if table saw manufacturers are required to meet a performance requirement for table saws that limits the depth of cut to the specified test probe, upon making contact with the

<sup>50</sup> Gass, S. (2012). Comments and Information Responsive to the ANPR for Table Saw Blade-contact injuries by SawStop, LLC. <https://www.regulations.gov/document?D=CPSC-2011-0074-1106>.

<sup>51</sup> UL Research Report, 2014, *supra* note 26 at 22.

<sup>52</sup> *Id.* at 5.

<sup>53</sup> The units for electrical capacitance is the farad (F). For most applications, the capacitance value is very small so the picofarad (pF) is used to denote one trillionth ( $10^{-12}$ ) of a farad.

saw blade at an approach rate of 1.0 m/s, to 3.5 mm. The proposed rule would require a test probe to act as surrogate for the human body/finger contact with the saw blade and to allow accurate measurement of the depth of cut.

Although the test probe and test method described in TAB A of the staff briefing package, are appropriate for the evaluation of AIM systems using an electrical detection system, other test probes and test methods using a different detection system may be developed to detect human body/finger contact with the saw blade and to measure depth of cut. There are many possible methods to detect human contact with a saw blade that range from electrical, optical, thermal, electromagnetic, to ultrasound and others. For example, a detection system could be developed that uses thermal sensing properties of the human body/finger or visual sensing and tracking of the human body/finger. The Commission believes that AIM systems using a different detection approach than what is currently on the market may be developed, based on sound material science and engineering knowledge.

Likewise, there are many different methods to limit the depth of cut to a probe. SawStop removes the blade from contact with the finger by stopping the blade and allowing angular momentum to retract the blade. The Bosch REAXX™ retracts the blade with an explosive discharge. Other ways of retracting the blade could include pneumatic (using high pressure air), or hydraulic (high pressure oil) systems. Another method to minimize blade contact could involve moving the finger or hand away from the blade by projecting the blade away from the hand or projecting the table upwards rather than retracting the blade. The Commission seeks comments on the feasibility of developing new AIM technology on table saws and whether different detection methods may be applied as part of an AIM system.

The proposed rule would establish a performance requirement, but it does not dictate how table saw manufacturers would meet those requirements. Rather, firms would have the flexibility to determine the appropriate technology to meet the specified performance requirement. In the staff's briefing package, CPSC staff has explained the test procedure and equipment that staff would use to assess compliance with an AIM system that uses electrical sensing technology. However, manufacturers need not use this particular test procedure, so long as the test method

they use effectively assesses compliance with the standard.

The Commission is aware that, currently, there are only two AIMs systems currently capable of mitigating a blade-contact injury, those used by SawStop and Bosch REAXX™, which operate by sensing electrical properties of the human body/finger and then retracting the blade. Although the Commission believes that new AIM technologies can be developed in addition to the existing AIM technologies to meet the performance requirements, if such new technologies cannot be developed, the Commission has considered the economic impacts on manufacturers who may be required to license the existing technologies. That discussion appears in section XI of the preamble and in TAB C of the staff briefing package.

### VIII. Stockpiling

In accordance with Section 9 of CPSA, the proposed rule contains a provision that would prohibit a manufacturer from "stockpiling," or substantially increasing the manufacture or importation of noncomplying table saws between the date that the proposed rule may be promulgated as a final rule and the final rule's effective date. The proposed rule would prohibit the manufacture or importation of noncomplying table saws in any period of 12 consecutive months between the date of promulgation of the final rule and the effective date, at a rate that is greater than 120% of the rate at which they manufactured or imported table saws during the base period for the manufacturer. The base period is any period of 365 consecutive days, chosen by the manufacturer or importer, in the 5-year period immediately preceding promulgation of the rule.

Assuming a promulgation date in 2018, the sales period from 2013–2017 (shipments were 600,000 in 2013 and 625,000 in 2014) would allow manufacturers to produce more than 720,000 saws (600,000 × 120 percent), assuming sales in years 2015 to 2017 are stable. In the longer term of 2002 to 2014, annual shipments averaged 675,000 table saws. The stockpiling limit would thus allow the industry to meet any foreseeable increase in the demand for table saws without allowing large quantities of table saws to be stockpiled.

### IX. Response to Comments

In this section, we describe and respond to comments to the table saw ANPR. We present a summary of comments by topic, followed by the Commission's response. The

Commission received over 1,600 comments in response to the ANPR. The comments can be viewed on [www.regulations.gov](http://www.regulations.gov) by searching under the docket number of the ANPR, CPSC–2011–0074. Approximately 134 commenters supported developing regulatory standards for table saws. The other commenters generally opposed the rulemaking proceeding. These comments are addressed below.

#### A. Mandatory Standard Would Create Monopoly

*Comment:* Numerous commenters stated that table saw performance requirements that mitigate blade-contact injuries would force all manufacturers to use the SawStop patented technology. Many commenters stated that mandating the use of the SawStop technology will result in a monopoly and stifle innovation, granting an unfair advantage to one company. Commenters stated that table saw performance requirements would be "a design standard" because SawStop's parent company (SD3, LLC) owns a number of U.S. patents for sensing technology and blade braking and blade retracting technology. Some commenters stated that if the CPSC did not mandate a particular technology, other companies could introduce their own safety technologies, some of which may prove to be better than SawStop's technology. Some commenters predicted that if CPSC did not mandate the SawStop AIM technology, other injury mitigation technologies would be developed and the competition among the technologies would eventually bring down the prices associated with these new technologies.

*Response:* The proposed performance requirements would not require manufacturers to use the SawStop patented technology. The proposed rule does not mandate a particular detection method or test method to mitigate blade-contact injury. The proposed performance requirement for table saws limits the depth of cut to a test probe, upon making contact with the saw blade at a radial approach rate of 1.0 m/s, to 3.5 mm. Any test probe that is used must act as a surrogate for a human body/finger to ensure that the depth of the cut can be measured properly upon contact with the saw blade. There are many methods to detect human contact with a saw blade that range from electrical, optical, thermal, electromagnetic, to ultrasound and others. Likewise, there are many methods to limit the depth of cut to a probe that would not require retraction of the saw blade. Although all of these different systems do not yet exist, such AIM systems may be developed.

Although the proposed rule does not require a particular AIM technology, the Commission is aware that, currently, there are only two AIMs systems capable of mitigating a blade-contact injury, those used by SawStop and Bosch REAXX™. Both of these systems operate by sensing electrical properties of the human body/finger and limiting the depth of cut by retraction of the blade.

The Commission is also aware of ongoing litigation between SawStop and other table saw manufacturers, including Bosch. For example, on July 16, 2015, SawStop filed a complaint against Bosch at the ITC, requesting an investigation under section 337 of the Tariff Act of 1930, to limit entry into the United States of the Bosch REAXX™ table saws that allegedly infringed on several SawStop patents. *In the Matter of Certain Table Saws Incorporating Active Injury Mitigation Technology and Components Thereof*, Investigation No. 337-TA-965. The status of litigation between Bosch and SawStop is ongoing and has not been resolved. We note that some of the allegedly infringed upon patents may expire in 2020, and 2022, which may resolve the patent issues in the ITC investigation. However, we do not know what other SawStop patents may be impacted by companies that attempt alternative AIM technologies, nor do we know the expiration dates of the other existing SawStop patents given that SawStop filed more than 100 patents with the U.S. Patent and Trademark Office related to SawStop's woodworking safety systems. Therefore, it is possible that any injury mitigation system on a table saw that relies on sensing electrical properties, or other properties of the human body and finger, and engages a reaction system may potentially infringe on a SawStop patent.<sup>54</sup>

The outcome of ongoing lawsuits involving the SawStop technology will determine some of the impacts that may result from a mandatory rule requiring AIM technology for table saws. If the courts determine that the patents covering the SawStop technology allow for companies to manufacture their own saws with alternative AIM technologies (such as the Bosch REAXX™ saw), then some manufacturers may choose to try to develop their own proprietary technology or license the Bosch

technology (if available) as an alternative to the SawStop technology.

Alternatively, if the courts decide that other technologies do, in fact, infringe upon SawStop patents, then SawStop may effectively have a monopoly on the technology needed to comply with a mandatory rule, until SawStop's patents expire. However, even if the patents expire, if new AIM technology is not developed, other manufacturers likely would be required to work with SawStop and/or Bosch to license the SawStop or Bosch technologies for use in their saws. Even if all of the relevant patents eventually become public, many manufacturers may not be able to develop their own AIM system, and will either have to license the technology or exit the table saw market. As discussed in section XI of the preamble and in TAB C of the staff briefing package, the level at which the royalty payments are set will play a significant role in determining the economic impacts that CPSC's rule could have on table saw manufacturers.

#### B. Voluntary Standard Process

1. *Comment:* Numerous commenters stated that CPSC staff should work with the table saw industry to offer solutions. The commenters stated that the voluntary standards process is working and has resulted in the addition of a permanent riving knife on all table saws. In addition, other commenters stated that the industry has also required the modular blade guard on all table saws, which has improved the safety of table saws.

Numerous commenters also stated that current table saws (some referring to older table saws with traditional blade guards, and some referring to newer table saws with riving knives and modular blade guards) are safe, if used properly. Many commenters cited their own personal experiences with table saw use and claimed that because they have not had an injury this proves that current table saws are safe.

*Response:* CPSC staff performed a trend analysis of the annual estimated number of emergency department-treated table saw blade-contact injuries from 2004 to 2015. This trend analysis includes the timespan before the voluntary standard required riving knives and modular blade guards on table saws (2004 to 2009) and the timespan after the requirements were implemented (2010 to 2015). Staff's review shows that there is no discernible change in the number of injuries or types of injuries related to table saws from 2004 to 2015. CPSC staff then analyzed the risk of blade-contact injury per 10,000 table saws in use for

each year in the analysis. CPSC staff performed a trend analysis on the risk of blade-contact injuries and found that there is no discernible change in the risk of blade-contact injury associated with table saws from 2004 to 2015.

In addition, staff is aware of at least 11 incidents from the CPSC database (2004–2015) that involve table saws that meet the current voluntary standard requirements for a riving knife and modular blade guard. A riving knife may reduce the occurrence of kickback (that can lead to unexpected stock movement and finger/hand contact with the blade) on a table saw, but kickback can still occur on table saws equipped with a riving knife. Furthermore, reducing kickback will not eliminate blade-contact injuries because blade-contact injuries can occur without kickback of the stock.

The new modular blade guard system is a significant improvement over the old guard design; however, the effectiveness of any blade guard system depends upon an operator's willingness to use it. Results of the modular blade guard survey in 2015 of table saw owners with modular blade guards indicate that a majority of respondents (80%) reported that there are circumstances that require the blade guard to be removed and a majority of respondents removed the blade guard "sometimes" (28%), "often" (17%) or "always" (14%).<sup>55</sup> The results of the user survey demonstrate that removal of the blade guard is a necessary and proper action when making certain cuts on table saws. In addition, many users choose not to use the modular blade guard at all or only some of the time. Any situation where the blade guard is not used eliminates the effectiveness of the blade guard in preventing blade-contact injuries.

Based on the trend analysis of blade-contact injuries and risk of blade-contact injuries from 2004 to 2015, the CPSC incidents, and staff's review of responses to the modular blade guard survey, the Commission does not see evidence that the voluntary standard requirements have reduced or changed blade-contact injuries on table saws. In addition, CPSC staff has participated with the table saw industry and other stakeholders in UL working groups since September 2011 to develop safety standards for table saws. UL proposed AIM system performance requirements for table saws in February 2015 and February 2016, which indicates that the voluntary standards governing body believes that table saws should exhibit

<sup>54</sup> SawStop has also filed antitrust claims alleging that several major table saw manufacturers conspired to boycott SawStop's safety technology and manipulate safety standards. See *SawStop LLC v. Black & Decker, et. al*, 801 F.3d 412 (4th Cir. 2015); *SawStop LLC v. Black & Decker, et. al*, CV No. 1:14-cv-00191, 2016 WL 6093488 (E.D.Va. Oct. 18, 2016).

<sup>55</sup> Sherehly, B. and Nooraddini, I. (2016), *supra* note 11.

active injury mitigation performance. However, despite these efforts, the AIM requirements have not been adopted in the UL standard. Therefore, the Commission believes that the voluntary standard activities have not been effective at addressing blade-contact injuries on table saws.

### C. Consumer Choice

1. *Comment:* Numerous commenters stated that table saw users should be responsible for their actions, should use common sense when operating the table saw, and should accept the risk of using a table saw. Many commenters stated that SawStop table saws are already available and the free market system should determine whether or not consumers will purchase a table saw with enhanced safety features. Many of these same commenters opposed any mandate from the federal government to make table saws safer. These commenters contended that the federal government should not regulate consumer choice or behavior. Many commenters stated that other products can also cause injury such as knives or band saws and ask if the CPSC will regulate those products as well. Other commenters argued that lawsuits against table saw manufacturers reward users who are irresponsible and use table saws improperly.

*Response:* CPSC staff's analysis of blade contact incidents indicates that there are many scenarios in which an operator's finger/hand can contact a table saw blade, and there are certain cuts on table saws that require removal of the blade guard. Therefore, an operator's decision to use a table saw without all safety devices does not necessarily indicate intentional neglect or ignorance on the part of the operator. Sudden movement of the workpiece from kickback can cause the operator to lose control of the workpiece and cause his/her hand to fall into or be "pulled" into the blade. Hand/finger contact is also possible without kickback, in situations where the operator's hand gets too close to the blade while feeding the workpiece or the operator is distracted and inadvertently contacts the saw blade. In addition, many of the scenarios leading to blade contact may be more likely if the consumer is tired or if the view of the blade, or cut, is impaired in some way.

An estimated 4,700 amputations related to table saws occur each year. When compared to all other types of consumer products, an estimated 18.6 percent of all amputations in the NEISS in 2015 are related to table saws. When compared to all other workshop products, table saws accounted for an

estimated 52.4 percent of all amputations related to workshop products in 2015. Based on the severity of injuries and recurring hazard patterns of blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the risk of injuries associated with blade contact on table saws.

2. *Comment:* Many commenters supported preserving consumer choice in the table saw market by not mandating AIM technology. Most wanted table saws equipped with AIM technology to be available, and some even stated that they owned a SawStop saw; however, they wanted to preserve the option to purchase less expensive table saws not equipped with an AIM technology. Many commenters stated that the consumer should decide whether table saws equipped with AIM technology are worth the increased cost. Some commenters stated that there are already safety devices, such as splitters, blade guards, and push sticks, which if used properly, will reduce injuries; and therefore, consumers who properly use these devices should not be forced to pay more for saws with AIM technology. Some commenters requested that manufacturers be required to offer at least one table saw with AIM technology, instead of requiring all table saws to be equipped with the technology. Other commenters noted that saws equipped with AIM technology are already available in the marketplace and if consumers wanted these saws, they could purchase them.

*Response:* We acknowledge that, although some consumers would prefer table saws with the AIM technology, other consumers would prefer to have the option to purchase a table saw without the AIM technology. In addition, some consumers may also prefer the use of passive table saw safety devices, as opposed to the AIM technology. However, the Commission believes that while the proposed rule would prevent consumers from purchasing table saws without some type of AIM technology, the proposed requirement would also substantially reduce the serious blade-contact injuries involving table saws every year. In addressing the blade contact risk, the Commission must weigh the costs of blade-contact injuries against the cost of limiting consumer choice and the rule's potential effect on the utility, cost, and product availability to consumers.

As discussed in section XI of the preamble and in TAB C of the staff briefing package, the Commission considered the costs and benefits of proposing the rule. Based on estimates

from NEISS and the CPSC's Injury Cost Model (ICM), the proposed rule would address an estimated 54,800 medically treated blade-contact injuries annually. The societal costs of these injuries (in 2014 dollars and using a 3 percent discount rate) amounted to about \$4.06 billion in 2015. Amputations accounted for about 14 percent of the medically treated blade-contact injuries but almost two-thirds of the injury costs. Overall, medical costs and work losses account for about 30 percent of these costs, or about \$1.2 billion. The intangible costs associated with pain and suffering account for the remaining 70 percent of injury costs. Because of the substantial societal costs attributable to blade-contact injuries, and the expected high rate of effectiveness of the proposed requirement in preventing blade-contact injuries, the estimated net benefits (*i.e.*, benefits minus costs) for the market as a whole averaged \$1,500 to \$4,000 per saw. Aggregate net benefits on an annual basis could amount to about \$625 million to about \$2,300 million.

However, the Commission also considered alternatives to the rule, including no regulatory action, deferring to the voluntary standard, later effective dates, exempting certain classes or types of table saws, and information and education campaigns. These alternatives are discussed in detail in section XI.J. of the preamble and TAB C of the staff briefing package. The Commission determined preliminarily that the various alternatives would not greatly reduce the number of blade-contact injuries that would be addressed by the proposed rule. Based on the severity of injuries and recurring hazard patterns of blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries on all table saws. However, the Commission seeks comment on various alternatives that would not require all table saws to be produced with the AIM technology.

### D. Table Saw Incident Data Analysis

1. *Comment:* Numerous commenters stated that CPSC staff injury data analysis was faulty because it did not include the effects of the modular blade guard system. Specifically, the commenters argued that a meaningful analysis cannot be completed based on the 2007–2008 Injury Report because it includes data only related to old guard designs rather than the new modular blade guarding system. The Power Tool Industry (PTI) estimated that, in 2012, more than 900,000 table saws had been sold since 2007 that use the modular



blade guard. Some commenters stated that CPSC staff failed to estimate the risk of injury associated with table saw use, and that this data is needed to evaluate the effectiveness of the voluntary standard requirements for a riving knife and modular guard on table saws.

*Response:* For the proposed rule, CPSC staff estimated the yearly table saw blade-contact injuries from 2004 to 2015 by using estimates from NEISS. The date range for the trend analysis includes a timespan before the voluntary standard required table saws to be equipped with a riving knife and modular blade guard (2004 to 2009) and a timespan after the voluntary standard requirements became effective on most table saws (2010 to 2015). A proportion of table saws manufactured before the current voluntary standard became effective is expected to remain in use throughout this whole period. However, in more recent years, after the current voluntary standard became effective, an increasing proportion of table saws in use conforms to the current voluntary standard. Thus, if the voluntary standard was positively impacting the number or severity of injuries, there would be a steady decrease in the number of injuries or severity of injuries as the proportion of compliant table saws increased. However, the data reviewed by CPSC staff do not indicate that requirements in the voluntary standard have had any impact in reducing the number or severity of blade-contact injuries on table saws.

CPSC staff performed trend analyses for blade-contact injuries, as well as blade contact amputations, hospitalizations, and finger/hand injuries from 2004 to 2015. CPSC staff concludes that there is no discernible change in the number of blade-contact injuries or types of injuries related to table saw blade contact from 2004 to 2015. CPSC staff also performed a trend analysis for the risk of blade-contact injury per 10,000 table saws and, likewise, concludes that there is no discernible change in the risk of injury associated with table saws from 2004 to 2015.

CPSC staff has also reviewed incidents reported through means other than the NEISS, which are entered in the CPSC's CPSRMS database. Of the 53 incidents identified in the CPSRMS database that were reported in the period from 2004 to 2015, 36 involved table saws with a traditional blade guard and 11 involved table saws with a modular blade guard. A review of the reports indicates that the incident scenarios for table saws with modular blade guards are similar to incidents

involving table saws with traditional blade guards in terms of their use with and without blade guards and accidents occurring with and without unexpected stock movement from kickback of the material. In addition, the modular blade guard survey conducted by the CPSC in 2015 indicates that consumers frequently remove the modular blade guard to perform certain cuts, or do not use the modular blade guard at all or only some of the time.

Based on the trend analysis of blade-contact injuries and risk of blade-contact injuries dating from 2004 to 2015 conducted by staff, plus anecdotal evidence from CPSRMS that blade-contact injuries continue to occur on table saws that meet the current voluntary standards requirements, and results from the modular blade guard survey, the Commission does not see evidence that the voluntary standard requirements for riving knives or modular blade guards have reduced or mitigated blade-contact injuries on table saws. Accordingly, the Commission believes that the proposed performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries associated with table saws.

*2. Comment:* One commenter questioned the results of the 2007–2008 NEISS special study indicating that 68.7 percent of saws involved in incidents were fixed cabinet saws, 18.3 percent were semi-portable contractor saws, and 10.5 percent were portable bench saws. The commenter stated the results were inconsistent with other data in the survey regarding the table saws' characteristics.

*Response:* CPSC staff conducted a re-analysis of the saw type and drive type responses provided by the injury victims in the 2007–2008 special study and published the results of the re-analysis in June 2014. CPSC staff stated that consideration should be given to staff's finding that the distribution of injuries for different types of saws cannot be based on how respondents answered questions about the type of saw.<sup>56</sup> However, as discussed in section IV of the preamble, the Commission is not relying on any data used in the 2007–2008 special study for the proposed rule.

*3. Comment:* Several commenters stated that most table saw injuries are caused by kickback of the workpiece and the SawStop system does not prevent kickback. Others stated that

riving knives will eliminate kickback and therefore reduce most injuries.

*Response:* Based on CPSC staff's review of the data, the Commission believes that while the proposed rule would not eliminate kickback, the proposed performance requirement would reduce injuries that occur when kickback results in blade contact. CPSC staff's analysis of blade contact incidents indicates that there are many scenarios in which an operator's finger/hand can contact a table saw blade and there are certain cuts on table saws that require removal of the blade guard. Sudden movement of the workpiece from kickback can cause the operator to lose control of the workpiece and cause his/her hand to fall into or be "pulled" into the blade. However, hand/finger contact is also possible without kickback when the operator's hand gets too close to the blade while feeding the workpiece, or when the operator is distracted and inadvertently contacts the saw blade.

CPSC staff identified 53 incidents in the CPSRMS database that involve blade-contact injury on a table saw that occurred between January 1, 2004 and December 31, 2015, and were reported to CPSC by March 1, 2016. For the majority of incidents, it is unknown whether unexpected workpiece movement was involved in the blade contact. However, of the incidents where information about the contribution of workpiece movement was known, most blade-contact injuries involved some type of unexpected workpiece movement. In addition, 11 of the 53 incidents involved table saws that meet the current voluntary standard requirements for a riving knife and modular blade guard. CPSC staff believes that the data show that blade-contact injuries continue to occur on table saws equipped with a riving knife and modular blade guard.

*4. Comment:* One commenter claimed that the full NEISS sample overestimated the number of table saw blade-contact injuries in 2007–2008 based on estimates from the National Electronic Injury Surveillance System—All Injury Program (NEISS–AIP). More specifically, the commenter argued that because the proportion of NEISS–AIP amputations (52%) treated in hospital emergency department(s) (ED) was statistically less than the proportion of ED amputations from the full NEISS estimate, NEISS–AIP is the appropriate and preferable sample to use when making national estimates of table saw ED injuries.

*Response:* In the proposed rule, CPSC staff has reviewed updated incident data based on estimates from NEISS hospital

<sup>56</sup> See <http://www.cpsc.gov/Global/Research-and-Statistics/Injury-Statistics/Home%20Maintenance%20and%20Construction/CoverpageandMemoofStaffAnalysisofTableSawTypeinNEISSSpecialStudy.pdf>.



records for injuries related to product code 0841 (table or bench saws) for 2015. For the ANPR, staff's estimate of ED-treated blade-contact injuries for table saws, including the estimate of ED-treated amputations, was based on the weighted national estimate of actual blade-contact injuries reported through the full NEISS sample of hospitals during 2007–2008. NEISS is a stratified national probability sample of approximately 100 U.S. hospital EDs that allows the CPSC to make statistically valid national estimates of product-related injuries treated in U.S. hospital EDs. The NEISS–AIP is a statistical subsample of the full NEISS sample that is administered by the CDC and consists of approximately two-thirds of the NEISS hospitals in each stratum. This subsample collects information on injuries outside CPSC's jurisdiction, including occupational, motor vehicle, boating, and other injuries.

For table saw injuries (product code = 0841) in 2007–2008, approximately 62 percent of the weighted national estimate comes from the hospitals in the NEISS–AIP subsample. Although the commenter estimated that amputations from the NEISS–AIP subsample accounted for only about 52 percent of amputations from the total NEISS sample and reported that the difference was statistically significant, contrary to the commenter's assertions, the proportion of amputations coming from NEISS–AIP was not, in fact, statistically different than the overall national estimate of table saw injuries that came from the full NEISS sample.

#### E. Economic Issues

1. *Comment:* One commenter stated that CPSC staff gives no basis for projecting injury estimates derived from NEISS onto other medically treated injuries to obtain a national injury rate for table saws. The commenter noted that other estimates of table saw-related injuries differ from CPSC's; using the NIOSH hospital sample, the average total number of work-related injuries treated in hospital emergency rooms for table saws was below the CPSC estimate. The commenter asserted that, to the extent that more serious injuries are likely to be treated in emergency rooms, the mix of injury severity based on the NEISS data overstates the severity mix once the injury total is multiplied by a set factor.

*Response:* The CPSC staff uses the CPSC's ICM to project the number of medically treated injuries treated outside of hospital emergency departments (e.g., non-ED office visits, including medical treatment in doctor's

offices, emergency clinics, ambulatory care centers, etc.).<sup>57</sup> As described more fully in section XI of the preamble and TAB C of the staff briefing package, estimates were derived from empirical relationships between ED-treated injuries and injuries treated in other settings, based on National Health Interview Survey records (which provided detailed information on where the injuries were treated) stretching over 10 years.

The estimate of occupational table saw injuries treated in hospital EDs is not relevant for the table saw analysis. The CPSC excludes occupational injuries from the CPSC estimate of consumer injuries whenever possible. Moreover, the NIOSH estimates mentioned by the commenter were not based on a "NIOSH hospital sample." Rather they were based on the NEISS–AIP, a subsample of NEISS hospitals administered by the CDC. The AIP subsample covers a much broader range of injuries, i.e. occupational, motor vehicle, boating and other injuries, in addition to injuries that are consumer product related, so the number of records collected is much higher for the AIP subsample. Thus, the results for the CPSC estimate of consumer injuries and the NIOSH estimate of occupational injuries are not inconsistent.

Finally, the mix of injury severities from the NEISS ED injury sample was not simply projected onto the estimate of injuries treated outside of hospital EDs. Rather, the estimates were based on the characteristics of injuries and victims treated outside of hospital EDs. For example, based on information from the National Health Interview Survey, a 40-year-old woman is almost twice as likely to be treated in a doctor's office (or some other non-ED settings) with a fractured clavicle than would a 10-year-old boy.<sup>58</sup> Consequently, for this example, the ICM would estimate more injuries treated outside the emergency room for 40-year-old women and fewer injuries treated outside of hospital EDs for 10-year-old boys. The more serious and life threatening injuries are more likely to be treated in hospital

emergency rooms, and this is reflected in the CPSC injury estimates.

2. *Comment:* Two commenters focused on several aspects of the economic value of injury risks used by the CPSC in its 2011 analysis. One commenter suggested that the CPSC did not provide any supporting data for any of the four cost components of the ICM: Medical treatment, lost time from work, product liability costs, and pain and suffering. The commenter suggested that counting product liability costs as well as pain and suffering may lead to double counting. Furthermore, the commenter asserted that the appropriate method for assessing the benefits from public programs is society's willingness to pay to avert small risks, an *ex ante* amount, as opposed to a retrospective piecemeal approach adopted by the CPSC. Finally, this commenter noted that even if jury awards for pain and suffering corresponded to willingness to pay values, there is no justification for applying these rates to all table saw injuries. Another commenter stated that the pain and suffering portion of the ICM injury cost estimates are overstated and inappropriate.

*Response:* The methodology and data supporting the various components in the ICM are described in section XI of the preamble and in TAB C of the staff briefing package. The societal costs of blade-contact injuries represent the pool from which the benefits of a blade contact rule are derived. The societal costs of these injuries are quantified with the ICM. The ICM is fully integrated with NEISS, and, in addition to providing estimates of the societal costs of injuries reported through NEISS, it also estimates the costs of medically treated injuries that are treated outside of hospital EDs. The major aggregated societal cost components provided by the ICM include medical costs, work losses, and the intangible costs associated with lost quality of life or pain and suffering. In recent years, CPSC staff has excluded the product liability costs from ICM cost estimates. Although this component was intended to represent the costs of administering the product liability system in the United States, there was the possibility of some double counting, as suggested by the commenter. Accordingly, product liability costs administration costs are not included in the proposed rule.

The commenter also promotes the concept of willingness-to-pay over the method used by CPSC staff to estimate the likely benefits of regulation. CPSC does use willingness-to-pay estimates in valuing fatal injuries. However, such estimates do not generally exist for

<sup>57</sup> Miller, Lawrence, Jensen, Waehrer, Spicer, Lestina, Cohen. *The Consumer Product Safety Commission's Revised Injury Cost Model* (Dec. 2000), available at: <https://www.cpsc.gov/PageFiles/100269/costmodel1.PDF>. Since the table saw ANPR was published, the methodology for projecting the number of non-ED-treated injuries has been updated. It is described in: *Revised Incidence Estimates for Non-Fatal, Non-Hospitalized Consumer Product Injuries Treated Outside Emergency Departments*, Bruce Lawrence, Pacific Institute for Research and Evaluation, Calverton, MD, (April 2013).

<sup>58</sup> Miller et al., 2000, *supra* note 57, Table 6.

nonfatal injuries, such as blade-contact injuries on table saws.

3. *Comment:* One commenter asserted that the injury data used by CPSC's staff to estimate societal costs in its 2011 analysis were based on extrapolations that were imprecise and resulted in greatly overstated societal costs. The commenter based this statement on two factors. First, the commenter asserted that injury costs should be limited to blade-contact injuries reported through hospital emergency rooms. Second, because only about 11 percent of ED-treated injuries resulted in hospitalization, the commenter suggested that inclusion of the ED-treated and released injuries greatly exaggerated the CPSC estimate of societal costs.

*Response:* CPSC staff uses the ICM to project the number of medically treated injuries treated outside of hospital emergency departments, and the costs of those injuries. Estimates were derived from empirical relationships between ED-treated injuries and injuries treated in other settings, and based on National Health Interview Survey records (which provided detailed information on where the injuries were treated) stretching over 10 years.<sup>59</sup> Cost estimates for the injuries treated outside of hospital emergency departments are generally less than the costs of injuries initially treated in emergency rooms. To exclude injuries treated outside of hospital emergency departments would severely underestimate the types and costs of injuries associated with table saw use.

Moreover, while it is true that costs associated with injuries that were treated and released from emergency departments are substantially less than hospitalized injuries, the costs associated with treated and released injuries can still be substantial. To exclude the treated and released injuries, which typically account for about 90 percent to 95 percent of table saw injuries presenting at hospital EDs, would substantially underestimate the cost of table saw injuries.

4. *Comment:* One commenter asserted that the methodology CPSC uses to extrapolate from ED-treated injuries to all medically treated injuries does not acknowledge that table saw injuries are likely to be more serious, and thus, more likely to require treatment in a hospital ED, than injuries involving fingers, wrists, hands, and lower arms that are associated with other consumer products. Accordingly, the commenter contended that the ICM overstates the annual number of blade-contact injuries treated during non-ED office visits. The

commenter suggested that this purported error would be corrected by reducing CPSC's estimate of non-ED office visits (based on ratios involving rates of hospitalization). The commenter concluded that there were about 42,800 medically attended blade-contact injuries involving table saws annually during 2007–2008, about 36 percent less than CPSC's estimate of 67,300.

*Response:* CPSC staff's review of 2015 data, based on estimates from NEISS and the CPSC's ICM, shows that the draft proposed rule would address an estimated 54,800 medically treated blade-contact injuries annually. As described in more detail in section XI of the preamble, and TAB C of the staff briefing package, the ICM uses empirically derived relationships between ED-treated injuries and injuries treated in other settings to estimate the number of injuries treated outside of hospital EDs. The methodology does not use a single 1 to 1 extrapolation factor, as suggested by the commenter. Nor does it estimate non-ED table saw blade-contact injuries by assuming "that the average injury severity (and thus the likelihood of seeking ED treatment) is comparable to that for other types of products," as suggested by the commenter. Rather, based on national survey data from the National Health Interview Survey, the ICM uses information on the age, sex, diagnosis (e.g., fracture, amputation), body part, and injury disposition to estimate injuries treated in non-ED settings. For example, according to national survey data (from the National Health Interview Survey), a 40-year-old woman is almost twice as likely to go to a doctor's office, an emergency clinic, or some other non-ED office setting with a fractured clavicle as a 10-year-old boy. Consequently, as suggested by this example, the ICM estimates more injuries treated outside the emergency room for certain combinations of injury and victim characteristics. For other types of injuries, a greater proportion would be treated in hospital emergency rooms.

The ICM uses a classification tree that takes into account age, gender, body part, and injury diagnosis in determining the ratios of non-ED office visits to ED-treated injuries. Thus, for example, estimates of non-ED doctor-treated finger amputations involving table saws are not product specific, but rather, are based on general ratios of finger amputations involving all consumer products in each of the medical treatment settings (*i.e.*, the ratio of finger amputations treated in the EDs to amputations treated in non-ED office visits), with adjustments for the other

factors noted above. At the time of the ANPR, these estimates were based on an analysis of 10 years of data from the National Health Interview Survey (NHIS, 1987 to 1996) which provided information on the proportion of finger amputations initially treated in the ED relative to the proportion of finger amputations initially treated outside of the ED during non-ED office visits. The current version of the ICM uses data from the 1996–2007 Medical Expenditure Panel Survey (MEPS) using the same classification tree methodology to estimate the proportion of injuries treated outside the ED.<sup>60</sup>

The hospital admitted injuries that the commenter discussed are used by the ICM only to estimate the injuries that bypass the emergency room and are admitted directly to the hospital. Injuries that bypass the ED, but result in hospitalization would, for example, include cases in which an injury is initially treated in a doctor's office, but the doctor decides that the victim should be hospitalized immediately. One medical facility, the Maryland Institute for Emergency Medical Services Systems (MIEMSS) also directly admits trauma victims. The ratio used for estimating these direct admissions was computed with data from the National Ambulatory Medical Care Survey and the National Hospital Discharge Survey.<sup>61</sup>

The commenter points out that, when compared to injuries involving other products, a higher proportion of table saw blade-contact injuries that are treated initially in hospital EDs result in hospital admission. Based on NEISS estimates, this statement is correct. It may also suggest that, relative to other product-related hazards, a higher proportion of blade-contact injuries is likely to be treated initially in hospital EDs as opposed to non-ED settings (a conclusion that is fully consistent with the staff's ICM estimates of table saw blade-contact injuries). However, this conclusion is not sufficient to allow us to quantify directly the proportion of blade-contact injuries treated outside the ED. Nor does it imply, by itself, that the ICM has overestimated the number of table saw injuries initially treated in non-ED office visits or that the number of injuries treated outside of hospital

<sup>60</sup> Lawrence, 2013, *supra* note 57.

<sup>61</sup> Since the ANPR was published, the methodology for projecting the number of admitted injuries bypassing the emergency room has been updated and is described in Bhattacharya, S., Lawrence, B., Miller, T.R., Zaloshnja, E., Jones, P.R., *Ratios for Computing Medically Treated Injury Incidence and Its Standard Error from NEISS Data* (Contract CPSC–D–05–0006, Task Order 8). Calverton, MD: Pacific Institute for Research and Evaluation, (Aug. 2012).

<sup>59</sup> Miller *et al.*, 2000, *supra* note 57.

EDs should be lowered. The ICM bases estimates of non-ED office visits on 10 years of NHIS data showing the relationship between injuries treated in the ED and injuries treated elsewhere.

To estimate the number of injuries treated in non-ED settings, the commenter applied diagnosis-specific ratios of the hospitalization rate for table saw injuries to the hospitalization rate for other products. However, this appears to be an *ad hoc* procedure for reducing non-ED office visits (which the commenter had already concluded, without supporting data, to be too high). Moreover, the commenter presented no empirical basis for estimating (or reducing) the number of injuries treated in non-ED office visits based solely on information from ratios of hospitalized injuries. While the severity of an injury may affect where an injury is treated, the number of table saw injuries treated in doctors' offices cannot be determined directly and solely from estimates of injuries that are hospital admitted.

**5. Comment:** One commenter stated that the approach CPSC uses to value the intangible costs of injuries is based on estimates from an unrepresentative sample of jury awards and settlements involving unrelated products, motor vehicles, and premises liability. Moreover, the commenter stated that inflators used to "roll-forward" older ICM model values to estimate 2008 dollar costs produce much higher unit cost estimates than if reasonable alternative methods were used to adjust for changes in prices and wages over time.

**Response:** CPSC staff's evaluation of the intangible cost estimates in the ICM in the proposed rule is based on 2014 dollars and the methodology for the injury cost estimates has changed since the ANPR was issued. Using regression analysis allowed CPSC staff to adjust the pain and suffering awards by a number of relevant factors, including the injury diagnosis and body part affected, the sex of the victim, and the medical costs and work losses resulting from the injury. This process allowed the staff to provide specialized estimates of the intangible costs based on the characteristics of the injury. Additionally, because some of the awards involved motor vehicles and premises liability, the regression analysis also adjusted for these factors to isolate and exclude their impacts from the pain and suffering estimates attributable to consumer products.

Although the commenter criticizes the jury verdict methodology for estimating lost quality of life, and presents alternative valuations based on reductions in quality-adjusted life years, if these estimates are adjusted using

indices that reflect actual changes in price levels, rather than changes in the "real wage cost" (RWC) used by the commenter, then the estimates of costs associated with the lost quality of life would result in costs per table saw injury that are comparable to, or higher than, CPSC's estimates.

The commenter's approach for inflating non-medical costs for changes in the nominal price level is not appropriate because it provides estimates of changes in real wages, but does not adjust for changes in the price level. (The change in the RWC index is computed by dividing the changes in wages by the CPI-All Items index, and measures changes over and above inflation.) As a consequence, the commenter's approach using the RWC to inflate non-medical costs substantially underestimates the actual change in the nominal price level.

**6. Comment:** One commenter suggested that the tangible and intangible societal costs associated with table saw blade-contact injuries amounted to about \$1.39 billion, less than 60 percent of the CPSC societal cost estimate of \$2.36 billion used by CPSC staff in its 2011 analysis.

**Response:** The commenter's two adjustments to the table saw blade-contact injury estimates are the principal reason for the difference between the commenter's estimates of injury costs and the ANPR estimates. First, the commenter's use of the NEISS-AIP subsample proportions to adjust the estimate for non-admitted injuries, has no statistical justification. Second, the commenter's assertions that the CPSC underestimated the proportion of table saw injuries that were treated in a hospital setting (and hence the CPSC's estimate of other medically attended injuries is over estimated) is not supported by any empirical data. These two issues are discussed in greater detail in the responses to comments above. In contrast, CPSC's analysis is based on 10 years of the National Health Interview Survey which was used to calculate the ratios between injuries treated and released from the emergency department and those treated in doctors' offices and clinics. Correcting for these two injury adjustments would raise the commenter's cost estimate by 31.7 percent to about \$1.83 billion. Additionally, correcting both injury and inflator estimates would raise the injury cost estimate to approximately \$2.2 billion, roughly comparable to the \$2.36 billion estimate in the ANPR. As discussed in section XI of the preamble, and TAB C of the staff briefing package, estimates of societal costs calculated for the proposed rule are substantially

higher, approximately \$4.06 billion in 2014 dollars, based on more recent data and analyses.

**7. Comment:** One commenter asserted that an economic justification for product safety regulation requires some kind of fundamental market failure. The commenter noted that in the absence of such a failure the usual assumption is that consumers will purchase products that offer the mix of characteristics and product price that best match their preferences. The major types of market failure mentioned by the commenter include: (1) Inadequate or asymmetric information about risks; (2) externalities that impose costs on non-table saw users; and (3) market power that would allow firms some control over market prices. The commenter concluded that there was no economic justification for a possible table saw rule; in other words, none of the market failures was present or was not present to such a degree as to require a regulatory fix.

**Response:** According to the Office of Management and Budget's (OMB) Circular A-4 (2003)<sup>62</sup> which provides OMB's guidance on regulatory analyses, a key element of a good regulatory analysis is a statement of the need for such a rule and a description of the problem that the rule is intended to address.<sup>63</sup> If improved safety is needed, and private markets have been unable to efficiently provide it, such a market failure provides an economic justification for regulatory intervention. The major types of market failure, as described in *Circular A-4*, concern (1) inadequate or asymmetric information, (2) externalities, or (3) market power. Inadequate or asymmetric information would exist when consumers underestimate or are generally unaware of the risks posed by risky products or are unable to interpret or adequately process the risk information. Externalities would exist in the market place when one party's actions impose uncompensated benefits or costs on another party. Market power would exist when firms can exercise market power to reduce output below what would be offered in a competitive industry to obtain higher prices.

**Inadequate or asymmetric information.** Many of the risks associated with the use of table saws, as well as the potential severity of injuries when users come into contact with a moving blade, are obvious. However, some risks associated with the use of table saws may be poorly understood by consumers, such as sudden movement

<sup>62</sup> See [https://www.whitehouse.gov/omb/circulars\\_a004\\_a-4](https://www.whitehouse.gov/omb/circulars_a004_a-4).

<sup>63</sup> *Id.* at 3-7.

of the workpiece from kickback which can cause the operator to lose control of the workpiece and cause his/her hand to fall into or be “pulled” into the blade. Saw blades are jagged and rotate rapidly, and because the blades are used to cut wood their impact on fingers or hands is readily imaginable. Table saws also come with extensive warnings and safety devices (such as blade guards, riving knives, and anti-kickback pawls) that are intended to reduce the risk of blade contact. Hence, it would be difficult to argue that the risks of table saws use are unknown or somehow hidden from the consumer.

On the other hand, it is possible that some of those injured have not been trained in proper table saw use or have not paid close attention to product warnings. Non-occupational users may use table saws only sporadically and forget or simply neglect safety procedures. Fatigue is known to have played a role in some incidents, and the risk of fatigue due to extended periods of cutting may not be obvious to all consumers. Some of those injured may be adolescents or seniors who are either undergoing cognitive development or cognitive decline and may not fully appreciate the dangers posed by table saws. This is not to suggest that users are unaware of the obvious risks. However, casual users may be unaware of how quickly and how violently an injury can occur, if, for example, a cut results in kickback. Consequently, some consumers could underestimate the actual risks they face. It also may be difficult for occasional users to interpret or process the risk information in a way that allows them to take the appropriate level of safety precautions.

**Externalities.** Externalities exist when one party’s actions impose uncompensated benefits or costs on another party. In the case of table saws, the externalities would generally be financial. If, for example, medical treatment costs are not borne by the injured party, but rather shifted to the public at large, there is a financial externality that the purchaser may not take into account when buying or using a table saw. Based on the injury cost data reviewed by staff for the proposed rule, medical costs and lost wages amounted to roughly \$160 million and \$1,040 million, respectively. Some proportion of these medical costs and work losses are shifted to the public at large by means of insurance premiums and unemployment compensation.

**Market Power.** Market power exists when one or more firms can exert some control over the price of the product (by limiting production), or create barriers that prevent other firms from entering

the market. For table saws, patents acquired by one firm (*i.e.*, SawStop) regarding their AIM technology, combined with efforts to prevent patent infringement, appear to have provided that firm with sufficient market power to exert some control over the price of the technology (by means of licensing agreements) and to limit the ability of other firms to develop and market similar technology. The emergence of a second firm (*i.e.*, Bosch) that began producing and selling a table saw model with the AIM technology in 2016 does not preclude or negate the existence of market power for one or both of these firms. Moreover, litigation over the alleged patent infringement of the second firm is ongoing.

In summary, there could be several market impediments to a more widespread adoption of the AIM system technology by table saw purchasers. These impediments are discussed further in section XI of the preamble and at TAB C of the staff briefing package.

**8. Comment:** Based on an evaluation of information provided in the ANPR, and the methodology used in Dr. John Graham’s economic analysis of AIM technology,<sup>64</sup> one commenter concluded that mandating the SawStop technology for the bench-top category of table saws is not economically justifiable. Numerous other commenters also stated that the costs of regulation to increase table saw safety are not justified.

**Response:** The proposed rule would not mandate the SawStop technology for the table saw industry. However, the economic impact of the proposed rule, including potential royalty payments and licensing fees, is addressed in section XI of the preamble and in TAB C of the staff briefing package. Staff’s review of the potential benefits and costs of the proposed rule shows that the proposed rule would address roughly 54,850 medically treated blade-contact injuries annually. The societal costs of these injuries amount to about \$4.06 billion annually. Based on CPSC staff’s benefit and cost estimates, the net benefits (*i.e.*, benefits minus costs) of the proposed rule would amount to an average of \$1,500 to \$4,000 per saw for the market as a whole.

**9. Comment:** Some commenters asserted that a standard mandating the AIM technology will increase the price of table saws and will make table saws unaffordable for many individuals and

small businesses. Similarly, some said that mandating the AIM technology would increase the price of table saws to the point that it prohibits people from purchasing a table saw for home hobby use or for starting a small business. One commenter equated the increased cost of buying a table saw with AIM technology with having to pay for someone else’s stupidity. Another commenter opposed mandating the AIM technology because requiring automatic detection and blade retraction in the case of body-contact would eliminate the sub-\$1,000 saw segment.

**Response:** The Commission is aware that the proposed rule would be costly and would result in disruption of the table saw market. In addition, the Commission has to balance the number and severity of blade-contact injuries and the impact of the proposed rule on the product’s utility, cost and availability to the consumer. While the proposed rule would substantially reduce blade-contact injuries and the societal costs associated with those injuries, CPSC staff’s review showed that the impact of increasing table saw production costs on consumers also would be considerable. The prices for the least expensive bench saws now available are expected to more than double, to \$300 or more. In general, the retail prices of bench saws could increase by as much as \$200 to \$500 per unit, and the retail prices of contractor and cabinet saws could rise by as much as \$350 to \$1,000 per unit. These higher prices may be mitigated in the longer run, but the extent of any future price reductions is unknown. However, given that the least expensive bench saws currently cost about \$129, and the least expensive contractor saws are priced at about \$529, CPSC staff expects that some bench and contractor saws will retail for under \$1,000.

In addition, because of the likely decline in sales following the promulgation of a rule, consumers who choose not to purchase a new saw due to the higher price will experience a loss in utility by forgoing the use of table saws, or because they continue to use older saws which they would have preferred to replace.

There also may be some other utility impacts. The inclusion of the AIM technology may, for example, increase the weight and (potentially) the size of table saws to accommodate the new technology, to allow access to change the brake cartridge, and to mitigate the effects of the force associated with the activation of the brake cartridge. Although this factor may have a relatively small impact on the heavier and larger contractor and cabinet saws,

<sup>64</sup> Graham, John D., and Chang, Joice, 2014. Reducing the risk of injury from table saw use: The potential benefits and costs of automatic protection. *Risk Analysis*, 35(2) at 307–317.

the impact on some of the smaller and lighter bench saws could markedly reduce their portability.

CPSC staff found no evidence to suggest that the proposed rule will eliminate table saws from home hobby use or for starting small businesses. However, there will be significant impacts on the cost, utility and availability of table saws in the near term. In its preliminary regulatory analysis staff clearly sets out all these considerations. After careful review, the Commission has decided that issuing the proposed rule is appropriate.

*10. Comment:* Some commenters expressed concern about the effects of the proposed rule on small businesses, such as construction contractors, small woodworking shops, cabinet makers, and wood furniture shops. Concerns were raised about the ability of small businesses to afford new table saws and whether they would go out of business. Two commenters suggested that unemployment would increase due to these small businesses closing.

*Response:* As discussed in the initial regulatory flexibility analysis in section XII of the preamble, and TAB D of the staff briefing package, CPSC staff believes that the proposed rule will have an impact on small businesses. The price of table saws will increase significantly. However, staff believes that even if the increased cost of a new table saw was \$800, and a firm purchased a new table saw each year, the impact on the firm is unlikely to be significant unless the firm had annual receipts of less than \$80,000. Nevertheless, staff believes that it is possible that a small number of small businesses might lay off a small number of employees.

*11. Comment:* Some commenters stated that the SawStop technology is expensive given the cost of the cartridges and blades that would have to be replaced when the technology is triggered. One commenter noted that his blades cost about \$100 each and his dado set costs about \$300. The commenter expressed concern that the need to replace the cartridge when changing between saw blade and dado set would also increase the set-up time when making such transitions. Some commenters were concerned with false-positive detection with the SawStop systems, especially when cutting pressure-treated wood or metal, increasing their costs. One commenter claimed to have “managed medium size shops where the technology probably saved a finger” but also where “accidental tripping of the mechanism cost thousands of dollars annually.” Another commenter expressed some

concerns about the availability of replacement cartridges and whether they would be interchangeable among different brands or models of table saws. If replacement cartridges were specific to the brand or model of table saw, it could limit the availability and add to the cost of activation.

*Response:* CPSC staff is aware of two table saw AIM technologies that have been developed; the first requires replacement of an activation cartridge and, almost always, the repair or replacement of the blade once the system has been activated (SawStop). The second only requires replacement of the activation cartridge after two activations (Bosch REAXX™). However, the future availability of the second system is questionable due to ongoing patent litigation. Although conductive materials or wet wood that is moist enough to conduct enough electricity could activate the AIM system and trip the safety system, both the AIM systems currently in use allow bypass of the system which can be deactivated while cutting conductive materials or wet wood. Accordingly, replacement costs would generally be incurred only if the user’s hand or arm came into contact with an operating table saw blade. On average, the replacement cost for the average blade and/or cartridge is expected to amount to roughly \$11 to \$14 annually over the life of the saw, which would be far below the cost of a blade-contact injury that could amount to tens of thousands of dollars. CPSC staff acknowledges that if a different cartridge is required for use with a dado set, then switching between a regular blade and a dado set may require more time and expense than required in the absence of an AIM system. This may affect productivity in some shops that do a large volume of dado cuts.

*12. Comment:* One commenter stated that the increased cost of table saws that incorporate an AIM technology will not increase the likelihood that people will purchase table saws but it will likely reduce the demand for table saws and harm table saw manufacturers.

*Response:* A mandatory standard would increase the manufacturing cost of table saws and manufacturers would attempt to pass on the increased costs to consumers in the form of higher prices. Although some consumers might be more likely to purchase the safer table saws with the AIM technology, the expected price increase likely will result in a significant decrease in the quantity of table saws demanded. CPSC staff estimates that the number of table saws sold annually could decrease by about 90,000 to 250,000 units, at least

initially. Because of the expected higher costs and reduced sales, some table saw manufacturers are likely to be adversely affected by a mandatory standard.

*13. Comment:* One commenter compared a potential regulation requiring an AIM technology in table saws to regulations requiring the use of seat belts. The commenter stated that a person who injures a finger with a table saw is unlikely to become a burden to society at large, which the commenter states is often the case with victims of automobile accidents. Therefore, the commenter stated, the decision of whether to purchase a table saw equipped with AIM technology versus one without it should be left up to the consumer. Another commenter implied, however, that taxpayers will either pay for table saw injuries on what the commenter called the front end, due to the additional cost of a table saw equipped with AIM technology, or the tail end due to the disability of consumers injured in accidents involving table saws. The commenter stated that he preferred paying the additional cost on the front end.

*Response:* These commenters appear to be discussing the issue of externalities that might be associated with table saw injuries. Externalities would be the costs of injuries that are borne by third parties, people other than users or suppliers of table saws. The existence of externalities may provide a justification for regulation, if the purpose of the regulation is to reduce the costs that fall on third parties not engaged in the activity (*i.e.*, supplying or using table saws). For table saws, the externalities are largely financial and would exist when the costs of medical treatment and work losses resulting from blade contact are shifted to the public through medical insurance premiums and unemployment compensation. However, these externalities constitute a relatively small proportion of the societal costs associated with table saw blade-contact injuries. As described in the preliminary regulatory analysis, the primary cost of injury is associated with the intangible costs of injury, or pain and suffering. These costs are largely borne by the injury victims, rather than third party bystanders. Therefore, although some of the medical costs and some of lost productivity costs associated with table saw injuries could be considered externalities, most of the societal costs associated with table saw injuries are borne by the injured person and do not, therefore, constitute externalities.

## F. Unintended Consequences

1. *Comment:* Numerous commenters stated that adding AIM technology to table saws will give users a false sense of security and will increase unsafe behavior in users that will translate to injuries on other power tools. Many commenters felt that users will not learn to respect the dangers of table saws and power tools in general. Some asserted that excessive reliance on safety devices can lead to complacent behavior, which will inevitably result in an accident. One commenter suggested that mandating the AIM technology on all saws would result in additional non-blade contact and kickback injuries because consumers would be less likely to use other safety technology such as blade guards and riving knife/splitter combinations.

*Response:* As described in TAB E of the staff briefing package, consumer behaviors may adapt if an AIM system is installed on a table saw. CPSC staff agrees that reliance on the AIM safety technology could lead some users to reduce their use of other safety technology, such as blade guards or riving knife/splitter combinations, thereby increasing exposure and risk of operator blade contact. However, as discussed in section IV of the preamble, a review of incidents from the NEISS data and CPSC database that involve table saws indicates that blade-contact injuries continue to occur on table saws originally equipped with riving knives and modular blade guards. In addition, results of the modular blade guard survey indicate that a majority of respondents (80%) reported that there are circumstances that require the blade guard to be removed and a majority of respondents did not use the blade guard all of the time. Accordingly, consumers appear to already take actions that reduce the efficacy of safety devices, such as the removal of the blade guard or not choosing to use the modular blade guard at all.

Based on CPSC staff's analysis, the Commission cannot predict whether consumers will take less care when using a table saw with an AIM system relative to current table saws, but some consumers might be even less inclined to use blade guards, which many consumers already remove even in the absence of an AIM system. However, a key factor in assessing the ultimate effect of an AIM system is not simply whether consumers will be less careful when cutting with a table saw employing the system, or even whether the incidence of blade contact is likely to increase, but whether such changes likely will result in a decrease in serious

injuries. If the system is effective and works as intended, the severity of an injury resulting from blade contact will be lessened, which likely would reduce the overall number of severe injuries associated with table saws.

2. *Comment:* Several commenters suggested that some users might modify the saws to bypass the safety mechanism, especially in the case of false activations, which users will perceive as a nuisance.

*Response:* Although some consumers might attempt to bypass the AIM safety technology, CPSC staff believes that consumers would have little reason to bypass it once it is already on the table saw. Because the AIM technology is not generally expected to interfere with the normal use of the table saw and can be used with most types of cuts (with the possible exception for dado cuts on some table saws), there would be no incentive to alter or bypass the safety mechanism. Moreover, staff does not believe there is a high rate of false activations. Based on reports of sales of replacement brake cartridge on the SawStop system, which requires replacement of the brake cartridge and blade after an activation of the system, SawStop estimates that the AIM system may activate about once every nine years of use.

3. *Comment:* Numerous commenters also stated that to avoid paying for a table saw with additional safety features, consumers will pursue more dangerous methods to cut wood by using other tools, such as circular saws, buying used products, or continuing to use an older table saw past its safety life.

*Response:* CPSC staff agrees that the proposed rule would increase the price of table saws, and that these price increases are likely to reduce sales. We do not know how consumers, who would have purchased a new table saw had the price not increased, would respond. Some may hire professionals instead of doing some projects themselves. Others might borrow or rent table saws, or use an older table saw that they would have preferred to replace. Some might also attempt to use other tools in the place of table saws, as the commenters suggest. If the substitute tools are risky, then the estimated benefits attributed to the proposed rule would be reduced. The Commission seeks comment on the likelihood that consumers will pursue more dangerous methods to cut wood if table saws are equipped with AIM technology and the alternatives consumers will use to do so.

4. *Comment:* A couple of commenters expressed concern for the impact of the proposed rule on the ShopSmith multi-

tool system. The commenters stated that the ShopSmith equipment could not be redesigned to allow for the installation of a SawStop system. One commenter expressed concern that the proposed rule could force the company out of business.

*Response:* Incorporating an AIM technology on some table saws may present some especially difficult challenges that are not faced by other table saw manufacturers. Although the engineering challenges can be resolved, the upfront costs for incorporating the AIM system on some table saws may be substantial for a small business. As discussed in sections XI and XII of the preamble and TAB C and TAB D of the staff briefing package, it is possible that some small manufacturers would reduce their table saw offerings or even exit the table saw market if the proposed rule is issued as a final mandatory standard.

## G. Training and Warnings

1. *Comment:* Several commenters stated that table saw injuries are best reduced by training and educating users on safe practices and operation of table saws. Many believed mandatory training in the form of certification is needed while others believed that instructional videos should be provided with every table saw purchase. Other commenters stated that only warnings or instruction labels are required to reduce injuries.

*Response:* As discussed in TAB E of the staff briefing package, CPSC staff agrees that warnings, instructions, and other methods of educating consumers about the proper use of table saws are important. However, the effectiveness of such approaches is known to be limited. For example, safety and warnings literature consistently identify a classic hierarchy of approaches that should be followed to control hazards. The use of warnings is viewed universally as less effective at eliminating or reducing exposure to hazards than designing the hazard out of a product or guarding the consumer from the hazard. Therefore, the use of warnings is lower in the hazard control hierarchy than these other two approaches. Warnings are less effective because they do not prevent consumer exposure to the hazard, and instead, they rely on educating consumers about the hazard and persuading consumers to alter behavior to avoid the hazard. In addition, to be effective, warnings rely on consumers behaving consistently, regardless of situational or contextual factors that influence precautionary behavior, including fatigue, stress, or social influences. Thus, CPSC staff believes that warnings should be viewed as "last resort" measures that supplement,

rather than replace, redesign or guarding, unless these higher level hazard-control efforts are not feasible.

Educational programs may offer more opportunities to present hazard information in varied ways and in greater detail than is possible on a warning label. However, CPSC staff believes that educational programs suffer from limitations similar to those associated with warnings because, like all hazard communications, the effectiveness of such programs depends on affected consumers not only receiving and understanding the message, but also being persuaded to heed the message. Mere knowledge or awareness of a hazard is not necessarily enough. Some versions of the hazard control hierarchy, particularly those in the context of industrial or organizational settings, include training as a separate approach at the same approximate level as warnings because training also involves educating consumers about potential hazards and proper actions or procedures to avoid those hazards. In fact, instructional materials that accompany products can be viewed as a form of training. Thus, warnings, instructions, educational programs, and training serve similar functions and have similar weaknesses.

Although CPSC staff supports the use of these approaches, including providing consumers with instructional videos, human error is inevitable, even among expert woodworkers. Even consumers who are fully aware of the hazards and how to avoid them may suffer from slips or lapses that could lead to blade contact and injury despite the consumer's best intentions to use a product safely. A performance requirement that can detect and react to blade contact in a way that lessens the consequences makes the table saw more forgiving of such errors and expected behaviors, so that the results are not catastrophic. Moreover, mandating a performance requirement for table saws would not preclude manufacturers from encouraging table saw purchasers to become trained on safe table saw practices. Manufacturers can provide additional instruction videos on safe table saw practices or provide free training.

#### H. Other Comments

*1. Comment:* Several commenters stated that CPSC should mandate AIM technology on table saws only in industrial or workshop settings or schools.

*Response:* As discussed in section VI.C. of the preamble, the Commission does not have authority to regulate any risk of injury associated with a

consumer product if such risk could be eliminated or reduced to a sufficient extent by action taken by OSHA. However, if the risk to consumers cannot be sufficiently reduced or eliminated by OSHA's actions, the CPSC has the authority to address that risk of injury associated with the consumer product. As discussed in that section, the Commission believes that OSHA regulations do not sufficiently reduce the risk of blade-contact injuries to the consumer. Moreover, the Commission believes that there is no clear dividing line between consumer and professional saws, except at the very highest levels of price and performance. Although some of the more expensive, high voltage table saws may be used in construction work or by professional wood workers, many of these same saws may be also be used in the home, in schools, and in recreation (woodworking workshops, schools and clubs). Therefore, the Commission believes that these types of saws may be used more than occasionally by consumers and fall within the scope of the proposed rule. However, the Commission seeks comment regarding whether the scope of the rule should be modified to exclude certain types of table saws used primarily for commercial or industrial use.

*2. Comment:* Some commenters stated that the CPSC should provide an "open license" for AIM technology, offer a retrofit option for existing table saws, and encourage AIM technology through tax policy.

*Response:* The Commission has no authority under the CPSA to mandate an open license for AIM technology, require retrofits on existing table saws, or implement tax policies.

### X. Description of the Proposed Requirement

#### A. Scope, Purpose and Effective Date—§ 1245.1

The proposed rule would apply to all table saws, as defined, including bench saws, contractor saws, and cabinet saws. The proposed rule would include a requirement to mitigate the risk of blade-contact injuries on table saws. Specifically, the proposed rule would establish a performance standard such that table saws, when powered on, must limit the depth of cut to 3.5 mm when a test probe, acting as a surrogate for a human body/finger, contacts a spinning blade at a radial approach of 1.0 m/s.

Under the CPSA, the effective date for a consumer product safety standard must not exceed 180 days from the date the final rule is published, unless the Commission finds, for good cause, that

a later effective date is in the public interest. As discussed in section XI of the preamble, and TAB C of the staff briefing package, to meet the proposed performance requirements, it is likely that table saw manufacturers will have to develop new technology or redesign virtually all table saw models, retool production facilities, and enter into licensing arrangements. Because the Commission believes 180 days may not be adequate time to allow for such modifications, it is instead proposing an effective date of three years following publication of a final rule, at which time all table saws would be required to comply with the applicable requirements of the rule.

#### B. Definitions—§ 1245.2

The proposed rule would provide that the definitions in section 3 of the CPSA (15 U.S.C. 2051) apply. In addition, the proposed rule would include the following definition:

- **Table saw**—a woodworking tool that has a motor-driven circular saw blade, which protrudes through the surface of a table. Table saws include bench saws, contractor saws, and cabinet saws.

The Commission seeks comment on whether the definition of a table saw should be revised or whether additional definitions are necessary.

#### C. Requirements for Table Saw Blade Contact—§§ 1245.3 and 1245.4

##### 1. Description of Requirement

The proposal would require table saws, when powered on, to limit the depth of cut to 3.5 mm when a test probe, acting as a surrogate for a human body/finger, makes contact with a spinning saw blade at a radial approach rate of 1.0 m/s. The proposal would require that the test probe allow for the accurate measurement of the depth of cut from contact with the saw blade to assess compliance with the proposed requirement. Any test probe that is used should have the appropriate properties (such as electrical, optical, thermal, electromagnetic, ultrasound, etc.) to indicate human body/finger contact with the saw blade and the appropriate physical properties to accurately measure depth of cut. The test probe and test method described in TAB A of staff briefing package, (Appendix A), are considered appropriate for the evaluation of AIM systems using an electrical detection system. This test method may be used for such systems and will be used by CPSC staff in evaluating such systems. However, the Commission does not propose to make this test method mandatory because



other AIMS systems may use a different detection approach. For AIM systems using a different detection approach, the method should be modified based on sound material science and engineering knowledge to accurately assess compliance with the proposed requirement.

## 2. Rationale

The Commission believes that an AIM system can be used to reduce or limit the severity of a table saw blade-contact injury in conjunction with existing table saw voluntary standard requirements for a blade guard and riving knife. AIM systems provide a layer of safety that can mitigate a blade-contact injury if the blade guard or riving knife are removed or fail to function properly, as well as those blade-contact injuries that can occur when a blade guard or riving knife are in place and functioning properly, but where blade contact occurs nonetheless.

A performance requirement that limits the depth of cut to a test probe that contacts a saw blade to 3.5 mm will significantly reduce the severe lacerations, fractures, amputations, and avulsions associated with operator blade contact incidents on table saws because the probe will have the appropriate properties to indicate human body/finger contact with the saw blade and the equivalent injury mitigation on a real human finger will avoid most microsurgery. Most microsurgery will be avoided because the neurovascular bundle in a human little finger, which contains nerves and arteries, is at a depth of approximately 3.5 mm below the 0.5 mm thick epidermal layer of the skin. CPSC staff has determined that a 3.5 mm depth of cut into a conductive test probe is an appropriate surrogate for a 4mm depth of cut into a finger with insulating epidermis over conductive tissue. Additionally, incidents that occur under conditions that increase AIM performance (such as slower approach rate of the hand/finger to the saw blade and/or circumstances that increase detection) may result in minimal injuries.

The Commission recognizes there may be some scenarios, such as kickback, which can cause the operator's hand to be "pulled" into the blade at a high rate of speed or lead the operator to reach as fast as possible for a falling workpiece. There are other scenarios where the radial velocity of the hand/finger may exceed 1 m/s when it contacts the saw blade. At approach speeds greater than 1 m/s, AIM system performance may result in injury severity that requires extensive medical attention. Such incidents may include

the microsurgical repair of nerves, blood vessels, and tendons for an incident that might otherwise have resulted in an amputation or could involve injury to several digits or a wider area. Although some incidents may occur under conditions so demanding that AIM performance is unable to prevent a severe injury from occurring, available data on radial approach rates during kickback and non-kickback-related table saw blade contact incidents reviewed by staff indicate that the approach rate does not exceed 0.368 m/s.<sup>65</sup> Thus, CPSC staff's testing and research indicate that the majority of operator blade-contact injuries from table saws can be reduced or mitigated by the proposed performance requirement.

## D. Prohibited Stockpiling—§ 1245.5

In accordance with Section 9 of the CPSA, the proposed rule contains a provision that would prohibit a manufacturer from "stockpiling" or substantially increasing the manufacture or importation of noncomplying table saws between the date of the final rule and its effective date. The rule would prohibit the manufacture or importation of noncomplying table saws in any period of 12 consecutive months between the date of promulgation of the final rule and the effective date, at a rate that is greater than 120 percent of the rate at which they manufactured or imported table saws during the base period for the manufacturer. The base period is any period of 365 consecutive days, chosen by the manufacturer or importer, in the 5-year period immediately preceding promulgation of the rule.

The 5-year period in the anti-stockpiling provision is intended to allow manufacturers and importers sufficient flexibility to meet normal changes in demand that may occur in the period between the promulgation of a rule and its effective date while limiting their ability to stockpile noncomplying table saws for sale after that date. The Commission seeks comments on the proposed product manufacture or import limits and the base period with respect to the anti-stockpiling provision.

## E. Findings—§ 1245.6

In accordance with the requirements of the CPSA, we are proposing to make the findings required by section 9 of the CPSA. The proposed findings are discussed in section XVIII of the preamble.

## XI. Preliminary Regulatory Analysis

The Commission is proposing to issue a rule under sections 7 and 9 of the CPSA. The CPSA requires that the Commission prepare a preliminary regulatory analysis and that the preliminary regulatory analysis be published with the text of the proposed rule. 15 U.S.C. 2058(c).

### A. Introduction

The CPSC is issuing a proposed rule to address the unreasonable risk of blade-contact injuries associated with table saws. This rulemaking proceeding was initiated by an ANPR published in the **Federal Register** on October 11, 2016. In 2015, to enhance CPSC's understanding of the market for table saws, CPSC staff entered into two contracts with Industrial Economics, Inc. (IEC) to conduct market research and cost impact analysis on table saws. One report, titled "*Revised Final Table Saws Market Research Report*" (March 28, 2016) (referred to as IEC, 2016a), updates information relied upon in the ANPR and provided in public comments concerning the market for table saws. The report uses publically available information and limited outreach to potentially affected entities. The other report, titled "*Final Table Saws Cost Impact Analysis*" (June 9, 2016) (referred to as IEC, 2016b), estimates the manufacturing and other costs of possible requirements intended to mitigate table saw blade-contact injuries based on previous information collected by the CPSC in the ANPR, public comments, limited interviews with table saw manufacturers, additional research, and the results of IEC, 2016a. In addition to CPSC staff's analysis of existing data, studies, and reports, staff relies on the IEC reports for additional data and information to support the staff's preliminary regulatory analysis (TAB C of the staff briefing package) and initial regulatory flexibility analysis (TAB D of the staff briefing package). These reports are available on the CPSC's Web site at <https://www.cpsc.gov/research-statistics/other-technical-reports>.

### B. Market Information

#### 1. Manufacturers

A total of 22 firms are known to supply table saws to the U.S. market. This does not include manufacturers of miniature table saws used for constructing doll houses and other hobby products, or tile-cutting table saws. In addition, the 22 firms do not include a number of Asian table saw manufacturers who may have some limited U.S. distribution.

<sup>65</sup> See Gass, S. (2012), *supra* note 50.



The Power Tool Institute (PTI) estimates that its member companies account for 80 percent of all table saws sold in the United States. Most of these companies are large, diversified international corporations with billions of dollars in sales, such as Stanley Black and Decker, Robert Bosch, Makita, and Techtronic Industries Co., Ltd. These four large, diversified firms are currently supplying table saws to the U.S. market, but table saws make up a relatively small part of their revenues, probably less than one percent. PTI tends to represent the mass market bench table saw manufacturers, while many of the smaller suppliers are primarily in the cabinet and contractor saw market segments.

With the exception of two firms that sell only table saws or multi-purpose tools incorporating table saws (*i.e.*, SawStop and Shopsmith, respectively), anecdotal information provided to CPSC staff suggests that, for the smaller, more specialized firms supplying table saws to the U.S. market, table saws are generally not a large percentage of firms' sales. One company reported that table saw sales contribute a negligible fraction of its \$15 million annual revenue. Another company with an annual revenue of \$20 to \$40 million stated that table saws represent approximately five percent of total sales. Similarly, a third company indicated that only seven to eight percent of total revenue is attributable to table saw sales.<sup>66</sup>

## 2. Retail Prices of Table Saws

The range of prices for table saws generally overlaps for three products: Bench, contractor, and hybrid saws. Bench saws are the least expensive, ranging in price from \$129 to \$975, with a few exceptions. Prices for contractor saws range from \$529 to \$2,049, and prices for hybrid saws range from \$675–\$1,595. Generally, cabinet and sliding saws are more expensive. Prices for cabinet saws range from \$1,199 to \$5,349. The price range for sliding table saws (\$2,850–\$24,995) overlaps with the range for cabinet saws, but sliding saws are typically more expensive.

The SawStop models containing the AIM technology are consistently priced at the upper end of the price range in each of the three primary table saw categories (bench, contractor, and cabinet). Aside from a couple of bench saws priced at just under \$1,500, the SawStop bench saw is next most expensive in the bench saw category at \$1,299–\$1,399, depending on the distributor. Similarly, the three SawStop contractor saws, ranging in price from

\$1,599–\$2,049, represent some of the most expensive models in that product category, including the highest-priced offering. The SawStop cabinet models range in price from \$2,299–\$5,349, depending on power and performance. The SawStop model priced at \$5,349 represents the highest priced cabinet saw. The Bosch REAXX™ saw ranges in price from \$1,299–\$1,499.

## 3. Types of Table Saws Commonly Used By Consumers

There are three primary categories of table saws: Bench, contractor, and cabinet. Bench saws tend to be lightweight, portable, and with several exceptions, generally are priced from about \$150 to \$1,000. Bench saws generally are intended for consumer use, but also are used at work-sites. Contractor saws are larger, heavier, and more powerful than bench saws, and generally are priced from \$500 to \$2,000. Cabinet saws (also referred to as stationary saws) weigh from about 300 to 1,000 pounds, are not portable, and generally are priced from about \$1,200 to \$5,000. Although these saws all are used by consumers to some extent, contractor and cabinet saws are more likely to be used by professional and occupational users.

Based on staff discussions with industry representatives, electrical requirements and power appear to provide the best distinction between table saws typically used by consumers and those used most often in industrial settings. Two industry representatives indicated to staff that saws operating at 1.75 horsepower or greater likely cannot be run on typical household wiring. Most consumers do not have the necessary electrical wiring, specifically the specialized outlets and adapters, to accommodate power tools with horsepower ratings greater than 1.75 or requiring 220–240 volt power. Sliding table saws and many other cabinet saws require such electrical capabilities and, therefore, are less likely to be used by consumers. However, one manufacturer indicated the firm has begun development of a sliding saw aimed at the high-end do-it-yourself (DIY) market, and a representative from another firm indicated that some serious woodworking hobbyists may wire their home workshops to accommodate the more powerful saws. CPSC staff's review showed that 89 cabinet, hybrid, and sliding models run solely on 220–240 volts. Given wiring requirements, these 89 higher-voltage models are less likely to be used by typical consumers than industrial users.

## 4. Sales and Numbers in Use

Although the design and engineering of table saws may occur in the United States, most table saws are currently manufactured overseas; several firms staff contacted indicated that their saws are manufactured in Taiwan. For example, one company indicated that it operates quality control offices in Taiwan and China, and imports saws from Asia. This is supported by data from the ITC, which indicates that in 2014 approximately 99 percent of imported table saw units were built in Taiwan and China.<sup>67</sup> Additionally, a small volume of expensive saws most likely intended for industrial use and not intended for consumer use were imported from European and Canadian manufacturers.<sup>68</sup>

The annual number of table saws in use, a measure of risk exposure, was estimated with the CPSC's Product Population Model (PPM), a computer model that projects the number of products in use given estimates of annual product sales and product failure rates.<sup>69</sup> According to PTI, total annual shipments of all table saws to the U.S. market from 2002 to 2014 have ranged from 429,000 to 850,000. Estimates of sales value are not readily available industry-wide. CPSC staff estimated that bench saws account for about 75 percent of the units sold. Staff assumed further that contractor saws (including hybrids) and cabinet saws account for 20 percent and 5 percent, respectively. The failure rate used by staff (*i.e.*, the rate at which table saws go out of use) follows a gamma distribution, a commonly used distribution for the failure of products. That showed an average product life of 10 years for bench saws, 17 years for contractor saws, and 24 years for cabinet saws. Using these parameters, CPSC staff projected a total of about 8.2 million table saws in use in the United States in 2015, including about 5.1 million bench saws, 2.3 million contractor saws, and 0.8 million cabinet saws. Thus, staff estimated that bench, contractor, and cabinet saws account for about 62 percent, 28 percent, and 10

<sup>67</sup> Data compiled from tariff and trade data from the U.S. Department of Commerce and the ITC for Harmonized Tariff Schedule classification numbers 8465910036 (Tilting arbor table saw, woodworking) and 8465910078 (Sawing machines, woodworking, NESOI). See [https://dataweb.usitc.gov/scripts/user\\_set.asp](https://dataweb.usitc.gov/scripts/user_set.asp).

<sup>68</sup> For example, a \$25,000 computerized numerically controlled (CNC) panel saw designed to cut large pieces of wood, like sheets of plywood is likely only to be used industrially.

<sup>69</sup> Lahr, M.L., Gordon, B.B., 1980. *Product life model feasibility and development study*. Contract CPSC–C–79–009, Task 6, Subtasks 6.01–6.06). Columbus, OH: Battelle Laboratories.

<sup>66</sup> IEC, 2016a at 12.

percent of the table saw population, respectively. The Commission seeks comments concerning the proportion of table saw sales by table saw type, or any additional information on the expected product life of table saws.

### C. Benefit-Cost Analysis

This section of the analysis consists of a comparison of the benefits and costs of the proposed rule. The analysis is conducted from a societal perspective, considering all of the significant costs and health outcomes. CPSC staff reviewed the characteristics and societal costs of table saw blade-contact injuries. The benefits of the proposed rule are measured as the estimated reduction in the societal costs of injuries resulting from the use of saws containing the AIM technology. The costs of the proposed rule are defined as the added costs associated with the incorporation of the AIM technology in the table saws. Staff calculates the benefits and costs of the proposed rule on a per product in use basis.

Because of the differences in the physical characteristics, the use patterns, and the likely population of users of each of the table saw types (*i.e.*, bench, contractor, and cabinet saws), an independent evaluation of the benefits and costs for each table saw type could be useful. For example, the costs of the proposed rule could exceed the benefits for one or more saw types, even though, in aggregate, benefits could exceed costs for the market as a whole. However, because staff did not have information on the types of saws involved in the injuries, we did not assess the societal costs or benefits of the proposed rule by saw type. Nevertheless, staff has sufficient information on the potential costs of the proposed rule to conduct a breakeven analysis for the various saw types—an analysis that allows us to estimate the number of injuries for each of the saw types that would need to be prevented for the benefits of the proposed rule to equal or exceed the costs. Aggregated estimates of the benefits and cost on an annual basis can be readily calculated given projections of annual table saw sales. CPSC staff also compared breakeven estimates for the various saw types to possible hypothetical distributions of injuries to estimate the number of injuries for each of the saw types that would need to be prevented for the benefits of the proposed rule to equal or exceed the costs.

#### 1. Blade-Contact Injuries

The proposed rule is intended to address table saw injuries resulting from blade contact. As discussed in section

IV of the preamble and TAB B of the staff briefing package, an estimated 30,800 injuries reported through NEISS during 2015 were likely to have involved blade contact.

In addition to injuries initially treated in hospital EDs, many product-related injuries are treated in other medical settings, such as, among others, physicians' offices, clinics, and ambulatory surgery centers. Some injuries also result in direct hospital admission, bypassing the hospital ED entirely. The number of table saw injuries treated outside of hospital EDs are estimated with the CPSC's ICM, which uses empirical relationships between the characteristics of injuries (diagnosis and body part) and victims (age and sex) initially treated in hospital EDs and the characteristics those initially treated in other settings.<sup>70</sup> The ICM estimate of injuries treated outside of hospitals or hospital EDs (*e.g.*, in doctors' offices, clinics, *etc.*) is based on data from the Medical Expenditure Panel Survey (MEPS).

The MEPS is a nationally representative survey of the civilian, non-institutionalized population that quantifies individuals' use of health services and corresponding medical expenditures. It combines data from a panel of participants interviewed quarterly over a two-year time period with data from the respondents' medical providers. The MEPS is administered by the Agency for Healthcare Research and Quality (AHRQ). The ICM uses the MEPS data, in combination with a classification tree analysis technique, to project the number and characteristics of injuries treated outside of hospitals.

To project the number of direct hospital admissions which bypass hospital EDs, the ICM uses data from the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project (HCUP–NIS), which was also analyzed using a classification tree analysis technique. HCUP is a family of healthcare databases and related software tools and products developed through a federal-state-industry partnership and sponsored by AHRQ. The HCUP–NIS provides information annually on approximately 3 to 4 million inpatient stays from about a thousand hospitals.

The classification tree analysis technique (also called decision tree) is a statistical tool that divides and sorts data into smaller and smaller groups for estimating the ED share of injuries until no further gains in predictive power can be obtained. This technique allows for

more precise estimates of injuries treated in doctor visits or injuries admitted directly to the hospital than other regression techniques. For example, where data is available, the age and sex of the victim can have an influence on the estimates of the number of injuries treated outside the emergency department. When we combine the national estimates of the NEISS with the non-ED estimates from the ICM using classification tree techniques, we obtain a total of medically treated injuries.

Based on the annual estimate of about 30,800 blade-contact injuries initially treated in hospital EDs, the ICM projects approximately 24,050 blade-contact injuries treated in other treatment settings. Combined with the ED-treated injuries, there were an estimated annual total of about 54,850 medically treated blade-contact injuries. About 13.7 percent of the medically treated injuries involved amputations, 56.9 percent involved lacerations, 22.8 percent involved fractures, and 6.1 percent involved avulsions.<sup>71</sup> About 27.5 percent of the amputations resulted in hospital admission, compared to about 4.0 percent of lacerations and 12.1 percent of fractures. About 31.5 percent of the amputations were treated in the doctors' offices/clinics and other non-hospital settings, compared with about 41.0 percent of lacerations, 50.3 percent of fractures, and 38.7 percent of avulsions.

The blade-contact injury rate per 100,000 saws is calculated by dividing medically treated injuries by the estimated number of table saws in use. Overall, the blade-contact injury rate for table saws amounted to about 670 medically treated injuries per 100,000 saws. An approximate 95 percent confidence interval for medically treated injuries, based on estimates of the coefficient of variation (CV) from the NEISS injury estimates, ranges from about 550 to 790 medically treated injuries per 100,000 saws in use.

#### 2. Injury Costs of Blade-Contact Injuries

The societal costs of blade-contact injuries represent the pool from which the benefits of a blade contact rule are derived. The societal costs of these injuries are quantified with the ICM. The ICM is fully integrated with NEISS, and, in addition to providing estimates of the societal costs of injuries reported through NEISS, it also estimates the costs of medically treated injuries that

<sup>70</sup> Miller *et al.*, 2000, Lawrence, B., 2013, *supra* note 57; Bhattachara, S., *et al.*, 2012, *supra* note 61.

<sup>71</sup> Medically treated table saw injuries, by injury diagnosis, differ from the NEISS estimates because the NEISS cases are limited to those initially treated in hospital emergency departments.

are initially treated outside of hospital emergency departments. The major aggregated societal cost components provided by the ICM include medical costs, work losses, and the intangible costs associated with lost quality of life or pain and suffering.<sup>72</sup>

Medical costs include three categories of expenditures: (1) Medical and hospital costs associated with treating the injury victim during the initial recovery period and in the long run, including the costs associated with corrective surgery, the treatment of chronic injuries, and rehabilitation services; (2) ancillary costs, such as costs for prescriptions, medical equipment, and ambulance transport; and (3) costs of health insurance claims processing. Cost estimates for these expenditure categories were derived from a number of national and state databases, including the MEPS, the HCUP–NIS, the Nationwide Emergency Department Sample (NEDS), the National Nursing Home Survey (NNHS), MarketScan® claims data, and a variety of other federal, state, and private databases.

Work loss estimates include: (1) The forgone earnings of the victim, including lost wage work and household work, (2) the forgone earnings of parents and visitors, including lost wage work and household work, (3) imputed long term work losses of the victim that would be associated with permanent impairment, and (4) employer productivity losses, such as the costs incurred when employers spend time juggling schedules or training replacement workers. Estimates are based on information from HCUP–NIS, NEDS, Detailed Claims Information (a workers' compensation database), the National Health Interview Survey, U.S. Bureau of Labor Statistics, and other sources.

The intangible, or non-economic, costs of injury reflect the physical and emotional trauma of injury as well as

the mental anguish of victims and caregivers. Intangible costs are difficult to quantify because they do not represent products or resources traded in the marketplace. Nevertheless, they typically represent the largest component of injury cost and need to be accounted for in any benefit-cost analysis involving health outcomes.<sup>73</sup> The ICM develops a monetary estimate of these intangible costs from jury awards for pain and suffering. Although these awards can vary widely on a case-by-case basis, studies have shown them to be systematically related to a number of factors, including economic losses, the type and severity of injury, and the age of the victim.<sup>74</sup> Estimates for the ICM were derived from regression analysis of jury awards in nonfatal product liability cases involving consumer products compiled by Jury Verdicts Research, Inc.

Based on ICM estimates, the aggregate present value of the injury costs associated with the estimated 54,843 medically-treated table saw injuries amounted to about \$4.06 billion (in 2014 dollars) when future injury losses (primarily those associated with long term work loss) were discounted at 3 percent. This suggests injury costs of about \$74,050 per injury (*i.e.*, \$4.06 billion ÷ 54,843 injuries). When future losses were discounted at 7 percent, the aggregated present value amounted to about \$3.65 billion, or about \$66,650 per injury (*i.e.*, \$3.65 billion ÷ 54,843 injuries).

OMB (2003) recommends discounting future benefits (or costs) using both 3 percent and 7 percent discount rates. The 7 percent discount rate is intended to reflect the rate of return to private

capital in the U.S. economy. The 3 percent rate is intended to represent what is sometimes called the “social rate of time preference,” which is more consistent with the rate which “society” discounts future consumption flows to their present value.<sup>75</sup> Using the lower social discount rate means that future benefits are valued somewhat more highly than they would be with the a higher discount rate. Most sources suggest that the social rate of time preference is more appropriate when evaluating health-related interventions,<sup>76</sup> which is the intended purpose of the proposed rule. Consequently, the 3 percent discount rate is probably the more appropriate discount rate for evaluating the benefits and costs of the proposed rule. Presenting most results using both the 3 percent and 7 percent, as recommended by OMB, shows the sensitivity of the results to variations in the discount rate.

The distribution of injury costs, by medical treatment setting (using the 3 percent discount rate) showed that overall, medical costs and work losses accounted for roughly 30 percent of the total, while the non-economic losses associated with pain and suffering accounted for 70 percent. Injury cost estimates for non-hospitalized injuries ranged from about \$28,000 for blade-contact injuries treated outside of hospitals and EDs, to about \$42,000 for injuries initially treated in hospital EDs (but not admitted). Injury costs for hospitalized injuries, in contrast, averaged about \$450,000 per injury.

While amputations accounted for about 13.7 percent of the medically treated blade-contact injuries, they accounted for almost 64 percent of the annual estimate of \$4.06 billion in societal costs resulting from blade contact. The average imputed cost per amputation injury amounted to about \$345,000, and ranged from \$120,000 to \$195,000 for non-hospitalized amputations to about \$825,000 per hospitalized amputation.<sup>77</sup> If

<sup>72</sup> Miller *et al.*, 2000, Lawrence, B., 2013 *supra* note 57; *see also*, Lawrence, Bruce, *Impact of alternative discount rates on injury cost model estimates* (Contract CPSC–D–05–0006, Task Order 7). Calverton, MD: Pacific Institute for Research and Evaluation (Nov. 2008); Lawrence, Bruce, *Updated price indexes for the Injury Cost Model* (Contract CPSC–D–0003, Task Order 3, Subtask 4). Calverton, MD: Pacific Institute for Research and Evaluation (Aug. 2015); Lawrence, Bruce, *Update medical costs for ED-treated injuries* (Contract CPSC–D–0003, Task Order 3, Subtask 1). Calverton, MD: Pacific Institute for Research and Evaluation (Jan. 2015); Lawrence, Bruce, *Update medical costs hospital-admitted injuries* (Contract CPSC–D–0003, Task Order 3, Subtask 2). Calverton, MD: Pacific Institute for Research and Evaluation (Jan. 2015); Lawrence, Bruce, *Updated survival probabilities for the Injury Cost Model* (Contract CPSC–D–0003, Task Order 3, Subtask 3). Calverton, MD: Pacific Institute for Research and Evaluation (Aug. 2015).

<sup>73</sup> Rice, Dorothy P., MacKenzie, Ellen J., and Associates, 1989. *Cost of injury in the United States: A report to Congress*. San Francisco, CA: Institute for Health & Aging, University of California and Injury Prevention Center, The Johns Hopkins University; Haddix, Anne C., Teutsch, Steven M., Corso, Phaedra S., 2003. *Prevention effectiveness: A guide to decision and economic evaluation* (2nd ed.). New York: Oxford University Press; Cohen, Mark A., Miller, Ted R., 2003. “Willingness to award” nonmonetary damages and implied value of life from jury awards. *International Journal of Law and Economics*, 23 at 165–184; Neumann, Peter J., Sanders, Gillian D., Russell, Louise B., Siegel, Joanna E. Ganiats, Theodore G., 2016. *Cost-effectiveness in health and medicine: Second Edition*. New York: Oxford University Press.

<sup>74</sup> Viscusi, W. Kip, 1988. The determinants of the disposition of product liability cases: Systematic compensation or capricious awards? *International Review of Law and Economics*, 8, at 203–220; Rodgers, Gregory B., 1993. Estimating jury compensation for pain and suffering in product liability cases involving nonfatal personal injury. *Journal of Forensic Economics* 6(3), at 251–262; Cohen, Mark A., Miller, Ted R. (2003). “Willingness to award” nonmonetary damages and implied value of life from jury awards. *International Journal of Law and Economics*, 23, at 165–184.

<sup>75</sup> OMB, 2003. *Circular A–4: Regulatory analysis*. Washington, DC: Office of Management and Budget. [https://www.whitehouse.gov/omb/circulars\\_a004\\_a-4](https://www.whitehouse.gov/omb/circulars_a004_a-4).

<sup>76</sup> Gold, Marthe R., Siegel, Joanna E. Russell, Louise B., Weinstein, Milton C., 1996. *Cost-effectiveness in health and medicine*. New York: Oxford University Press; Haddix, Anne C., Teutsch, Steven M., Corso, Phaedra S., 2003. *Prevention effectiveness: A guide to decision and economic evaluation* (2nd ed.). New York: Oxford University Press; Neumann, Peter J., Sanders, Gillian D., Russell, Louise B., Siegel, Joanna E., Ganiats, Theodore, G., 2016. *Cost-effectiveness in health and medicine: Second Edition*. New York: Oxford University Press.

<sup>77</sup> About 29.3 percent of the amputation injury costs were attributed to medical costs and work

amputations were excluded from the injury cost estimates, the injury costs would have been reduced from about \$74,050 per injury to about \$31,200 per injury.

In contrast to the average injury cost of about \$345,000 per medically treated amputation, the average imputed cost for lacerations (which accounted for about 56.9 percent of medically treated injuries) amounted to about \$19,500. The average imputed cost for fractures (accounting for about 22.8 percent of injuries) and avulsions (6.1 percent of injuries) amounted to about \$48,250 and \$72,900, respectively.

3. Societal Costs, per Table Saw in Use

Table 10 presents estimates of the present value of societal costs, per table saw in use. Row (a) shows the aggregate annual societal costs, by discount rate. Row (c) shows annual societal costs *per saw*, and the results are calculated by dividing the aggregate annual societal costs (row a) by table saws in use (row b).

Row (e) presents the present value of societal costs, and the results were calculated using the row (c) estimate of annual societal costs and a 3 percent and 7 percent discount rate over the

saw's expected useful product life (row d). For this analysis, the expected product life was based on an average for the three saw types, weighted by the proportion of saws in use for each table saw type. The present value figure amounts to about \$5,400 per table saw using a 3 percent discount rate and about \$3,800 at 7 percent; this present value estimate represents the maximum per unit benefits that could be derived from a rule addressing blade contact if such a rule prevented all blade-contact injuries.

TABLE 10—PRESENT VALUE OF SOCIETAL COSTS PER TABLE SAW IN USE

	Discount rate	
	3 percent	7 percent
(a) Aggregate Annual Societal Costs (Billions \$) .....	\$4.06	\$3.65
(b) Table Saws in Use (Millions) .....	8.2	8.2
(c) Societal Costs per Table Saw [(a) ÷ (b)] .....	\$495	\$445
(d) Expected Useful Product Life (years) .....	13.3	13.3
(e) Present Value of Societal Costs, per Table Saw .....	\$5,366	\$3,772

4. Effectiveness and Expected Benefits of the Proposed Rule

The benefits of the proposed rule are measured as the reduction in the societal costs of injuries resulting from the use of the safer saws. Consequently, CPSC staff estimated the expected effectiveness of the proposed rule in preventing blade-contact injuries. Although effectiveness cannot be determined precisely, staff believes that an AIM system can reduce or mitigate a blade-contact injury even if the blade guard or riving knife is removed or fails to function properly. Based on testing experience with existing AIM systems, CPSC staff believes that the proposed performance requirement can significantly reduce the severity of injury involving blade contact.

However, a rule requiring manufacturers to develop an AIM technology to meet the proposed performance requirement will not prevent all blade-contact injuries. It will not prevent blade-contact injuries that occur: (1) When the blade is operating but the AIM system has been deactivated; (2) when the operator's hand is moving into the blade so quickly that contact with the blade cannot be reduced sufficiently to prevent serious injury; and (3) when the AIM technology leads to complacency or reductions in safety efforts by users that result in injury.

Based on CPSC staff's testing of existing AIM systems, we assume that the AIM technology will prevent or substantially or mitigate 70 percent to 90 percent of blade-contact injuries. The estimate of 90 percent effectiveness assumes that all blade-contact injuries, including blade-contact injuries initiated by kickback, will be addressed by the AIM technology, but that about 10 percent of blade-contact injuries will not be prevented or mitigated because of the reasons given above. The estimate of 70 percent effectiveness assumes that about 40 percent of blade-contact injuries involved kickback, and that only about half of the kickback injuries would be prevented or substantially mitigated. Additionally, we assume that the mitigated accidents that would have resulted in amputations, avulsions, and fractures are not prevented entirely, but become medically treated lacerations, and that accidents that would have resulted in medically treated lacerations are either mitigated to injuries that do not require medical attention or are prevented entirely.

Expected benefit of the rule, per table saw, over the saws expected product life are as follows:

- Benefits at 70 percent effectiveness at 3 percent—\$3,335
- benefits at 70 percent effectiveness at 7 percent—\$2,345
- benefits at 90 percent effectiveness at 3 percent—\$4,288

- benefits at 90 percent effectiveness at 7 percent—\$3,015

The benefits at 70 and 90 percent effectiveness, result in about a 62 percent and 80 percent reduction, respectively, in the estimated societal costs.

5. Costs To Meet Performance Requirements

This section discusses the types of costs that would result from a rule that would require an AIM safety technology to meet the proposed performance requirement, and quantifies some estimates of these costs provided by industry participants. Table saw manufacturers are likely to incur three primary types of costs to incorporate AIM technology into their table saws, including:

- *Costs to develop AIM technology.* Manufacturers would have to either design and develop their own AIM technology or license the AIM technology developed and owned by another party.
- *Redesign and retooling costs.* Incorporating AIM technology into existing models would require manufacturers to redesign each model and retool the facilities where the saws are manufactured. All table saw models not currently incorporating the AIM technology likely would require redesign to provide room for blade retraction, to allow access for users to

loss; 70.7 percent were attributed to pain and suffering.

change the cartridge and, if necessary, the blade, and to withstand the force of the AIM system being triggered.

- *Materials costs.* The combination of the addition of a brake cartridge, or other means of stopping or retracting the blade after contact with flesh, and the redesign of the table saw to accommodate the additional electronic components and wiring, the required clearances, and the weight and dimensions of the AIM technology, would result in increased material costs.

#### a. Costs To Develop AIM Technology

The proposed performance requirement for table saws would limit the depth of cut to a test probe, upon making contact with the saw blade at a radial approach rate of 1.0 m/s, to 3.5 mm. Although the proposed rule would allow for a variety of detection methods (such as electrical, optical, thermal, electromagnetic, ultrasound) to comply with the proposed requirements, the Commission is aware that, currently, only two manufacturers have developed an AIM technology using an electric detection system that is available on the market: SawStop and Bosch REAXX™ table saws.<sup>78</sup> If manufacturers are unable to develop their own AIM system, or if their AIM technology infringes on SawStop patents, we believe that ongoing patent infringement litigation initiated by SawStop may have a bearing on SawStop or other companies' willingness to license their AIM technologies. Various stakeholders have expressed concern that a mandatory rule could impose a monopoly for SawStop technology given the numerous patents that have been filed on its behalf. PTI reports that SawStop has filed more than 140 patent applications, and has over 100 issued patents pertaining to SawStop technology.

On July 16, 2015, SawStop filed a complaint in the U.S. District Court in Oregon for patent infringement against Bosch. On the same date SawStop also filed a complaint against Bosch with the ITC requesting a permanent order excluding from entry into the United States certain table saws incorporating AIM technology and components that infringe on SawStop's patent claims. The complaint filed in the District Court in Oregon is on hold pending the final

<sup>78</sup> A third company, Whirlwind Tool Company, has developed a "Black Box flesh-sensing prototype," which does not involve a blade retraction system, but uses a fixed protective guard and a very rapid, non-destructive motor-braking to stop the saw blade when the operator's hand is too close to the spinning blade. However, the Whirlwind system is not yet available in the market.

decision of the ITC. In the ITC proceeding, an administrative law judge (ALJ) issued an initial determination in September 2016 that the Bosch REAXX™ bench saw infringes on several SawStop patents.<sup>79</sup> Specifically, the ALJ found that Bosch infringes the claims of U.S. Patent No. 7,895,927 ('927 Patent),<sup>80</sup> titled "Power Equipment with Detection and Reaction Systems"; and U.S. Patent No. 8,011,279 ('279 Patent) titled "Power Equipment with Systems to Mitigate or Prevent Injury."<sup>81</sup>

On November 10, 2016, the ITC decided not to review the ALJ's initial determination, and requested that interested parties provide written submissions on the issues of remedy, the public interest, and bonding by November 22, 2016, with reply submissions due December 2, 2016. On January 27, 2017, the ITC issued remedial orders including a limited exclusion order and cease and desist order against Bosch effective March 29, 2017. On April 6, 2017, Bosch filed an appeal of the ITC determination in the U.S. Court of Appeals for the Federal Circuit.

The outcome of the ongoing lawsuit involving the SawStop technology will determine some of the impacts that may result from a mandatory rule requiring AIM technology in table saws. If the court determines that the patents covering the SawStop technology allow for companies to manufacture their own saws with alternative AIM technologies (such as the Bosch REAXX™ saw), then some manufacturers may choose to try to develop their own proprietary technology or license the Bosch technology (if available) as an alternative to the SawStop technology.

Alternatively, if the court decides that alternative technologies do in fact infringe upon SawStop patents, then SawStop may effectively have a monopoly on the technology needed to comply with a mandatory rule until the patents expire. Other manufacturers likely would be required to work with SawStop to license the SawStop technology for use in their saws, or

<sup>79</sup> Certain Table Saws Incorporating Active Injury Mitigation Technology and Components Thereof, USITC, Inv. No. 337-TA-965 (ALJ Thomas B. Pender, Sept. 9, 2016).

<sup>80</sup> As described in ID, the '927 patent generally describes woodworking machine safety systems that include reaction systems designed to retract a cutting tool below a working system with approximately 14 milliseconds after the detection of a dangerous condition. *Id.* at 5–6.

<sup>81</sup> As described in the ID, the '279 patent generally describe woodworking safety systems that include an actuator designed to move a moveable component in order to mitigate injury in response to detection of a dangerous condition. *Id.* at 6.

leave the table saw market. PTI and SawStop agree that this is the case. The level at which the royalty payments are set will play a significant role in determining the economic impacts the CPSC's proposed rule would have on table saw manufacturers. We note that some of the allegedly infringed upon patents may expire in 2020 ('927), and 2022 ('279). However, given the extensive number and reach of the SawStop patents, we do not know how, and to what extent, the SawStop patents may impact companies who attempt to introduce alternative AIM technologies. Nor do we know when the other SawStop patents expire or whether SawStop will file additional patents.

The royalty fee for licensing the AIM technology from SawStop is uncertain. Although Dr. Gass has indicated that SawStop would accept royalty payments of 8 percent of a saw's wholesale price if all table saws are required to use SawStop's AIM technology,<sup>82</sup> there is no certainty that SawStop would actually license the technology under terms that would be acceptable to other manufacturers. Indeed, with the exception of one company,<sup>83</sup> several companies that have attempted to license the SawStop technology thus far have not been successful.<sup>84</sup>

CPSC staff believes that in addition to the direct manufacturing and replacement parts costs and the lost consumer surplus discussed below, approximately \$30 million to \$35 million annual royalty fees for the AIM technology could accrue to patent holders. This estimate is based on the assumption that royalty fees will amount to about 8 percent of the wholesale costs of table saws when a rule would become effective. However, because royalties represent transfers from manufacturers to a patent holder, they are not included as costs for purposes in the benefit-cost analysis.<sup>85</sup> The rationale for not including royalties is based on the premise that royalty fees represent a transfer from one market segment to another (*i.e.*, from table saw manufacturers to patent holders) and remain available (by a different party) for productive use. Nevertheless, from the point of view of an individual manufacturer who pays the royalty, the payment represents a cost. Table saw manufacturers who would be paying royalties to a competitor would, in

<sup>82</sup> IEc, 2016a at 19.

<sup>83</sup> SawStop and Griggio, an Italian manufacturer collaborated to develop a sliding table saw. IEc, 2016a at 18.

<sup>84</sup> *Id.*

<sup>85</sup> OMB, 2003. Circular A–4, available at: [https://www.whitehouse.gov/omb/circulars\\_a004\\_a-4](https://www.whitehouse.gov/omb/circulars_a004_a-4).

effect, be reducing their competitiveness relative to the patent holder receiving the royalties. Consequently, the royalty transfers represent an impact of the proposed rule that needs to be considered, and staff has evaluated the potential costs of royalties as discussed in Table 12.

#### b. Redesign Costs

Interviews with several manufacturers, as well as a review of public comments provided by PTI to the ANPR, revealed general agreement that implementing a rule requiring AIM technology would necessitate a complete redesign of all saws that do not currently incorporate the AIM technology. More specifically, the trunnion system would have to be redesigned, and the cabinet/interior of the saw would need to be modified to incorporate the technology and allow access to change out the brake cartridge or to allow clearance for blade retraction.<sup>86</sup> The support structure, such as the stand, would also likely need to be redesigned to bear the extra weight of the AIM system and to absorb the force applied by the triggering of the AIM mechanism. PTI estimates that the cost to redesign and retool existing table saws would range from \$2 million to \$10 million per company.<sup>87</sup>

SawStop has indicated that SawStop's tooling costs were approximately \$200,000 for its first cast iron (*i.e.*, contractor/cabinet) table saw, and were approximately \$700,000 for its first benchtop table saw.<sup>88</sup> SawStop's estimates are within the range of estimates provided by other firms. In interviews with manufacturers, several companies indicated the cost to redesign saws could be approximately \$500,000 per saw.<sup>89</sup> One company indicated that retooling could cost \$100,000 to \$200,000. An additional cost of several hundred thousand dollars may be necessary depending on the level of engineering required for the redesign. For example, according to one company, a redesign of the trunnion system alone may cost \$200,000.

Several companies suggested that the redesign and retooling of table saws would, at least on the initial models, be expected to take one to three years. However, redesigning and retooling subsequent models would require a shorter period and cost less. Four small

firms interviewed indicated that the cost of redesigning their saws to incorporate AIM technology may be too great, relative to their sales volume, to support such a redesign. They indicated that they might respond by reducing or eliminating their offerings of table saws to the U.S. market.<sup>90</sup>

#### c. Material Costs

In addition to the redesign and tooling costs, additional costs would result from the additional components and the increased use of raw materials associated with inclusion of the AIM system. For SawStop models, the additional costs associated with the AIM system is approximately \$58 (including brake cartridge, cartridge key, cartridge cable, cartridge bracket, insulation on arbor, electrode shell assembly, and power supply/motor control). An estimate from another firm suggested \$74 (including cartridge, electronics, and mechanical parts).

The AIM technology also will affect the weight of the table saws, adding to material costs. Although the added weight is applicable to all table saws equipped with the AIM technology, the added weight will particularly affect the bench saws, which typically can be transported by a single person. Currently, the lightest bench saws weigh 35 to 40 pounds. While the various components needed for AIM compliance may only weigh a few pounds, the structure of some saws may need to be strengthened to be stable and to withstand the shock of blade braking and/or retraction if those methods are used. This need for strength may contribute substantially to the added weight of some complying saws. Adding the AIM technology effectively could double the weight of some of the lightest saws, reducing the portability and utility of lightweight bench saws.

#### D. Unit Manufacturing Cost Impact

##### 1. Low-End Manufacturing Costs

For bench saws, SawStop has indicated that retail prices for bench saws would increase by no more than \$150 per unit as result of the rule.<sup>91</sup> Dr. Gass estimates that in the short-term (*i.e.*, within the first five years following the promulgation of the rule), the cheapest saws available (*i.e.*, inexpensive bench saws that currently cost about \$150) will have a price of approximately \$299. Thus, SawStop projects a short term cost increase of about \$150. In the absence of more

specific information about manufacturing costs, CPSC staff uses this figure as the basis for the low-end estimate of manufacturing cost increases for bench saws.

For contractor and cabinet saws, the low-end expected cost impacts were based on discussions with other industry members. One manufacturer estimated that the retail price of the single table saw model that they produce would increase by about 30 percent as a result of the rule, including the cost of royalties. Excluding royalties, this estimate suggested a cost increase associated with redesign, retooling, and materials of about \$256.<sup>92</sup> For this analysis, we assume that this \$256 low-end cost increase can be applied to all contractor and cabinet saws.

##### 2. High-End Manufacturing Costs

For bench saws, the high-end cost increase is based on information provided by PTI, whose members produce primarily bench saws. PTI estimates that the increase would be \$100 to \$800 per saw, excluding royalties.<sup>93</sup> In the absence of more specific estimates, CPSC staff uses the midpoint of this range, \$450 per saw, as the short-term high-end estimate for bench saws.

For contractor and cabinet saw models, we apply the high-end of the range estimated by PTI and other manufacturers. One table saw manufacturer provided an estimate ranging from \$500 to \$800 for "larger saws," excluding royalties. Another manufacturer estimated that the retail price of saws would increase 20 percent, excluding the cost of royalties.<sup>94</sup> Applying this percentage to the company's cabinet saw models results in added costs of about \$260 to \$800. Consequently, CPSC staff assumes the high-end incremental cost increase is \$800, the upper bound of each range suggested by PTI and these two manufacturers. In the longer term, after about five years, we would expect that the incremental cost would decrease, though the magnitude of such a decrease is uncertain.

##### 3. Replacement Part Costs

In addition to the direct costs of the rule just described, there also will be the added costs of replacement parts related to the AIM system. For purposes of our analysis, we base the cost of replacement parts on the SawStop system, which requires replacement of the brake cartridge and blade after an

<sup>86</sup> A trunnion is an assembly that holds a saw's arbor to the underside of the saw table.

<sup>87</sup> Graham, J. 2010. *Expert report of Dr. John D. Graham*. (April 27). Submitted with the PTI public comments (2012) CPSC-2011-0074-1106, available at: [regulations.gov](#).

<sup>88</sup> SawStop Comment to the ANPR, *supra* note 50.

<sup>89</sup> IEC, 2016a at 20.

<sup>90</sup> *Id.*

<sup>91</sup> SawStop, LLC. 2009. Presentation to CPSC, December 8 & 9. See also, *Osorio v. One World Technologies, Inc.*, 659 F.3d 81, 83 (1st Cir. 2011).

<sup>92</sup> IEC, 2016b at 11-12.

<sup>93</sup> *Id.* at 12.

<sup>94</sup> *Id.*

activation of the system. Replacement part prices are estimated to include \$69 for a replacement brake cartridge (based on current online prices), and \$30 to \$90 for a replacement blade. Based on sales of replacement brake cartridges, SawStop estimates that the AIM system may activate about once every nine years of use.<sup>95</sup> At a replacement rate of once every nine years (and assuming \$60 per replacement blade), this results in an annual per-unit replacement part cost of approximately \$14  $[(\$69 + \$60) \div 9]$ . However, because blades depreciate and would require periodic replacement even in the absence of an AIM activation, we assume that the need for replacement blades due to an activation costs an average of about \$30 every nine years (rather than \$60), for an average of about \$11 annually  $[(\$69 + \$30) \div 9]$ . The present value of this expected annual cost of \$11 over the life of a typical table saw, and discounted at a rate of 3 percent, would amount to

about \$94 for bench saws (with a 10-year expected product life), \$145 for contractor saws (with an estimated 17-year product life), and \$186 of cabinet saws (with an expected 24-year product life). With a discount rate of 7 percent, the present value of expected costs would amount to about \$77, \$107, and \$126 for bench, contractor, and cabinet saws, respectively. For purposes of this cost analysis, we use the midpoint of this range. Hence, we estimate that replacement parts costs for the AIM system would amount to about \$86 for bench saws, \$126 for contractor saws, and \$156 for cabinet saws.

Additionally, the Bosch REAXX™ bench saws, introduced on June 1, 2016, use a \$100 cartridge that lasts for two activations. Since the blade is not destroyed by the activation, the Bosch system has lower replacement part costs. However, staff does not have any information on how frequently the cartridge will be activated. If, however,

the Bosch cartridge activates once every nine years, based on the SawStop experience, and the cost is \$100 for two activations, then the expected annual per-unit replacement cost would be about \$5.55 annually  $(\$100/2) \div 9$ . The present value of this expected annual cost of \$5.55 over an average product life of 10 years for a bench saw (discounted at a rate of 3 percent) would amount to about \$47 per saw, about half the expected costs of the SawStop system. Additionally, the Bosch system does not require any additional dado hardware related to the AIM system. Consequently, if the Bosch REAXX™ stays in the market, our baseline estimates of replacement costs might be reduced.

The direct manufacturing and replacement costs are presented in Table 11, and rely on the low- and high-end direct manufacturing costs and the SawStop replacement costs as described.<sup>96</sup>

TABLE 11—DIRECT MANUFACTURING AND REPLACEMENT COSTS

Table saw type	Direct manufacturing costs		Replacement parts costs	Total direct + replacement costs	
	Low-end estimates	High-end estimates		Low-end estimates	High-end estimates
Bench .....	\$150	\$450	\$86	\$236	\$536
Contractor .....	256	800	126	382	926
Cabinet .....	256	800	156	412	956

Based on the available information, there is considerable uncertainty concerning the per unit manufacturing cost impact of a rule requiring the use of AIM technology on table saws. Accordingly, the Commission seeks any comments that would allow us to make more precise estimates or narrow the range we present regarding the unit manufacturing cost impact of a rule requiring the use of AIM technology on table saws.

4. Impact on Product Usability

The AIM technology will also affect the weight of the table saws, adding to material costs. While the added weight is applicable to all table saws equipped with the AIM technology, the added weight will particularly affect bench saws, which, as currently configured, typically can be transported by a single person. Currently, the lightest bench saws weigh 35 to 40 pounds. While the various components needed for AIM

compliance may only weigh a few pounds, the structure of some saws may need to be strengthened to be stable and to withstand the shock of blade braking and/or retraction if those methods are used. This need for strength may contribute substantially to the added weight of some complying saws, perhaps as much as an 18 pound increase.

An additional four or five pounds is not a major weight penalty on a forty pound bench saw, but an 18 pound increase would reduce portability. An additional 20 pounds (on top of the 18 pounds) for a more substantial jobsite saw type structure, if necessary, would further decrease portability. For contractor saws, with wheels and stands, the weight penalty would not be substantial. Cabinet saws are not portable at all, so the weight penalty may make no real difference. However, adding the AIM technology could effectively double the weight of some of

the lightest saws, reducing the portability and utility of lightweight bench saws. The Commission seeks public comments on the impact of the AIM technology on the utility of table saws, and possible methods of quantifying these impacts.

E. Impact of Higher Prices on Sales and Lost Consumer Surplus

The increasing retail prices of table saws, as costs are passed on to consumers, will result in a reduction in table saw sales. As a consequence, and in addition to the price impacts on consumers who continue to purchase saws, consumers who decide not to purchase table saws because of the higher prices will experience a loss in consumer surplus. For purposes of this analysis, we assume that cost increases as well as royalties are pushed forward to consumers. Table 12 provides baseline sales and median retail price estimates,<sup>97</sup> along with the total per

<sup>95</sup> *Id.* at 13.

<sup>96</sup> The SawStop AIM system has optional hardware to perform dado cuts which includes an \$89 dado brake cartridge. This dado brake system is not included in Table 11.

<sup>97</sup> Retail price information was collected for all of the table saw models available. However, we were unable to calculate a weighted average retail price for each category of saw because we do not have sales information for the various models.

Consequently, we apply the median price advertised for each category as baseline pre-regulatory retail prices.

product compliance cost estimates, including both the costs associated with manufacturing the redesigned table saws and the expected costs of replacement parts over the expected

product life of a table saw. Table 12 also provides an estimate of the expected royalty fee, under the assumption, based on Dr. Gass's statements, that the fee would amount to 8 percent of a saw's

wholesale price.<sup>98</sup> The per unit cost and royalty fee estimates are provided for both the low-end and high-end cost estimates.

TABLE 12—BASELINE ANNUAL TABLE SAW SHIPMENTS, RETAIL PRICES, AND PER UNIT COMPLIANCE COST ESTIMATES AND ROYALTY FEES

Table saw type	Pre-regulatory baseline estimates		Per unit cost estimates *		Per unit royalty fees	
	Shipments **	Median price (per unit)	Low-end estimates (% of baseline)	High-end estimates (% of baseline)	Low-end cost estimates	High-end cost estimates
Bench .....	499,000	\$400	\$236 (59.0%)	\$536 (134%)	\$37	\$57
Contractor .....	133,000	1,225	\$382 (31.2%)	\$926 (75.6%)	99	135
Cabinet .....	33,000	2,550	\$412 (16.2%)	\$956 (37.5%)	187	223

\* Includes direct manufacturing and replacement part costs.  
 \*\* Excludes 10,000 units assumed to contain the AIM technology

Table 13 shows the expected reduction in annual sales as well as the expected lost consumer surplus. Reduced sales could range from 93,400 table saws under the low-end cost

estimates (column a) to about 251,700 under the high-end cost estimates (column d), a sales reduction of about 14.0 percent to 37.8 percent, respectively. The annual loss in

consumer surplus ranges from about \$10.0 million under the low cost estimates (column c), to about \$72.3 million, under the high cost estimates (column f).

TABLE 13—AGGREGATE EXPECTED POST-REGULATORY ANNUAL TABLE SAW SALES, SALES REDUCTION, AND LOST CONSUMER SURPLUS, BY COST LEVEL AND TABLE SAW TYPE

Table saw type	Low-end cost estimate			High-end cost estimate		
	Expected sales reduction (a)	Expected post-regulatory sales (b)	Aggregate lost consumer surplus (millions \$) (c)	Expected sales reduction (d)	Expected post-regulatory sales (e)	Aggregate lost consumer surplus (millions \$) (f)
Bench .....	\$78,500	\$420,500	\$7.3	\$213,000	\$286,000	\$54.0
Contractor .....	13,000	120,000	2.3	34,200	98,800	16.0
Cabinet .....	1,900	31,100	0.4	4,500	28,500	2.3
Total .....	93,400	571,600	10.0	251,700	413,300	72.3

Table 14 presents the total costs per table saw, including both the direct manufacturing costs, replacement part costs, and the lost consumer surplus. The lost consumer surplus, per table

saw, is calculated as the aggregate lost consumer surplus (from Table 13, columns c and f) divided by the post-regulatory estimate of sales (Table 13, columns b and e). Total per unit costs

range from roughly \$253 to \$725 per bench saw to roughly \$400 to \$1,088 per unit for contractor and cabinet saws.

TABLE 14—TOTAL COSTS OF THE PROPOSED RULE, PER TABLE SAW, BY COST LEVEL AND TABLE SAW TYPE

Table saw type	Low-end cost estimates, per table saw			High-end cost estimates, per table saw		
	Direct + replacement costs (a)	Lost consumer surplus (b)	Total (a) + (b) (c)	Direct + replacement costs (d)	Lost consumer surplus (e)	Total (d) + (e) (f)
Bench .....	\$236	\$17	\$253	\$536	\$189	\$725
Contractor .....	382	19	401	926	162	1,088

<sup>98</sup> IEC, 2016b at 14. Staff also spoke with Dr. Gass on November 26, 2015, who indicated that SawStop

would accept royalty payments of 8 percent of a

saw's wholesale value if a rule is mandated requiring AIM technology on all table saws.



TABLE 14—TOTAL COSTS OF THE PROPOSED RULE, PER TABLE SAW, BY COST LEVEL AND TABLE SAW TYPE—Continued

Table saw type	Low-end cost estimates, per table saw			High-end cost estimates, per table saw		
	Direct + replacement costs	Lost consumer surplus	Total (a) + (b)	Direct + replacement costs	Lost consumer surplus	Total (d) + (e)
	(a)	(b)	(c)	(d)	(e)	(f)
Cabinet .....	412	13	425	956	81	1,037

The annual aggregate costs of the rule are estimated in columns (c) and (f) of Table 15, and range from about \$170 million based on our low-end cost estimates, to about \$345 million based on our high-end cost estimates. Bench table saws account for about 63 percent of the total under the low-end annual cost estimates and about 60 percent of the costs under the high-end estimates.

TABLE 15—ANNUAL POST-REGULATORY SALES, PER UNIT COST ESTIMATES, AND AGGREGATE ANNUAL COSTS OF THE PROPOSED RULE, BY COST LEVEL AND TABLE SAW TYPE

Table saw type	Low-end cost estimates			High-end cost estimates		
	Annual post-regulatory table saw sales	Per unit costs (direct costs + replacement costs + lost consumer surplus)	Aggregate costs (millions \$) (a) × (b)	Annual post-regulatory table saw sales	Per unit costs (direct costs + replacement costs + lost consumer surplus)	Aggregate costs (millions \$) (d) × (e)
	(a)	(b)	(c)	(d)	(e)	(f)
Bench .....	\$420,500	\$253	\$106.4	\$286,000	\$725	\$207.4
Contractor .....	120,000	401	48.1	98,800	1,088	107.5
Cabinet .....	31,100	425	13.2	28,500	1,037	29.6
Total .....	571,600	.....	167.7	413,300	.....	344.5

Over time, we would expect the costs of the AIM technology to decrease. If, for example, we assume that the annual aggregate costs remain constant for years 1 through 5, but decline by about one-third in years 6 through 10, the present value of the aggregate costs over 10 years (using a 3 percent discount rate) would range from about \$1,200 million to \$2,500 million; on an annualized basis, this would amount to about \$140 million to \$290 million annually. Alternatively, if annual aggregate costs

remain constant for years 1 through 5, but decline by about two-thirds in years 6 through 10, the present value of the aggregate costs over 10 years (using a 3 percent discount rate) would range from about \$990 million to \$2,000 million; on an annualized basis, this would amount to about \$120 million to \$240 million.

*F. Benefit-Cost Findings*

The expected benefits and costs of the proposed rule, are presented and compared in Table 16. The estimated

benefits per table saw are provided in rows (a) and (b). The estimated costs per table saw are shown in rows (c) and (d). Cost estimates were developed from Table 15; they represent the average lower and upper bound cost estimates, weighted by projected sales. Net benefits per table saw are estimated in rows (e) and (f), and range from about \$2,500 to \$4,000 with a 3 percent discount rate and about \$1,500 to \$2,700 at 7 percent.

TABLE 16—ESTIMATES OF BENEFITS, COSTS AND NET BENEFITS, BY TABLE SAW [2014 dollars]

Categories	Discount rate		Row
	3 Percent	7 Percent	
<b>Estimates per Table Saw, Over Its Expected Product Life</b>			
Expected Benefits per Table Saw:			
70% Effective .....	\$3,335	\$2,345	(a)
90% Effective .....	\$4,288	\$3,015	(b)
Expected Costs per Table Saw:			
Lower Bound Cost Estimates .....	\$293	\$293	(c)
Higher Bound Cost Estimates .....	\$833	\$833	(d)
Range of Expected Net Benefits per Table Saw:			
(a) – (d) .....	\$2,502 to	\$1,512 to	(e)

TABLE 16—ESTIMATES OF BENEFITS, COSTS AND NET BENEFITS, BY TABLE SAW—Continued  
[2014 dollars]

Categories	Discount rate		Row
	3 Percent	7 Percent	
(b) – (c) .....	\$3,995	\$2,722	(f)
<b>Expected Annual Sales</b>			
Low Cost Estimate .....	\$571,600	571,600	(g)
High Cost Estimate .....	\$413,300	413,300	(h)
<b>Aggregate Annual Estimates, Based on One Year of Sales</b>			
Range of Expected Benefits (Millions \$):			
(a) + (h) .....	\$1,378	\$969	(i)
	to	to	
(b) + (g) .....	\$2,450	\$1,723	(j)
Range of Expected Costs (Millions \$):			
(c) × (g) .....	\$168	\$168	(k)
	to	to	
(d) × (h) .....	\$344	\$344	(l)
Range of Expected Net Benefits (Millions \$):			
(i) – (l) .....	\$1,034	\$625	(m)
	to	to	
(j) – (k) .....	\$2,282	\$1,555	(n)

Given table saw sales estimates, shown in rows (g) and (h) of Table 16, we can provide aggregate annual estimates of the benefits and costs of the proposed rule. As shown in rows (i) and (j), estimates of aggregate annual benefits range from about \$970 million to \$2,450 million, and aggregate costs, shown in rows (m) and (n), range from about \$170 million to about \$345 million. Aggregate net benefits, from rows (m) and (n), range from about \$1,030 million to \$2,280 million with a 3 percent discount rate, and from about \$630 million to \$1,560 million at 7 percent.

#### G. Sensitivity Analysis

The benefit-cost analysis described our methodology and the results of our reference case analysis. This section presents an analysis to help evaluate the sensitivity of the results to variations in some of the key parameters and assumptions of the analysis. Such an analysis is needed to account for uncertainty in the values of the input variables. The variables CPSC staff examines include: (1) The expected product life of table saws, (2) the number of table saws in use, (3) the national estimate of medically treated

injuries involving table saws, and (4) our estimates of injury costs.

Relative to the reference case analysis, the sensitivity analysis allows: The expected product life of table saws to vary by about 20 percent; the number of table saws in use to vary by 25 percent; and the national estimate of medically treated injuries by the upper and lower bounds of an approximate 95 percent confidence interval. Finally, we evaluate the results of the analysis when benefits are limited to the economic costs of injury (*i.e.*, medical costs and work loss), and the intangible costs associated with pain and suffering are excluded. This exclusion of pain and suffering is not intended to suggest that the intangible costs are not important; rather it simply shows the impact of limiting the costs to the economic losses associated with medical costs and work losses.

Table 17 describes the results of the sensitivity analysis. Only changes in *net benefits* per table saw are shown in the table. Aside from changing the input variables, the methodology used to estimate net benefits in the sensitivity analysis was identical to that presented in the reference case analysis shown in Table 16.

Variations in the expected product life of the table saws had a relatively small impact on net benefits (See Table 17, Part B, rows b and c). A longer expected product life reduces societal costs per table saw on an annual basis (because there would be more saws in use), but increases the number years over which benefits are accumulated in the present value calculation. Conversely, a shorter expected product life increases the annual societal costs per table saw (because there would be fewer saws in use), but decreases the number of years over which the benefits are accumulated. In all cases, net benefits remained positive and significant, and roughly equal to estimates from the reference case.

Variations in the number of saws in use, which might result if sales were systematically under- or over-estimated, had a somewhat greater impact on net benefits (Table 17, Part B, rows d and e). Net benefits rose when fewer saws were assumed to be in use, because injury costs were apportioned over a smaller population of saws; conversely, net benefits decreased when more saws were assumed to be in use. Nevertheless, net benefits remained positive.

TABLE 17—SENSITIVITY ANALYSIS: EXPECTED NET BENEFITS ASSOCIATED WITH VARIATIONS IN INPUT VALUES

Row	Input value	Range of expected net benefits per table saw, by discount rate	
		3 Percent	7 Percent
Part A: Reference Case Results.*			
a	Reference Case Analysis* (Rows (i) and (j) from Table 16)	\$2,502 to \$3,995	\$1,512 to \$2,722.
Part B: Alternative Inputs for Sensitivity Analysis			
Row	Input variable and value(s) used in sensitivity analysis	Range of expected net benefits by discount rate	
		3 Percent	7 Percent
Expected Product Life (years)			
b	Lower expected product life: 10.8 years	2,817 to 4,400	1,834 to 3,136.
c	Higher expected product life: 16.2 years	2,502 to 3,995	1,414 to 2,596.
Saws in Use			
d	25% fewer saws in use: 6.1 million	3,651 to 5,472	2,319 to 3,760.
e	25% more saws in use: 10.3 million	1,822 to 3,121	1,034 to 2,107.
Medically Treated Injuries (per year)			
f	Approximate lower 95% CI: 45,150	1,914 to 3,239	1,098 to 2,190.
g	Approximate upper 95% CI: 64,500	3,088 to 4,749	1,924 to 3,252.
Exclusion of Pain and Suffering Estimates from Injury Costs			
h	Medical costs and work losses only, excluding imputed costs of pain and suffering..	279 to 1,136	– 52 to 711.

\* Reference Case Inputs: 3% discount rate; expected product life, 13.3 years; saws in use, 8.2 million; medically treated blade-contact injuries, 54,843 per year; including 100% of pain and suffering estimates in injury cost calculation.

Variations in the national estimate of medically treated injuries (rows f and g), were based on the lower and upper bounds of an approximate 95 percent confidence interval, based on estimates the coefficient of variation (CV) from the NEISS injury estimates. The upper bound estimates increased net benefits substantially, as would be expected, while the lower bound estimates lowered them.

Finally, net benefits were significantly reduced when benefits were limited to the reduction in economic losses associated with medical costs and work losses, excluding the intangible costs associated with pain and suffering (Table 17, Part B, row h). Reductions in pain and suffering accounted for about 70 percent of the societal costs associated with blade-contact injuries. Nevertheless, although net benefits appear to have remained positive using a 3 percent discount rate, benefits were generally comparable to costs when a 7 percent discount rate was applied.

*H. Breakeven Analysis*

The preceding analysis evaluated the expected benefits and costs of the

proposed rule over the table saw market as a whole, combining all of the saw types into a single category. However, because we had no information on the distribution of injuries by saw type, we were unable to evaluate the relationship between benefits and costs for each of the three major saw categories: Bench saws, contractor saws, and cabinet saws.

Such a detailed analysis of benefits and costs, by saw type, is useful because the saw types have different physical characteristics and different patterns of usage. Contractor saws, in general, are heavier, less mobile, and more expensive than bench saws; similarly, cabinet saws are heavier, less mobile, and more expensive than contractor saws. Some types of table saws may be used more frequently or more intensively than others. Contractor and cabinet saws may be more likely to be used by hobbyists or occupational users who may, relative to bench saw users, have more expertise or experience in the safe use of table saws.

On the other hand, many consumers use table saws only occasionally. These types of consumers may be less likely to fully understand table saw risks (e.g.,

how quickly and unexpectedly kickback injuries can occur) or to remember safety procedures; they are also probably more likely to purchase the inexpensive bench saw models. Consequently, because of the different characteristics and potentially varying use patterns associated with the various saw types, it is possible that the costs of the proposed rule might exceed the benefits for one or more table saw types, even though, in aggregate (as shown above), benefits exceed aggregate costs for the market as a whole.

Although we cannot conduct a benefit-cost analysis of the individual saw types, we can evaluate the relationship between benefits and costs of the proposed rule by saw type. To do this, we will, for each saw type, estimate the number of injuries that would have to be prevented in order for benefits to equal or exceed the costs. This is called a breakeven analysis, and the number of injuries that would have to be prevented before benefits would equal costs can be called the breakeven estimate. We will then develop several hypothetical distributions of injuries across saw types, and compare the expected injury

reduction for each to the breakeven estimates. Table 18 shows the breakeven injury estimates, including hypothetical injury distributions and the expected injury reduction associated with one year of table saw sales, by table saw type.

CPSC staff applied the breakeven analysis to table saw sales from a single year to allow staff to calculate the breakeven injury estimate from information that we have already presented in this regulatory analysis. Staff also followed the single years'

worth of table saw sales through their useful product lives to determine the expected number of injuries that would likely be prevented by the proposed rule.

**TABLE 18—BREAKEVEN INJURY ESTIMATES AND THE EXPECTED INJURY REDUCTION ASSOCIATED WITH ONE YEAR OF TABLE SAW SALES, BY TABLE SAW TYPE**

Row		Type of saw		
		Bench	Contractor	Cabinet
a	Breakeven Injury Estimates	1,437–3,116	650–1,615	178–445.
<b>Hypothetical Injury Distributions</b>				
b	1. Every Saw Has the Same Annual Risk of Injury.			
c	Annual Risk per Saw	0.00669	0.00669	0.00669.
d	Estimated Annual Injuries	1,913–2,812	661–803	191–208.
e	Present Value of Annual Injury Estimate	13,435–23,990	6,451–10,567	2,186–3,323.
f	Present Value of Expected Injury Reduction *	8,330–19,192	4,000–8,454	1,355–2,818.
g	2. Equivalent risks for the saw types, over expected product life.			
h	Annual Risk per Saw	0.00808	0.00475	0.00337.
i	Estimated Annual Injuries	2,312–3,399	470–571	96–105.
j	Present Value of Annual Injury Estimate	16,237–28,993	4,586–7,512	1,101–1,774.
k	Present Value of Expected Injury Reduction *	10,067–23,194	2,843–6,010	682–1,419.
l	3. Injury Risks Proportional to the Median Saw Price.			
m	Annual Risk per Saw	0.00318	0.00974	0.02027.
n	Estimated Annual Injuries	910–1,337	962–1,169	578–631.
o	Present Value of Annual Injury Estimate	6,389–11,408	9,396–15,389	6,628–10,679.
p	Present Value of Expected Injury Reduction *	3,961–9,126	5,825–12,311	4,109–8,543.
q	4. Injuries are Proportional to Median Saw Price.			
r	Annual Risk per Saw	0.00103	0.00700	0.04187.
s	Estimated Annual Injuries	295–433	691–840	1,193–1,302.
t	Present Value of Annual Injury Estimate	2,070–3,696	6,749–11,054	13,687–22,053.
u	Present Value of Expected Injury Reduction *	1,283–2,957	4,184–8,843	8,486–17,642.

\* Assumes 70 percent to 90 percent of the blade-contact injuries are prevented or mitigated by the proposed rule.

**1. Calculation of the Breakeven Injury Estimates**

Breakeven injury estimates are derived from: (1) The expected post-regulatory sales, and (2) the aggregate cost estimates, by saw type, presented in Table 15. For example, to calculate the breakeven injury estimate for bench saws, we begin with the aggregate cost estimates of \$106.4 million to \$207.4 million. The \$106.4 million was based on our lower bound cost estimate for bench saws (annual sales of 420,500 bench saws × \$253 cost per bench saw) and \$207.4 million was based on our upper bound cost estimate (annual sales of 286,000 bench saws × \$725 cost per bench saw).

If we divide these aggregate cost estimates by the average cost per injury (i.e., \$74,050 with a 3 percent discount rate and \$66,550 at 7 percent), we can estimate a range of injuries that would have to be prevented for benefits to

equal or exceed costs. For bench saws, using a 3 percent discount rate, the breakeven estimates range from 1,437 injuries (\$106.4 million ÷ \$74,050) to 2,801 injuries (\$207.4 million ÷ \$74,050). Using a 7 percent discount rate, the breakeven estimates range from about 1,599 injuries (\$106.4 million ÷ \$66,550) to about 3,116 (\$207.4 million ÷ \$66,550). If, for simplicity, we combine these ranges, we have an overall breakeven range from about 1,437 (based on the lower bound cost estimate injury costs discounted at 3 percent) to 3,116 injuries (based on the upper bound cost estimate and injury costs discounted at 7 percent).

This breakeven estimate means that if the proposed rule could prevent at least 1,437 to 3,116 bench saw injuries over the expected product life of one years' production and sale of bench saws, then the benefits of the proposed rule would equal or exceed the costs for that saw type. Using the same methodology, the

breakeven injury estimate for contractor saws ranges from 650 to 1,615, and the breakeven estimate for cabinet saws ranges from 178 to 445. CPSC staff notes that throughout this breakeven analysis, we are implicitly assuming that the types of injuries experienced, and hence the societal costs, are the same across the three types of table saws. However, in reality, the distribution of injuries and the resulting societal costs, by saw type, are likely to vary.

**2. Hypothetical Blade-Contact Injury Distributions**

Because we have no information on the actual distribution of blade-contact injuries across saw types, CPSC staff considered four hypothetical distributions. The first assumes that injuries are proportional to saws in use, and that every table saw has an equal likelihood of injury on an annual basis. Thus, the risk for a bench saw, over the course of a year, is equal to the risk for

contractor and cabinet saws. Because the present value of the expected injury reduction for bench saws (8,330 to 19,192; row f) exceeds the breakeven range (1,437 to 3,116; row a), we can say that the benefits are very likely to exceed the costs for bench saws for this hypothetical injury distribution. Additionally, the present value of prevented injuries ranges from 4,000 to 8,454 injuries for contractor saws and 1,355 to 2,818 injuries for cabinet saws. Because the present value of each of these ranges exceeds the breakeven range (650–1,615 for contractor saws and 178–445 for cabinet saws), we can say that, for this distribution of injuries, the estimated benefits of the proposed rule are likely to exceed the costs for all three table saw types.

The second hypothetical injury distribution assumes that the risks for the saw types are equal to one another over their expected product lives. Consequently, given the expected product life of about 10 years for bench saws, 17 years for contractor saws, and 24 years for cabinet saws, the annual risk for contractor saws would, on an annual basis, be about 59 percent (10 years ÷ 17 years) of the risk for bench saws, and the risk for cabinet saws would be about 42 percent (10 years ÷ 24 years) of the risk for bench saws. Given the distribution of an estimated 8.2 million table saws currently in use by saw type, this hypothetical injury distribution would suggest that about 75.2 percent of the 54,843 blade-contact injuries in 2015 involved bench saws, 19.9 percent involved contractor saws, and 4.9 percent involved cabinet saws. This injury distribution suggests increased injury risk for bench saws but lower risks for contractor and cabinet saws (row h). Nevertheless, the present value of injuries prevented (row k) would continue to exceed the breakeven levels (row a).

Our third hypothetical injury distribution assumes that the blade contact risk for the three table saw types is proportional to their median retail prices. Given the median retail prices (*i.e.*, \$400 per bench saw, \$1,225 per

contractor saw, and \$2,550 per cabinet saw), the annual risk on a contractor saw would be about 3.06 times the risk for a bench saw (*i.e.*, \$1,225 ÷ \$400) and the annual risk on a cabinet saw would be about 6.37 times the risk for a bench saw (*i.e.*, \$2,550 ÷ \$400). Given the distribution of the estimated 8.2 million table saws currently in use by saw type, this hypothetical injury distribution would suggest that about 29.6 percent of the 54,843 blade-contact injuries in 2015 involved bench saws, 40.8 percent involved contractor saws, and 29.6 percent involved cabinet saws. Relative to the first two hypothetical injury distributions, this injury distribution would suggest that injury risks are lower on bench saws, but higher on contractor and cabinet saws (row m). The results suggest that the present value of injuries prevented (row p) would exceed the breakeven levels.

Whereas the third hypothetical injury distribution suggested that *injury risks* were proportional to median prices, our fourth hypothetical injury distribution assumes that estimated *blade-contact injuries*, by table saw type, are proportional to the median retail prices. Consequently, the annual number of blade-contact injuries on contractor saws would be about 3.06 times the number on bench saw injuries, and the number of injuries on cabinet saws would be about 6.37 times the number on bench saws. Given the distribution of the estimated 8.2 million table saws currently in use by saw type, this hypothetical injury distribution would suggest that about 9.6 percent of the 54,843 blade-contact injuries in 2015 involved bench saws, 29.3 percent involved contractor saws, and 61.1 percent involved cabinet saws. Comparing the present value of the expected injury reduction (row u) with the breakeven injury estimates (row a) suggests that the expected injury reduction would exceed the breakeven level. However, for bench saws, the present value of injury reduction (1,283 to 2,957) appears to be generally comparable to, or slightly lower than, the breakeven level (1,437 to 3,116).

3. Sensitivity Analysis of Breakeven Results

The breakeven analysis evaluated four hypothetical injury distributions, and found (for the most part) that the expected injury reduction for each of the saw types substantially exceeded the breakeven estimates, regardless of the hypothesized injury distribution. The CPSC staff also conducted a sensitivity analysis of the breakeven results by allowing variation in some key parameters and assumptions underlying the analysis, including variations in the number of table saws in use, the national estimate of medically treated injuries, and estimates of injury costs. Results are presented in Table 19, which shows the *present value of the expected injury reduction* for the four injury distributions presented in Table 18, when estimates of the number of Tables saws (by type) were either 25 percent lower or 25 percent higher than in the base analysis and when estimates of medically treated injury estimates were set equal to the lower and higher bounds of an approximate 95 percent confidence interval, based on the coefficient of variation from the NEISS blade-contact injury estimates.

As suggested by rows (b) through (p) of Table 19, the present value of the expected injury reductions from the first three hypothetical injury distributions remain uniformly higher than the breakeven estimates (row a), as do the projected injury reductions for contractor and cabinet saws from the fourth hypothesized injury distribution (rows q through u). However, considering bench saws from the fourth injury distribution, the present value injury estimates appear to be generally comparable, or marginally lower, than the breakeven injury estimates when: (1) The estimate of bench saws in use was assumed to be 25 percent higher than the reference case (row s); and (2) when bench saw injuries were estimated at the lower bound of an approximate 95 percent confidence interval for medically treated injuries (row t).

TABLE 19—SENSITIVITY ANALYSIS FOR BREAKEVEN RESULTS

Row		Type of saw		
		Bench	Contractor	Cabinet
a	Breakeven Injury Estimates	1,437–3,116	650–1,615	178–445
Hypothetical Injury Distributions and Present Values for Expected Injury Reductions, Conditional on the Described Input Variation				
b	1. Every Saw Has the Same Annual Risk of Injury.			
c	25% fewer Table Saws in Use	11,106–25,590	5,333–11,271	1,807–3,758
d	25% more Table Saws in Use	6,664–15,354	3,200–6,762	1,084–2,254
e	Lower bound Estimate of Medically Treated Injuries	6,860–15,806	3,294–6,962	1,117–2,320

TABLE 19—SENSITIVITY ANALYSIS FOR BREAKEVEN RESULTS—Continued

Row		Type of saw		
		Bench	Contractor	Cabinet
f	Upper bound Estimate of Medically Treated Injuries	9,799–22,578	4,705–9,945	1,595–3,315
g	2. Equivalent Risks for the Saw Types, Over Expected Product Life.			
h	25% fewer Table Saws in Use	13,420–30,920	3,791–8,011	910–1,892
i	25% more Table Saws in Use	8,052–18,552	2,274–4,807	595–1,135
j	Lower bound Estimate of Medically Treated Injuries	8,291–19,104	2,342–4,950	562–1,169
k	Upper bound Estimate of Medically Treated Injuries	11,843–27,287	3,346–7,070	803–1,670
l	3. Injury Risks Proportional to the Median Saw Price.			
m	25% fewer Table Saws in Use	5,281–12,169	7,767–16,414	5,479–11,391
n	25% more Table Saws in Use	3,168–7,310	4,660–10,089	3,287–6,834
o	Lower bound Estimate of Medically Treated Injuries	3,262–7,517	4,798–10,139	3,384–7,036
p	Upper bound Estimate of Medically Treated Injuries	4,660–10,736	6,853–14,482	4,834–10,050
q	4. Injuries are Proportional to the Median Saw Price.			
r	25% fewer Table Saws in Use	1,710–3,942	5,579–11,790	11,314–23,523
s	25% more Table Saws in Use	1,027–2,364	3,347–7,074	6,788–14,114
t	Lower bound Estimate of Medically Treated Injuries	1,057–2,435	3,446–7,283	6,989–14,530
u	Upper bound Estimate of Medically Treated Injuries	1509–3,477	4,922–10,402	9,982–20,754

The CPSC staff also considered the sensitivity of the results to the exclusion of the intangible costs associated with the pain and suffering. The staff is not suggesting that the intangible costs are unimportant; rather the analysis simply shows the impact of limiting the costs to the economic losses associated with medical costs and work losses. By implicitly reducing injury costs, we are in effect changing the breakeven estimates which, were estimated as the quotient of aggregate injury costs for each type of saw divided by the average injury cost. Using a 3 percent discount rate, and excluding the pain and

suffering component, the average injury cost would be reduced from about \$74,050 to \$21,900; using a 7 percent discount rate, the average injury cost would be reduced from about \$66,550 to \$17,300. Consequently, following the bench saw example discussed earlier, the breakeven estimate, excluding the intangible costs associated with pain and suffering, would range from 4,854 injuries (106.4 million ÷ \$21,900) to 9,461 injuries (\$207.4 million ÷ \$21,900) when discounted at 3 percent. When discounted at 7 percent, the breakeven estimate would range from 6,150 injuries (\$106.4 million ÷ \$17,300) to

11,994 injuries (\$207.4 million ÷ \$17,300). Thus, for bench saws, the overall range for the breakeven injury estimate is 4,854 to 11,994 injuries. Using the same methodology, the breakeven injury estimate for contractor and cabinet saws would range from 2,194 to 6,217 and 602 to 1,711, injuries respectively.

The breakeven injury estimates for the three types of saws, excluding pain and suffering, are presented in Table 20 and compared to the present value of the expected injury reductions developed in Table 18.

TABLE 20—BREAKEVEN INJURY ESTIMATES (EXCLUDING PAIN AND SUFFERING) AND THE PRESENT VALUE OF EXPECTED INJURY REDUCTIONS ASSOCIATED WITH ONE YEAR OF TABLE SAW SAWS, BY TABLE SAW TYPE

Row		Type of saw		
		Bench	Contractor	Cabinet
a	Breakeven Injury Estimates	4,854–11,988	2,194–6,214	602–1,711
Hypothetical Injury Distributions				
b	1. Equivalent Risks for the Saw Types, on an Annual Basis.			
c	Present Value of Expected Injury Reduction	8,330–19,192	4,000–8,454	1,255–2,818
d	2. Equivalent Risks for the Saw Types, Over Expected Product Life.			
e	Present Value of Expected Injury Reduction	10,067–23,194	2,843–6,010	682–1,419
f	3. Injury Risks Proportional to the Median Saw Price.			
g	Present Value of Expected Injury Reduction	3,961–9,126	5,825–12,311	4,109–8,543
h	4. Injuries are Proportional to Median Saw Price.			
i	Present Value of Expected Injury Reduction	1,283–2,957	4,184–8,843	8,486–17,642

The results suggest that, even without the pain and suffering component, the expected injury reduction would exceed the breakeven estimates for most of the saw types and injury distributions.

However, there were several exceptions. First, the present value of the expected injury reduction was generally comparable to the breakeven injury estimates for contractor and cabinet

saws under the second hypothetical injury distribution (row e). Second, the present value estimates were generally comparable to, or slightly less than, the breakeven estimates for bench saws

under the third hypothetical injury distribution (row g). And third, the present value estimates were lower than the breakeven estimates for bench saws under the fourth hypothetical injury distribution (row i).

Staff's analysis shows, that, for the most part, the sensitivity analysis of the breakeven estimates indicated that estimates of the present value of the expected injury reduction were either comparable to or substantially exceeded the breakeven injury estimates for the various saw types and across all of the hypothetical injury distributions. The primary exception involved bench saws under the fourth hypothetical injury distribution, in which the relative risk on cabinet saws was roughly 40 times the risk on a bench saw.

#### *I. Summary of the Preliminary Regulatory Analysis*

Based on CPSC staff's analysis, the proposed rule would address approximately 54,800 medically treated table saw blade-contact injuries that occur annually. The societal cost of these injuries, on the order of about \$3.65 billion to \$4.06 billion annually, represents the pool from which the benefits would be derived. Medical costs and work losses, the economic losses associated with these injuries, account for about 30 percent of the total; the intangible, or non-economic, costs associated with pain and suffering account for the remaining 70 percent of the total. We expect the proposed rule would prevent or substantially mitigate 70 percent to 90 percent of the medically treated blade-contact injuries.

CPSC staff's review also shows substantial net benefits (*i.e.*, benefits—costs) for the proposed rule. Estimates of net benefits, across all saw types, averaged about \$1,500 to \$4,000 per saw over its expected product life. Aggregate net benefits over approximately one year's production and sale of table saws could amount to about \$625 million to about \$2,300 million. Net benefits varied but generally remained positive in our sensitivity analysis.

Because we had no information on the distribution of injuries across saw types (*i.e.*, bench, contractor, and cabinet saws), CPSC staff was unable to compare directly the benefits and costs for each saw type. However, based on several assumptions discussed above and in TAB C of the staff briefing package, staff was able to conduct a breakeven analysis by estimating the approximate number of injuries that would have to be substantially mitigated for each type of saw for the benefits to equal or exceed the costs. This analysis suggested that, under most plausible

injury distributions, the benefits likely would exceed the costs for each saw type.

Notwithstanding the high level of expected net benefits, the proposed rule also would be costly and would result in disruption of the table saw market. Under the rule, table saw manufacturers would need to develop their own AIM technology, without impinging on existing patents or license the patented AIM technology that already exists. Most, if not all, table saw models not already incorporating the AIM technology would require major design changes and the retooling of production facilities, a process that likely would take two or more years to accomplish. The cost impact of the proposed rule on market sales might also be substantial, potentially reducing aggregate sales by about 14 percent to 38 percent annually. In discussions between staff and manufacturers, several firms indicated that the cost of redesigning their saws to incorporate the AIM technology may be too great, relative to their sales volume, to support such a redesign. These firms indicated that they might respond by reducing or eliminating their offerings of table saws to the U.S. market.

Although the proposed rule would substantially reduce blade-contact injuries and the societal costs associated with those injuries, the impact of increasing table saw production costs on consumers also would be considerable. Staff expects that the prices for the least expensive bench saws now available could more than double, to \$300 or more. In general, the retail prices of bench saws could increase by as much as \$200 to \$500 per unit, and the retail prices of contractor and cabinet saws could rise by as much as \$350 to \$1,000 per unit.<sup>99</sup> These higher prices may be mitigated in the longer run, but the extent of any future price reductions is unknown.

Additionally, because of the likely decline in sales following the promulgation of a rule, consumers who choose not to purchase a new saw due to the higher price will experience a loss in utility by forgoing the use of table saws, or because they continue to use older saws which they would have preferred to replace. There may also be some other utility impacts. The inclusion of the AIM technology will, for example, increase the weight and (potentially) the size of table saws to accommodate the new technology, to allow access to change the brake

cartridge, and to mitigate the effects of the force associated with the activation of the brake cartridge. While this factor may have a relatively small impact on the heavier and larger contractor and cabinet saws, the impact on some of the smaller and lighter bench saws could markedly reduce their portability.

As discussed further below, the Commission also considered several alternatives to the proposed rule. These alternatives would mitigate the proposed rule's costs and potential disruptions in the marketplace. In particular, they could, individually or in combination, reduce the adverse impacts of the proposed rule on manufacturers (including small manufacturers), allow for greater choice in the types and safety characteristics of the table saws that consumers can purchase, reduce the impact of the proposed rule on table saws intended for commercial or professional use, and address the market failures resulting in the need for a product safety rule in the first place. However, these alternatives would reduce the expected benefits of the proposed rule. These alternatives are the same alternatives as those considered in the initial regulatory flexibility analysis in section XII of the preamble, and TAB D of the staff briefing package. Accordingly, any potential impacts of alternatives on small manufacturers are also addressed here in section XI.J.

#### *J. Regulatory Alternatives*

##### *1. No Action Alternative*

Under this alternative, the Commission would take no regulatory action and the status quo would be maintained, at least in the short term. This option acknowledges that passive safety devices, such as blade guards, riving knives, and pawls, are already provided to purchasers of new table saws and can be used by consumers to prevent many types of blade-contact injury. Additionally, the option recognizes that table saws with the AIM technology are already available for consumers who want and can afford them.

Over the longer term, changes in the voluntary standard may increase the level of safety with table saws. Sales of table saws with the AIM technology may also gradually increase as consumers become more familiar with the improved safety characteristics of these table saws. Table saws with AIM systems are now available for purchase by consumers in all table saw categories, including the introductions of the SawStop bench saw model in March 2015 and the introduction of the Bosch

<sup>99</sup> The current retail prices of the SawStop models and the Bosch REAXX™ model currently marketed are consistent with the upper end of these possible price increases.

REAXX™ jobsite saw in June 2016. Moreover, sales of saws with the AIM technology could expand further if prices decline. However, for now, the price differentials between a table saw with AIM and a comparable saw without AIM are substantial, particularly for bench saws.

We cannot estimate the benefits and costs that would be associated with this alternative because the estimates would be affected by factors such as the extent to which manufacturers introduce new table saws with AIM technology, the price of the table saws, and the rate at which consumers would choose to purchase table saws with AIM technology in the absence of a rule. However, because the rate at which AIM technology would be adopted in the absence of a mandatory rule probably would be substantially lower than the rate under a mandatory rule, both the benefits and costs of this alternative would be much lower than estimated for the proposed rule. Most significantly, although taking no mandatory regulatory action would minimize the impact on small table saw manufacturers, it would not mitigate the large number of blade-contact injuries that are associated with table saws.

## 2. Defer to the Voluntary Standard for Table Saws

Another alternative would be for the CPSC staff to continue participating and encouraging safety improvements to the voluntary standard for table saws, UL 987. While this option would be similar to the ‘no action alternative,’ the Commission could direct the staff to continue to pursue safety improvements in the voluntary standard, including the adoption of the AIM safety technology over time, as a conditional alternative to a mandatory standard. The Commission could consider proposing a mandatory standard if the voluntary standard development activities remain unsatisfactory.

CPSC staff has had an ongoing, active role in the voluntary standards body and the development of UL 987. Staff has supported recent changes in the voluntary standard, including requirements for improved blade guards and riving knives, and considers the newer blade guard systems to be a significant improvement over earlier systems. However, as discussed in section VI of the preamble, there is little evidence that improvements in these passive safety devices has effectively reduced the number or severity of blade-contact injuries on table saws. Additionally, voluntary standards committees have twice rejected initiatives by UL to adopt voluntary

standards that include AIM systems for table saws. Although relying on the voluntary standard process would minimize the impact on small table saw manufacturers, that approach would be unlikely to mitigate the blade-contact injuries that are associated with table saws.

## 3. Later Effective Dates

The proposed rule includes an effective date that is 3 years after the final rule is published in the **Federal Register**. Given the complexities and costs that would be associated with developing (or licensing) the AIM technology, redesigning virtually all table saw models, and retooling production facilities, an effective date later than 3 years could further reduce the impact of the rule on small manufacturers. A longer effective date would allow manufacturers additional time to spread the costs of developing or negotiating for the rights to use an AIM technology, to modify the design of their table saws to incorporate the AIM technology, and to retool their factories for production. For manufacturers that might choose to exit the table saw market, perhaps because their volume of table saw sales does not justify the cost of redesigning the table saws, the additional delay might also provide them with more time to consider alternative business opportunities. A later effective date might especially benefit manufacturers of bench saws because of the added technical difficulties in engineering small bench saws to incorporate an AIM technology.

While later effective dates would mitigate somewhat the impact of the proposed rule on some manufacturers, including small manufacturers, that approach also could delay the introduction of table saws with AIM technology into the market and possibly discourage manufacturers from introducing table saws with AIM technology earlier than the effective date. Moreover, a delayed effective date would delay the mitigation of blade-contact injuries associated with table saws, and reduce the net benefits associated with the proposed rule. The Commission seeks comment on the duration of the effective date and whether a longer or shorter effective date is appropriate.

## 4. Exempt Contractor and Cabinet Saws From a Product Safety Rule

Another alternative considered by the Commission would exempt cabinet and/or contractor saws that are used by and are intended for professional, commercial, or industrial users. Or the Commission could exempt an even

smaller subset of cabinet or industrial saws based on a certain size, weight, power, and electrical specifications. These alternatives would reduce the impact on small table saw manufacturers because cabinet and contractor saw manufacturers tend to be small. (Manufacturers of bench saws, on the other hand, tend to be large.) However, there is no clear dividing line between consumer and professional saws, except at the very highest levels of price and performance. Additionally, we have little information on the proportion of occupational purchasers for contractor saws and cabinet saws.

Moreover, as discussed above in section VI.C. of the preamble, although most cabinet and contractor saws are used by professionals or in commercial settings, they are available for sale to consumers, and many serious consumer woodworkers and hobbyists also use these saws. Cabinet and contractor saws are also frequently used in schools and other educational settings. CPSC staff’s breakeven analysis found that mandating AIM technology on cabinet and contractor saws likely would result in substantial net benefits under the various scenarios modelled. However, the Commission seeks comment regarding whether the scope of the rule should be modified to exclude certain types of table saws that are primarily used for commercial or industrial use or that have certain specifications.

## 5. Limit the Applicability of the Performance Requirements to Some, but Not All, Table Saws

Rather than requiring all table saws to meet the requirements of the proposed rule, the Commission could consider an alternative that requires only a subset of table saws to meet the requirements. For example, if a firm produces only bench saws, the Commission might require the firm to produce at least one bench saw model that meets the requirements of the standard. Similarly, if a firm produces bench saws and contractor saws, the Commission might require the firm to produce at least one bench saw model and one contractor saw model that meet the requirements of the standard. Or, as a variation, the Commission might allow each manufacturer to produce at least one bench saw model that does not meet the requirements of the standard as long as their other bench models conform to the requirements of the rule.

Limiting the requirement for the AIM technology to a subset of table saws could have several advantages. Saw with the AIM technology would be available in substantially greater numbers than they have been in recent



years. It would also address the potential market failure associated with one firm's market power over the AIM technology through patents, effectively eliminating competition, while at the same time allowing consumers to choose table saws without AIM technology if they prefer. Consequently, consumers who place a great value on safety or who face greater than average risks will find the safer table saws more desirable and will be more likely to buy them. Consumers who do not want the safer but more expensive saws can decide to purchase saws without the AIM technology. In this way, consumer preferences might be better matched with the products they wish to purchase.

If licensing agreements satisfactory to all parties could be arranged, this alternative would also alleviate (though not eliminate) the burden of the proposed rule on some manufacturers, including small manufacturers, because it would not require that all of their saws contain the AIM technology. However if licensing arrangements could not be agreed upon, then small manufacturers might be faced with an even greater burden and potentially face even higher prices. If patent holders are not willing to license their technology under reasonable terms, the impact on small manufacturers could be greater because they would need either to incur greater costs to develop their own technology or exit the table saw market.

Moreover, this alternative would address only a portion of blade-contact injuries. If, for example, the requirement led to about 50 percent of table saws being equipped with the AIM technology, the expected benefits would be on the order of about 50 percent of the benefits described in the reference case analysis (or somewhat higher if consumers with the greater risks were more likely to purchase the safer table saws).<sup>100</sup> Accordingly, this alternative would not mitigate the large number of blade-contact injuries associated with table saws, and would reduce the net benefits associated with the proposed rule. The Commission seeks comment on what impact limiting the

<sup>100</sup> We cannot predict what proportion of table saw sales would ultimately contain the AIM technology under this alternative. If consumers place a high value on safety, and prices are reduced or moderated over time, the proportion might be high. If, however, consumers would generally prefer saws without the AIM technology because of the lower prices or for other reasons, the proportion would be lower. Product liability concerns on the part of manufacturers would probably increase the proportion of table saws with the AIM technology. Once the table saws with AIM technology become more commonplace, table saws without the technology would be more likely to be challenged in product liability suits.

requirement for the AIM technology to a subset of table saws would have on manufacturers, including small businesses.

#### 6. Information and Education Campaign

The Commission could conduct an information and education campaign informing consumers about blade contact hazards and blade-contact injuries, and the benefits of the AIM technology. This alternative could be implemented on its own, in the absence of other regulatory options, or it could be implemented in combination with any of the alternative options.

As discussed in section IX of the preamble and in TAB E of the staff briefing package, the effectiveness of warnings and instructions is limited. Although educational programs offer more opportunities to present hazard information in varied ways, and in greater detail than warning labels, the effectiveness of such programs is also limited because they depend on consumers not only receiving and understanding the message, but also being persuaded to heed the message. Although the Commission believes that such a campaign could help inform consumers, based on the severity of injuries and recurring hazard patterns of blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries on table saws.

#### XII. Initial Regulatory Flexibility Analysis

This section provides an analysis of the impact the proposed rule would have on small businesses. Whenever an agency is required to publish a proposed rule, section 603 of the Regulatory Flexibility Act (RFA) requires that the agency prepare an initial regulatory flexibility analysis (IRFA) that describes the impact that the rule would have on small businesses and other entities. 5 U.S.C. 603. An IRFA is not required if the head of an agency certifies that the proposed rule will not have a significant economic impact on a substantial number of small entities. 5 U.S.C. 605. The IRFA must contain:

- (1) A description of why action by the agency is being considered;
- (2) a succinct statement of the objectives of, and legal basis for, the proposed rule;
- (3) a description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply;
- (4) a description of the projected reporting, recordkeeping and other

compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record; and

(5) identification to the extent practicable, of all relevant Federal rules which may duplicate, overlap or conflict with the proposed rule.

An IRFA must also contain a description of any significant alternatives that would accomplish the stated objectives of the applicable statutes and that would minimize any significant economic impact of the proposed rule on small entities. According to the IRFA, alternatives could include: (1) Differing compliance or reporting requirements that take into account the resources available to small businesses; (2) clarification, consolidation, or simplification of compliance and reporting requirements for small entities; (3) use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part of the rule thereof, for small entities. The alternatives the Commission considered are discussed in section XI(J) of the preamble and TAB D of the staff briefing package.

#### A. Reason for Agency Action

The proposed rule for table saws would reduce an unreasonable risk of injury associated with blade-contact injuries on table saws. CPSC staff estimates that there are approximately 54,800 medically treated blade-contact injuries annually based on 2015 injury data and estimates from the ICM. Almost 23 percent of the injuries involved fractures, amputations accounted for 14 percent of the injuries, and lacerations accounted for about 57 percent. AIM technology has been shown to effectively mitigate the severity of injuries caused by a victim's hand or other body part contacting the blade while the table saw is in operation. Accordingly, the proposed rule would establish a performance requirement to address the risk of injuries associated with blade-contact injuries on table saws.

#### B. Objectives of and Legal Basis for the Proposed Rule

The objective of the proposed rule is to mitigate operator injuries resulting from blade contact on table saws. The Commission published an ANPR in October 2011, which initiated this proceeding to evaluate regulatory options and potentially develop a mandatory standard to address the risks of blade-contact injuries associated with the use of table saws. The proposed rule

is being promulgated under the authority of the CPSA.

### *C. Small Entities to Which the Proposed Rule Will Apply*

The proposed rule would apply to manufacturers, importers, and private labelers of table saws that are sold in the United States. As of February 2016, CPSC is aware of 22 firms that supply table saws to the U.S. market. Of these 22 firms, at least 8, and possibly 10, are small according to criteria established by the Small Business Administration (SBA).<sup>101</sup> According to the SBA criteria, a table saw manufacturer is considered small if it has fewer than 500 employees, and a table saw importer is considered small if it has fewer than 100 employees. Private labelers of table saws are considered “small” if their annual revenue exceeds \$38.5 million in the case of home centers, \$32.5 million in the case of department stores, and \$7.5 million in the case of hardware stores.<sup>102</sup>

Small table saw manufacturers supply mostly contractor and cabinet saws, which are typically more expensive and heavier than bench saws. Contractor saws generally retail for between \$529 to \$2,049 and weigh between about 198 and 414 pounds. Cabinet saws typically retail for \$1,199 to \$5,349 and weigh between about 321 and 1,040 pounds. One small company sells a multipurpose machine that includes a table saw, lathe, drill press, sander, and router, among other tools. The cost of this multipurpose machine starts at about \$3,379. As of March 2016, only three bench saw models were being offered by small manufacturers. One of these was a bench saw that was much heavier (233 pounds) and more expensive (\$1,499) than most other bench saws. Another bench saw, offered by SawStop, already incorporates an AIM technology and retails for around \$1,300. The size and weight of the third bench is more typical of the bench table saws offered by the larger manufacturers.<sup>103</sup>

### *D. Compliance, Reporting, and Record Keeping Requirements of Proposed Rule*

The proposed rule would establish a performance requirement limiting the

depth of cut to 3.5 mm when a test probe contacts the spinning saw blade at a radial approach rate of 1.0 m/s.

Section 14 of the CPSA requires manufacturers, importers, or private labelers of a consumer product subject to a consumer product safety rule to certify, based on a test of each product or a reasonable testing program, that the product complies with all rules, bans or standards applicable to the product. The proposed rule does not specify a test procedure that the Commission would use to determine compliance with the standard. Any test procedure that will accurately determine compliance with the proposed performance requirements may be used. However, if a final rule is issued, manufacturers must certify that the product conforms to the standard, based on either a test of each product, or any reasonable method to demonstrate compliance with the requirements of the standard. For products that manufacturers certify, manufacturers would issue a general certificate of conformity (GCC).

Section 14 of the CPSA sets forth the requirements for GCCs. Among other requirements, each certificate must identify the manufacturer or private labeler issuing the certificate and any third party conformity assessment body, on whose testing the certificate depends, the place of manufacture, the date and place where the product was tested, each party's name, full mailing address, telephone number, and contact information for the individual responsible for maintaining records of test results. The certificates must be in English. The certificates must be furnished to each distributor or retailer of the product and to the CPSC, if requested.

#### **1. Costs of Proposed Rule That Would Be Incurred by Small Manufacturers**

To comply with the proposed rule, table saw manufacturers would need to license or develop an AIM technology. To license a technology, manufacturers will have to pay a royalty to the owner of the patents on the technology. The royalty cost for licensing an AIM technology is uncertain. Dr. Gass of SawStop has indicated that SawStop would be willing to license the SawStop AIM technology for a royalty payment of 8 percent of the wholesale price of the saw, but only if the Commission establishes a mandatory standard requiring AIM technology. There is no certainty that SawStop actually would license its technology under terms that would be acceptable to other manufacturers even if a mandatory standard were established. Several companies have asserted that they had

attempted to license the SawStop technology without success. Bosch uses an AIM technology on its REAXX™ bench saw that was developed, in part, through a joint venture of several members of the PTI. The terms under which this technology may be available for license are not known and may be affected by ongoing patent infringement litigation.

To avoid royalty or licensing fees, the manufacturer would have the challenge of developing its own AIM technology that did not infringe on an existing patent. At a minimum, developing an AIM system would likely cost at least several hundred thousand dollars, and perhaps several million dollars, based on the estimated costs of developing the existing technologies. However, the extent and scope of the SawStop patents that could impact future AIM technological developments is unknown. It is possible that new AIM technologies that are developed could also infringe on existing SawStop patents that have been filed or are pending.

After acquiring an AIM technology, manufacturers will need to redesign their table saws and retool their manufacturing facilities to incorporate the technology. According to several manufacturers, incorporating an AIM technology would require a redesign of each table saw including possibly, the trunnion, the cabinet, and interior of the saw. In addition, the support structure of the table saw, including the stand, might have to be strengthened to bear the added weight of the system and to absorb the force that could result from the system being triggered.

Estimates of the redesign and retooling costs ranged from a low of about \$100,000 per model to \$700,000. The redesign and retool process would be expected to take 1 to 3 years depending upon the problems encountered in the process. The redesign and retooling costs for subsequent models might be somewhat less than the costs associated with the first model.

There is some uncertainty as to how the redesign and retooling costs would affect manufacturers. One manufacturer noted that the redesign and retooling costs have to be paid upfront and manufacturers generally desire to amortize these costs over three years. However, most table saw brand owners contract with Chinese or Taiwanese manufacturers to actually manufacture the table saws. In some cases, these manufacturers may produce table saws for more than one firm and may be willing to absorb some of the costs in order to remain in the market.

<sup>101</sup> IEC, 2016a at 9.

<sup>102</sup> Under the North American Industrial Classification System (NAICS) manufacturers of table saws are classified in category 333243 (Sawmill, Woodworking, and Paper Machinery Manufacturing). Importers or private labelers of table saws include some department stores (NAICS category 4452111, home centers (NAICS category 444110), and some hardware stores (NAICS category 444130).

<sup>103</sup> IEC, 2016a, Table Saw Models, February 29, 2016.

In addition to the redesign and retooling costs, there will be added costs due to the additional components required on saws that incorporate an AIM technology. Depending upon the specific system used, the additional parts may include a brake cartridge, cables, additional parts or brackets to secure the brake cartridge, electrodes and assemblies and a power supply or motor control. These additional components are expected to add between \$58 and \$74 to the manufacturing cost of a table saw.

## 2. Impacts on Small Businesses

To comply with the proposed rule, most small manufacturers are expected to license an AIM technology instead of developing their own technology. The costs of attempting to develop their own AIM technology would probably be too high for most small manufacturers. However, there is no certainty that small manufacturers would be able to negotiate acceptable licensing agreements with SawStop or another patent holder. If small manufacturers are unable to negotiate acceptable licensing agreements for AIM technology, it is likely that all small table saw manufacturers, with the exception of SawStop, will exit the U.S. table saw market.

If small table saw manufacturers are able to license AIM technology, they would be expected to evaluate the sales volume of each table saw model and the likely cost of redesigning and retooling the model and decide whether to continue offering the model in the United States. If the manufacturer does not believe that the sales volume would be sufficient to recoup these costs in a reasonable amount of time, it is likely that the manufacturer would discontinue the sale of the model (at least in the United States).<sup>104</sup> The fact that some small table saw manufacturers might license the AIM technology from SawStop would mean that these manufacturers would be paying royalties to a competitor. This would be expected to reduce their competitiveness in the table saw market. Four firms indicated to CPSC staff that they would likely reduce or eliminate the table saws that they currently offer in the United States if AIM technology is mandated.

With the exception of SawStop and one other firm, most small table saw manufacturers also supply other types of woodworking or metal working

equipment. Anecdotal information suggests that U.S. sales of table saws account for a small percentage of the total revenue of most small firms. Information supplied by one manufacturer suggests that U.S. table saw sales accounted for about 1 percent of the firm's total revenue. Two other firms estimated that U.S. table saw sales accounted for between 5 and 8 percent of their total revenue. Actions that impact a firm's revenue by more than 1 percent are potentially significant. Therefore, given that it is likely that small table saw manufacturers would drop one or more table saws from the U.S. market if the proposed rule were adopted, and may leave the market entirely if they are unable to license an AIM technology, the proposed rule could have a significant impact on small manufacturers. However, the proposed rule is not likely to cause most small manufacturers to fail completely. One small manufacturer, SawStop, would significantly benefit from the promulgation of the proposed rule because it already manufactures table saws with AIM technology and owns multiple patents that cover AIM technology.

### *E. Federal Rules That May Duplicate, Overlap, or Conflict With the Proposed Rule*

OSHA has established standards that cover woodworking equipment used in workplace settings. These standards are codified at 29 CFR 1910.213. Generally, these requirements cover workplace safety and the use of safety devices such as blade guards and hoods. Currently, OSHA standards do not mandate performance requirements that would use AIM technology on table saws that are used by consumers. Accordingly, the Commission has not identified any federal rules that duplicate or conflict with the proposed rule.

### *F. Alternatives Considered To Reduce the Burden on Small Entities*

Under section 603(c) of the Regulatory Flexibility Act, an initial regulatory flexibility analysis should "contain a description of any significant alternatives to the proposed rule which accomplish the stated objectives of the applicable statutes and which minimize any significant impact of the proposed rule on small entities." CPSC examined several alternatives to the proposed rule that could reduce the impact on small entities. These include: (1) No regulatory action; (2) defer to voluntary standard activities for table saws; (3) establish alternative effective dates; (4) exempt or limit certain categories of table saws from the rule. These

alternatives are discussed in more detail in section XI.J. of the preamble. The Commission invites comments on this IRFA and the potential impact of the proposed rule on small entities, especially small businesses. Small businesses that believe they will be affected by the proposed rule are especially encouraged to submit comments. The comments should be specific and describe the potential impact, magnitude, and alternatives that could reduce the impact of the proposed rule on small businesses.

## XIII. Environmental Considerations

The Commission's regulations address whether CPSC is required to prepare an environmental assessment (EA) or an environmental impact statement (EIS). 16 CFR 1021.5. Those regulations state CPSC's actions that ordinarily have "little or no potential for affecting the human environment," and therefore, are categorically excluded from the need to prepare an EA or EIS. Among those actions are rules, such as the proposed rule addressing blade-contact injuries on table saws, which provide performance standards for products. *Id.* 1021.5(c)(1).

## XIV. Executive Order 12988 (Preemption)

In accordance with Executive Order 12988 (February 5, 1996), the CPSC states the preemptive effect of the proposed rule, as follows:

The regulation for addressing blade-contact injuries on table saws is proposed under authority of the CPSA. 15 U.S.C. 2051–2089. Section 26 of the CPSA provides that "whenever a consumer product safety standard under this Act is in effect and applies to a risk of injury associated with a consumer product, no State or political subdivision of a State shall have any authority either to establish or to continue in effect any provision of a safety standard or regulation which prescribes any requirements as to the performance, composition, contents, design, finish, construction, packaging or labeling of such product which are designed to deal with the same risk of injury associated with such consumer product, unless such requirements are identical to the requirements of the Federal Standard." 15 U.S.C. 2075(a). Upon application to the Commission, a state or local standard may be excepted from this preemptive effect if the state or local standard: (1) Provides a higher degree of protection from the risk of injury or illness than the CPSA standard, and (2) does not unduly burden interstate commerce. In addition, the federal government, or a

<sup>104</sup> One small manufacturer indicated to staff in a telephone call on November 30, 2015, that they would want to be able to amortize the redesign and retooling costs over a 3-year period.

state or local government, may establish or continue in effect a non-identical requirement for its own use that is designed to protect against the same risk of injury as the CPSC standard if the federal, state, or local requirement provides a higher degree of protection than the CPSA requirement. 15 U.S.C. 2075(b).

Thus, the table saw requirement proposed in today's **Federal Register** would (if finalized) preempt non-identical state or local requirements for table saws designed to protect against the same risk of injury from blade-contact injuries on table saws.

#### XV. Certification

Section 14(a) of the CPSA requires that products subject to a consumer product safety rule under the CPSA, or to a similar rule, ban, standard or regulation under any other act enforced by the Commission, must be certified as complying with all applicable CPSC-enforced requirements. 15 U.S.C. 2063(a). A final rule addressing blade-contact injuries on table saws would subject table saws to this certification requirement.

#### XVI. Paperwork Reduction Act

The proposed rule does not require manufacturers (including importers) to maintain records beyond those necessary to comply with 16 CFR part 1110. Accordingly, the proposed rule does not contain collection of information requirements as defined under the Paperwork Reduction Act, 44 U.S.C. 3501–3520.

#### XVII. Effective Date

The CPSA requires that consumer product safety rules take effect not later than 180 days from their promulgation unless the Commission finds there is good cause for a later date. 15 U.S.C. 2058(g)(1). The Commission proposes that the rule would take effect 3 years from the date of publication of the final rule for table saws.

Given the complexities and costs that would be associated with developing or licensing the AIM technology, redesigning virtually all table saw models, and retooling production facilities, the Commission believes that this later effective date could reduce the impact of the rule on manufacturers, including small manufacturers. This later date would allow manufacturers to spread the costs of developing or negotiating for the rights to use an AIM technology, modify the design of their table saws to incorporate the AIM technology, and retool their factories for the production of table saws with the new technology. For manufacturers who

might choose to exit the table saw market, perhaps because their volume of table saw sales does not justify the cost of redesigning the table saws, the additional delay might also provide them with more time to consider alternative business opportunities.

#### XVIII. Proposed Findings

The CPSA requires the Commission to make certain findings when issuing a consumer product safety standard. Specifically, the CPSA requires that the Commission consider and make findings about:

- The degree and nature of the risk of injury;
  - the number of consumer products subject to the rule;
  - the need of the public for the product and the probable effect on utility, cost, and availability of the product; and
  - other means to achieve the objective of the rule, while minimizing the impact on competition, manufacturing, and commercial practices.
- 15 U.S.C. 2058(f)(1).

The CPSA also requires that the Commission find that the rule is reasonably necessary to eliminate or reduce an unreasonable risk of injury associated with the product and that issuing the rule is in the public interest. 15 U.S.C. 2058(f)(3).

In addition, the Commission must find that:

- If an applicable voluntary standard has been adopted and implemented, that compliance with the voluntary standard is not likely to reduce adequately the risk of injury, or compliance with the voluntary standard is not likely to be substantial;
- that benefits expected from the regulation bear a reasonable relationship to its costs; and
- that the regulation imposes the least burdensome requirement that would prevent or adequately reduce the risk of injury. *Id.*

These findings are discussed below.

##### A. Degree and Nature of the Risk of Injury

In 2015, there were an estimated 33,400 table saw, emergency department-treated injuries. Of these, CPSC staff estimates that 30,800 (92 percent) are likely related to the victim making contact with the saw blade. Of the 30,800 emergency department-treated, blade-contact injuries, an estimated 28,900 injuries (93.8 percent) involved the finger. The most common diagnosis in blade-contact injuries is an estimated 18,100 laceration injuries (58.8 percent), followed by an estimated 5,900 fractures (19.0 percent), an

estimated 4,700 amputations (15.2 percent), and an estimated 2,000 avulsions (6.5 percent). An estimated 3,800 (12.3 percent) of the blade-contact injury victims were hospitalized.

An estimated 4,700 amputation injuries on table saws occurred in 2015, alone. Compared to all other types of consumer products, CPSC estimates that table saw-related amputations account for 18.6 percent of all amputations in the NEISS in 2015. When compared to all other workshop products, table saws account for an estimated 52.4 percent of all amputations related to workshop products in 2015. Based on NEISS estimates, the trend analysis for yearly blade-contact injuries associated with table saws showed no discernible change in the number of injuries or types of injuries related to table saw blade contact from 2004 to 2015. In addition, the trend analysis for the risk of blade-contact injury per 10,000 table saws in use yearly showed no discernible change in the risk of injury associated with table saw blade contact from 2004 to 2015.

##### B. Number of Consumer Products Subject to the Proposed Rule

The annual shipments of all table saws to the U.S. market from 2002 to 2014 have ranged from 429,000 to 850,000. Estimates of sales value are not readily available industry-wide. However, staff estimates that:

- Bench saws account for about 75 percent of the units sold and have an average product life estimated at 10 years;
- contractor saws (including hybrids) account for 20 percent of the units sold and have an average product life of 17 years;
- cabinet saws account for 5 percent of the units sold and have an average product life of 24 years;
- the annual number of table saws in use in the United States is 8.2 million table saws, including about 5.1 million bench saws, 2.3 million contractor saws, and 0.8 million cabinet saws.

Thus, bench, contractor, and cabinet saws account for about 62 percent, 28 percent, and 10 percent of the table saw population, respectively.

##### C. The Need of the Public for Table Saws and the Effects of the Proposed Rule on Their Utility, Cost, and Availability

Consumers commonly purchase table saws for the straight sawing of wood and other materials, and more specifically, to perform rip cuts, cross cuts, and non-through cuts. Because operator finger/hand contact with the table saw blade is a dominant hazard

pattern, the Commission proposes a performance requirement that would limit the depth of cut and significantly reduce the frequency and severity of blade-contact injuries on table saws.

The proposed rule would increase table saw production costs. CPSC expects that the prices for the least expensive bench saws now available would more than double, to \$300 or more. In general, the retail prices of bench saws could increase by as much as \$200 to \$500 per unit, and the retail prices of contractor and cabinet saws could rise by as much as \$350 to \$1,000 per unit. These higher prices may be mitigated in the longer run, but the extent of any future price reductions is unknown.

Because of the likely decline in sales following the promulgation of a rule, consumers who choose not to purchase a new saw, due to the higher price, will experience a loss in utility by forgoing the use of table saws, or because they continue to use older saws that they would have preferred to replace. There may also be some other impacts on utility, such as an increase in the weight and (potentially) size of table saws. This factor may have a relatively small impact on the heavier and larger contractor and cabinet saws, but could markedly reduce the portability of some of the smaller and lighter bench saws.

#### *D. Other Means To Achieve the Objective of the Proposed Rule, While Minimizing Adverse Effects on Competition and Manufacturing*

The Commission considered alternatives to the proposed rule. For example, the Commission considered not taking regulatory action, deferring to the voluntary standard development process, exempting or limiting certain table saws from regulation, and information and education campaigns. However, as explained further in these proposed findings (section XVIII.I. of the preamble), the Commission finds that these alternatives would not adequately mitigate the unreasonable risk of injuries that is associated with table saw blade contact.

#### *E. Unreasonable Risk*

CPSC estimates that 30,800 table saw-related injuries involving blade contact were treated in hospital emergency departments (ED) in 2015. An estimated 93.8 percent of these injuries involved the finger. The most common diagnoses in blade-contact injuries are laceration injuries, fractures, amputations, and avulsion. Thousands of amputations (an estimated 4,700 amputation injuries in 2015 alone) occur each year on table saws. When compared to all other

workshop products, table saws account for an estimated 52.4 percent of all amputations related to workshop products in 2015.

Existing safety devices, such as the blade guard and riving knife, do not adequately reduce the number or severity of blade-contact injuries on table saws. Table saws have been equipped with these passive safety devices since 2009 and there is no evidence of the effectiveness of these safety devices in reducing or mitigating blade-contact injuries. In CPSC's 2015 modular blade guard survey, a majority of respondents (80%) reported that there are circumstances that require the blade guard to be removed, and a majority of respondents reported they did not use the blade guard "sometimes" (28%), "often" (17%) or "always" (14%). Any situation where the blade guard is not used eliminates the effectiveness of the blade guard in preventing blade-contact injuries. In addition, a review of CPSC's database found 11 incidents involving table saws that meet the current voluntary standard requirements for riving knives and modular blade guards. These incidents show that blade-contact injuries continue to occur on table saws equipped with riving knives and modular blade guards.

CPSC's trend analysis of the annual estimated number of emergency department-treated injuries associated with table saws covered the timespan before the voluntary standard implemented the requirement for riving knives and modular blade guards on table saws (2004 to 2009) and the timespan after the requirements were implemented (2010 to 2015). The data showed that there is no discernible change in the number of injuries or types of injuries related to table saw blade contact from 2004 to 2015. A trend analysis to assess the risk of injury per 10,000 table saws in use showed there is no discernible change in the risk of injury associated with table saw blade contact from 2004 to 2015.

CPSC staff's review shows substantial net benefits for the proposed rule. Estimates of net benefits, across all table saw types, averaged about \$1,500 to \$4,000 per saw over its expected product life. Aggregate net benefits over approximately 1 year's production and sale of table saws could amount to about \$625 million to about \$2,300 million. The Commission concludes preliminarily that there is an unreasonable risk of injury associated with blade-contact injuries on table saws and finds that the proposed rule is reasonably necessary to reduce that unreasonable risk of injury.

#### *F. Public Interest*

This proposed rule is intended to address an unreasonable risk of blade-contact injuries on table saws. As explained in this preamble, adherence to the requirements of the proposed rule would reduce and mitigate severe blade-contact injuries on table saws in the future; thus, the rule is in the public interest.

#### *G. Voluntary Standards*

The current voluntary standard for table saws is Underwriters Laboratories Inc. (UL) 987, *Stationary and Fixed Electric Tools*. In August 2016, UL published the first edition of UL 62841-3-1, *Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery Part 3-1: Particular Requirements for Transportable Table Saws*. UL 62841-3-1. The effective date for UL 62841-3-1 is August 29, 2019. Until that date, UL 987 remains in effect, and table saw manufacturers can list their products to either UL 987 or UL 62841-3-1. Both standards specify that table saws shall be provided with a modular blade guard and riving knife.

The Commission does not believe that the voluntary standards adequately address blade-contact injuries on table saws. Existing safety devices, such as the blade guard and riving knife, which have been provided on table saws since 2009, do not adequately reduce the number or severity of blade-contact injuries on table saws. In CPSC's 2015 modular blade guard survey, 80 percent of respondents indicated that there are circumstances that require the blade guard to be removed. Clearly, removal of the blade guard eliminates its ability to prevent or reduce injuries. CPSC's review of incidents from the CPSC's database identified 11 incidents involving table saws that were equipped with riving knives and modular blade guard systems. These incidents show that blade-contact injuries continue to occur on table saws equipped with riving knives and modular blade guards. Finally, CPSC's trend analysis of the annual estimated number of emergency department-treated injuries associated with table saws from 2004 to 2015 shows that there is no discernible change in the number of injuries or types of injuries related to table saw blade contact from 2004 (when table saws did not have riving knives and modular blade guards) to 2015 (when table saws did have these features).

For these reasons, the Commission believes that the voluntary standard will not adequately address an unreasonable

risk of blade-contact injuries on table saws.

#### *H. Relationship of Benefits to Costs*

Based on estimates from NEISS and the ICM, the Commission finds that the proposed rule would address an estimated 54,800 medically treated blade-contact injuries annually. The societal costs of these injuries (in 2014 dollars and using a 3 percent discount rate) amounted to about \$4.06 billion in 2015. Amputations accounted for about 14 percent of the medically treated blade-contact injuries and almost two-thirds of the injury costs. Overall, medical costs and work losses account for about 30 percent of these costs, or about \$1.2 billion. The intangible costs associated with pain and suffering account for the remaining 70 percent of injury costs.

Because of the substantial societal costs attributable to Blade-contact injuries (about \$4 billion annually), and the expected high rate of effectiveness of the proposed requirements in preventing blade-contact injuries, the estimated gross benefits of the proposed rule (*i.e.*, the expected reduction in societal costs) could amount to an average of about \$2,300 to \$4,300 per saw. Based on 1 year's production and sale of table saws, aggregate gross benefits could range from about \$970 million to \$2,450 million annually.

Staff estimates showed that increased manufacturing cost, as well as the expected costs of replacement parts for the AIM system, would range from about \$230 to \$540 per bench saw, to about \$375 to \$925 per contractor saw, and to about \$400 to \$950 per cabinet saw. These costs likely would be mitigated somewhat over time, but the extent of any future cost reduction is unknown. Based on 1 year's production and sale of table saws, aggregate gross costs could range from about \$170 million to \$340 million annually. In addition to the direct manufacturing and replacement parts costs, firms may need to pay approximately \$30 million to \$35 million annually in royalty fees to patent holders for the AIM technology.

Additionally, some consumers who would have purchased table saws at the lower pre-regulatory prices will choose not to purchase new table saws. The cost impact of the proposed rule on market sales may reduce aggregate sales by as much as 14 percent to 38 percent annually. The decline in sales will result in lost utility to consumers who choose not to purchase table saws because of the higher prices. Further, more reductions in consumer utility may result from the added weight, and

hence, reduced portability associated with adding the AIM technology to the table saws.

Based on our benefit and cost estimates, the Commission estimates that net benefits (*i.e.*, benefits minus costs) for the market as a whole (*i.e.*, combining the three types of table saws together) amount to an average of about \$1,500 to \$4,000 per saw. Aggregate net benefits on an annual basis could amount to about \$625 million to about \$2,300 million.

#### *I. Least Burdensome Requirement That Would Adequately Reduce the Risk of Injury*

The Commission considered less burdensome alternatives to the proposed rule addressing blade-contact injuries on table saws and concluded preliminarily that none of these alternatives would adequately reduce the risk of injury.

*No Action Alternative.* The Commission considered not taking any regulatory action. Under this alternative table saws would continue to use existing passive safety devices, such as blade guards, riving knives, and anti-kickback pawls. Additionally, table saws with the AIM technology are already available for consumers who want and can afford them. However, not taking any action would leave the unreasonable risk of blade-contact injuries on table saws unaddressed. Based on the severity of injuries and recurring hazard patterns of Blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries on all table saws.

*Defer to the Voluntary Standard for Table Saws.* The Commission considered deferring action to allow the voluntary standard for table saws, UL 987, to develop AIM technology. Although the CPSC has supported recent changes in the voluntary standard with requirements for newer blade guard systems and riving knives and considers these to be a significant improvement over earlier systems, there is little evidence that improvements in these passive safety devices have effectively reduced injuries. Additionally, voluntary standards committees have twice rejected initiatives by UL to adopt provisions that would require AIM systems. Consequently, it does not appear that the voluntary standards process is likely to lead to a requirement for the AIM technology in the near future.

*Later Effective Dates.* The proposed rule would require an effective date that

is 3 years after the final rule is published in the **Federal Register**. The Commission considered a later effective date. An effective date later than 3 years could further reduce the impact of the rule on small manufacturers because it would allow them additional time to spread the costs of developing or negotiating for the rights to use an AIM technology, modify the design of their table saws to incorporate the AIM technology, and retool their factories for the production. For manufacturers that might choose to exit the table saw market, the additional delay might provide them with more time to consider alternative business opportunities.

However, later effective dates could also delay the introduction of table saws with AIM technology into the market and discourage manufacturers from introducing table saws with AIM technology earlier than the effective date, and possibly, put those manufacturers at a competitive disadvantage. Accordingly, the Commission believes that a 3-year effective date from the issuance of a final rule is an appropriate length of time.

*Exempt Contractor and Cabinet Saws from a Product Safety Rule.* The Commission considered whether to exempt cabinet and/or contractor saws used by professional, commercial, or industrial users, or based on certain size, weight, power, and electrical specifications of the table saw. However, based on the severity of injuries and recurring hazard patterns of blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries on all table saws. Moreover, there is no clear dividing line between consumer and professional saws, except at the very highest levels of price and performances.

*Limit the Applicability of the Performance Requirements to Some, but Not All, Table Saws.* The Commission also considered limiting the scope of the rule to a subset of table saws to allow manufacturers to produce both table saw models with AIM technology, and models without AIM technology. However, based on the severity of injuries and recurring hazard patterns of blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries on all table saws.

### *Information and Education Campaign*

The Commission also considered whether to conduct an information and education campaign informing consumers about the dangers of blade-contact hazards, and the benefits of the AIM technology. Although such a campaign could help inform consumers, without a performance requirement, that approach would not be sufficient to address the unreasonable risk of blade-contact injuries on table saws.

### **XIX. Request for Comments**

We invite all interested persons to submit comments on any aspect of the proposed rule. Specifically, the Commission seeks comments on the following:

#### *Scope*

- Information on whether certain types of table saws should be excluded from the scope of the rule, such as mini or micro tables saws, or table saws that are used primarily for commercial or industrial use.
- Information on whether the scope of the rule should be expanded to include types of saws other than table saws (*e.g.*, tile saws).
- Information on whether the definition of table saws should be revised, or whether other definitions are necessary.
- Information on home-made table saws or other dangerous alternatives consumers may pursue if they are not willing or are unable to purchase a table saw (with AIM capabilities).

#### *Market Information*

- Information on table saw sales, by table saw type (bench, contractor, cabinet), and information on the expected product lives of each type of table saw.

#### *Patents*

- Information on the effects of the pending expiration of certain SawStop patents in 2020 and 2022.
- Information on barriers to licensing technology that is patented.
- Information on the role of patents in standard business practice, and how this does or does not relate to table saw safety.

#### *Binding RAND Commitment*

- Information on the applicability of the American National Standards Institute's (ANSI) patent policy to any voluntary standard for table saws incorporating AIM technology. The patent policy requires that ANSI-Accredited Standards Developers who receive notice that a proposed standard may require the use of an essential

patent claim shall "receive from the patent holder or a party authorized to make assurances on its behalf, in written or electronic form, either:

(a) Assurance in the form of a general disclaimer to the effect that such party does not hold and does not currently intend holding any essential patent claim(s); or

(b) assurance that a license to such essential patent claim(s) will be made available to applicants desiring to utilize the license for the purpose of implementing the standard either: (i) Under reasonable terms and conditions that are demonstrably free of any unfair discrimination; or (ii) without compensation and under reasonable terms and conditions that are demonstrably free of any unfair discrimination." (RAND Commitment)

- Information on whether the refusal of a potential essential-patent holder of the AIM technology to give the required assurances set forth in the ANSI patent policy would prohibit a voluntary standard requiring such technology.

- Information on the effect that a RAND Commitment covering potentially essential patent claims would have on the proposed rule's economic impact, including, but not limited to, its impact on competition, small businesses, and the cost and availability of table saws.

- Information on whether, as a matter of policy, CPSC should finalize a mandatory rule implicating potential essential patents absent a RAND Commitment covering such patents.

- Information on other government agencies that have proposed or adopted regulations implicating potential essential patents, including whether the holders of those patents had entered into RAND Commitments prior to the finalization of such regulations.

#### *Utility*

- Information on what impacts AIM technology may have on the utility of table saw use by consumers.

#### *Effectiveness*

- Information on effectiveness of AIM technologies. The CPSC staff's regulatory analysis estimated that the requirements of the proposed rule would reduce the risk of blade-contact injury by 70 percent to 90 percent. The Commission seeks comments from the public that either support these effectiveness estimates or that help the Commission adjust them appropriately.

- Information concerning the extent to which table saws are used for cutting wet wood and conductive materials, such as non-ferrous metals, and the

extent to which the AIM technology may be deactivated during use.

- Information on whether consumers will use more unsafe methods to cut wood as an alternative to table saws that are equipped with AIM technology.

#### *Manufacturing Costs*

- Information on manufacturing costs. Based on the available information, there is considerable uncertainty concerning the per unit manufacturing cost impact on a table saw that would meet the requirements of the proposed rule. The Commission seeks any comments that would allow us to make more precise estimates or narrow the range we present regarding the unit manufacturing cost impact of a rule requiring the use of AIM technology on table saws.

- Information on the feasibility of incorporating AIM technology on small bench top table saws.

#### *Test Requirements*

- Information on how different detection methods may be applied as part of an AIM system and appropriate test methods to properly evaluate the triggering of AIM systems employing these detection methods.

- Studies or tests that have been conducted to evaluate AIM technology in table saws.

- Studies, research, or tests on the radial velocity of the human hand/finger in wordworking and, in particular, during actual blade contact incidents.

#### *Regulatory Alternatives*

- Information on whether a 36-month effective date is reasonable, and whether a longer or shorter effective date is warranted.

- Information on the feasibility of limiting or exempting a subset of table saws or certain types of table saws from the performance requirements.

- Information on the potential impact of the proposed rule on small entities, especially small businesses.

#### *Anti-Stockpiling*

- Information on the proposed product manufacture or import limits and the base period with respect to the anti-stockpiling provision.

Comments should be submitted in accordance with the instructions in the **ADDRESSES** section at the beginning of this document.

### **XX. Conclusion**

For the reasons stated in this preamble, the Commission proposes requirements to address an unreasonable risk of injury associated with table saws.



**List of Subjects in 16 CFR Part 1245**

Consumer protection, Imports, Information, Safety.

For the reasons discussed in the preamble, the Commission proposes to amend Title 16 of the Code of Federal Regulations as follows:

■ 1. Add part 1245 to read as follows:

**PART 1245—SAFETY STANDARD FOR BLADE-CONTACT INJURIES ON TABLE SAWS**

Sec.

- 1245.1 Scope, purpose and effective date.
- 1245.2 Definitions.
- 1245.3 Requirements.
- 1245.4 Test procedures.
- 1245.5 Prohibited stockpiling.
- 1245.6 Findings.

**Authority:** 15 U.S.C. 2056, 2058 and 2076.

**§ 1245.1 Scope, purpose and effective date.**

(a) This part 1245, a consumer product safety standard, establishes requirements for table saws, as defined in § 1245.2(a). These requirements are intended to reduce an unreasonable risk of injury associated with blade-contact injuries on table saws.

(b) Any table saw manufactured or imported on or after [date that 36 months after publication of a final rule] shall comply with the requirements stated in § 1245.3.

**§ 1245.2 Definitions.**

In addition to the definitions in section 3 of the Consumer Product Safety Act (15 U.S.C. 2051), the following definition applies for purposes of this part 1245.

(a) *Table Saw* means a woodworking tool that has a motor-driven circular saw blade, which protrudes through the surface of table. Table saws include bench saws, contractor saws, and cabinet saws.

(b) [Reserved].

**§ 1245.3 Requirements.**

(a) *General.* All table saws covered by this standard shall meet the requirements stated in paragraph (b) of this section.

(b) *Test.* All table saws, when powered on, shall limit the depth of cut to 3.5 mm when a test probe contacts the spinning saw blade at a radial approach rate of 1.0 meter per second (m/s).

(c) *Test Probe.* The test probe shall act as the surrogate for a human body/finger and allow for the accurate measurement of the depth of cut to assess compliance with paragraph (b) of this section.

**§ 1245.4 Test procedures.**

Any test procedure that will accurately determine compliance with the standard may be used.

**§ 1241.5 Prohibited stockpiling.**

(a) *Base period.* The base period for table saws is any period of 365 consecutive days, chosen by the manufacturer or importer, in the 5-year period immediately preceding the promulgation of the final rule.

(b) *Prohibited acts.* Manufacturers and importers of table saws shall not manufacture or import table saws that do not comply with the requirements of this part in any 12-month period between (date of promulgation of the rule) and (effective date of the rule) at a rate that is greater than 120 percent of the rate at which they manufactured or imported table saws during the base period.

**§ 1241.6 Findings.**

(a) *General.* To issue a consumer product safety standard under the Consumer Product Safety Act, the Commission must make certain findings and include them in the rule. 15 U.S.C. 2058(f)(3). These findings are presented in this section.

(b) *Degree and nature of the risk of injury.* (1) In 2015, there were an estimated 33,400 table saw, emergency department-treated injuries. Of these, CPSC staff estimates that 30,800 (92 percent) likely are related to the victim making contact with the saw blade. Of the 30,800 emergency department-treated, blade-contact injuries, an estimated 28,900 injuries (93.8 percent) involved the finger. The most common diagnosis in blade-contact injuries is an estimated 18,100 laceration injuries (58.8 percent), followed by an estimated 5,900 fractures (19.0 percent), an estimated 4,700 amputations (15.2 percent), and an estimated 2,000 avulsions (6.5 percent). An estimated 3,800 (12.3 percent) of the blade-contact injury victims were hospitalized.

(2) An estimated 4,700 amputation injuries on table saws occurred in 2015, alone. Compared to all other types of consumer products, CPSC staff estimates that table saw-related amputations account for 18.6 percent of all amputations in the NEISS in 2015. When compared to all other workshop products, table saws account for an estimated 52.4 percent of all amputations related to workshop products in 2015. Based on NEISS estimates, the trend analysis for yearly blade-contact injuries associated with table saws showed no discernible change in the number of injuries or types of injuries related to table saw

blade contact from 2004 to 2015. In addition, the trend analysis for the risk of blade-contact injury per 10,000 table saws in use yearly showed no discernible change in the risk of injury associated with table saw blade contact from 2004 to 2015.

(c) *Number of consumer products subject to the rule.* The annual shipments of all table saws to the U.S. market from 2002 to 2014 have ranged from 429,000 to 850,000. Estimates of sales value are not readily available industry-wide. However, staff estimates that bench saws account for about 75 percent of the units sold and have an average product life estimated at 10 years. Contractor saws (including hybrids account for 20 percent of the units sold and have an average product life of 17 years. Cabinet saws account for 5 percent of the units sold and have an average product life of 24 years. The annual number of table saws in use in the United States is 8.2 million, including about 5.1 million bench saws, 2.3 million contractor saws, and 0.8 million cabinet saws. Thus, bench, contractor, and cabinet saws account for about 62 percent, 28 percent, and 10 percent of the table saw population, respectively.

(d) *The need of the public for table saws and the effects of the rule on their utility, cost, and availability.* Consumers commonly purchase table saws for the straight sawing of wood and other materials, and more specifically, to perform rip cuts, cross cuts, and non-through cuts. Because operator finger/hand contact with the table saw blade is a dominant hazard pattern, the performance requirement would limit the depth of cut and significantly reduce the frequency and severity of blade-contact injuries on table saws. However, the rule would increase table saw production costs. CPSC expects that the prices for the least expensive bench saws now available would more than double, to \$300 or more. In general, the retail prices of bench saws could increase by as much as \$200 to \$500 per unit, and the retail prices of contractor and cabinet saws could rise by as much as \$350 to \$1,000 per unit. These higher prices may be mitigated in the longer run, but the extent of any future price reductions is unknown. Because of the likely decline in sales following the promulgation of a rule, consumers who choose not to purchase a new table saw, due to the higher price, will experience a loss in utility by forgoing the use of table saws, or because they continue to use older saws that they would have preferred to replace. There may also be some other impacts on utility, such as an increase in the weight and



(potentially) size of table saws. This factor may have a relatively small impact on the heavier and larger contractor and cabinet saws, but could markedly reduce the portability of some of the smaller and lighter bench saws.

(e) *Other means to achieve the objective of the rule, while minimizing the impact on competition and manufacturing.* The Commission considered alternatives to the rule. For example, the Commission considered not taking regulatory action, deferring to the voluntary standard development process, exempting or limiting certain table saws from regulation, and information and education campaigns. However, the Commission finds that these alternatives would not adequately mitigate the unreasonable risk of blade-contact injuries on table saws.

(f) *Unreasonable risk.* (1) CPSC estimates that 30,800 table saw-related injuries involving blade contact were treated in hospital emergency departments (ED) in 2015. An estimated 93.8 percent of these injuries involved the finger. The most common diagnoses in blade-contact injuries are laceration injuries, fractures, amputations, and avulsion. Thousands of amputations, (an estimated 4,700 amputation injuries in 2015 alone), occur each year on table saws. When compared to all other workshop products, table saws account for an estimated 52.4 percent of all amputations related to workshop products in 2015.

(2) Existing safety devices, such as the blade guard and riving knife, do not adequately reduce the number or severity of blade-contact injuries on table saws. Table saws have been equipped with these passive safety devices since 2009, and there is no evidence of the effectiveness of these safety devices in reducing or mitigating blade-contact injuries. In CPSC's 2015 modular blade guard survey, a majority of respondents (80%) reported that there are circumstances that require the blade guard to be removed, and a majority of respondents reported they did not use the blade guard "sometimes" (28%), "often" (17%) or "always" (14%). Any situation where the blade guard is not used, eliminates the effectiveness of the blade guard in preventing blade-contact injuries. In addition, a review of CPSC's database found 11 incidents involving table saws that meet the current voluntary standard requirements for riving knives and modular blade guards. These incidents show that blade-contact injuries continue to occur on table saws equipped with riving knives and modular blade guards.

(3) CPSC's trend analysis of the annual estimated number of emergency

department-treated injuries associated with table saws covered the timespan before the voluntary standard implemented the requirement for riving knives and modular blade guards on table saws (2004 to 2009) and the timespan after the requirements were implemented (2010 to 2015). The data showed that there is no discernible change in the number of injuries or types of injuries related to table saw blade contact from 2004 to 2015. A trend analysis to assess the risk of injury per 10,000 table saws in use showed there is no discernible change in the risk of injury associated with table saw blade contact from 2004 to 2015.

(4) CPSC staff's review shows substantial net benefits for the rule. Estimates of net benefits, across all table saw types, averaged about \$1,500 to \$4,000 per saw over its expected product life. Aggregate net benefits over approximately 1 year's production and sale of table saws could amount to about \$625 million to about \$2,300 million. The Commission concludes preliminarily that there is an unreasonable risk of injury associated with blade-contact injuries on table saws and finds that the rule is reasonably necessary to reduce that unreasonable risk of injury.

(g) *Public interest.* This rule is intended to address an unreasonable risk of blade-contact injuries on table saws. Adherence to the requirements of the rule would reduce and mitigate the severity of blade-contact injuries on table saws in the future; thus, the rule is in the public interest.

(h) *Voluntary standards.* (1) The current voluntary standard for table saws is Underwriters Laboratories Inc. (UL) 987, *Stationary and Fixed Electric Tools*. In August 2016, UL published the first edition of UL 62841-3-1, *Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery Part 3-1: Particular Requirements for Transportable Table Saws*. UL 62841-3-1. The effective date for UL 62841-3-1 is August 29, 2019. Until that date, UL 987 remains in effect, and table saw manufacturers can list their products to either UL 987 or UL 62841-3-1. Both standards specify that table saws shall be provided with a modular blade guard and riving knife.

(2) The Commission does not believe that the voluntary standards adequately address blade-contact injuries on table saws. Existing safety devices, such as the modular blade guard and riving knife, which have been provided on table saws since 2009, do not adequately reduce the number or severity of blade-contact injuries on table saws. In CPSC's 2015 modular blade guard survey, 80

percent of respondents indicated that there are circumstances that require the blade guard to be removed. Clearly, removal of the blade guard eliminates its ability to prevent or reduce injuries. CPSC's review of incidents from the CPSC's database identified 11 incidents involving table saws that were equipped with riving knives and modular blade guard systems. These incidents show that blade-contact injuries continue to occur on table saws equipped with riving knives and modular blade guards. Finally, CPSC's trend analysis of the annual estimated number of emergency department-treated injuries associated with table saws from 2004 to 2015 shows that there is no discernible change in the number of injuries, types of injuries, or risk of injuries related to table saw blade contact from 2004 (when table saws did not have riving knives and modular blade guards) to 2015 (when table saws did have these features). For these reasons, the Commission believes that the voluntary standard will not adequately address an unreasonable risk of injury associated with blade-contact injuries on table saws.

(i) *Relationship of benefits to costs.* (1) Based on estimates from NEISS and the ICM, the Commission finds that the rule would address an estimated 54,800 medically treated blade-contact injuries annually. The societal costs of these injuries (in 2014 dollars and using a 3 percent discount rate) amounted to about \$4.06 billion in 2015. Amputations accounted for about 14 percent of the medically treated blade-contact injuries but almost two-thirds of the injury costs. Overall, medical costs and work losses account for about 30 percent of these costs, or about \$1.2 billion. The intangible costs associated with pain and suffering account for the remaining 70 percent of injury costs.

(2) Because of the substantial societal costs attributable to blade-contact injuries (about \$4 billion annually), and the expected high rate of effectiveness of the requirements in preventing blade-contact injuries, the estimated gross benefits of the proposed rule (*i.e.*, the expected reduction in societal costs) could amount to an average of about \$2,300 to \$4,300 per saw. Based on 1 year's production and sale of table saws, aggregate gross benefits could range from about \$970 million to \$2,450 million annually.

(3) Staff estimates showed that increased manufacturing cost, as well as the expected costs of replacement parts for the AIM system, would range from about \$230 to \$540 per bench saw, about \$375 to \$925 per contractor saw, and about \$400 to \$950 per cabinet saw.

These costs likely would be mitigated somewhat over time, but the extent of any future cost reduction is unknown. Based on 1 year's production and sale of table saws, aggregate gross costs could range from about \$170 million to \$340 million annually. In addition to the direct manufacturing and replacement parts costs, firms may need to pay approximately \$30 million to \$35 million annually in royalty fees to patent holders for the AIM technology.

(4) Additionally, some consumers who would have purchased table saws at the lower pre-regulatory prices will choose not to purchase new table saws. The cost impact of the rule on market sales may reduce aggregate sales by as much as 14 percent to 38 percent annually. The decline in sales will result in lost utility to consumers who choose not to purchase table saws because of the higher prices. Further, more reductions in consumer utility may result from the added weight, and hence, reduced portability associated with addition the AIM technology on table saws.

(5) Based on our benefit and cost estimates, the Commission estimates that net benefits (*i.e.*, benefits minus costs) for the market as a whole (*i.e.*, combining the three types of table saws together) amount to an average of about \$1,500 to \$4,000 per saw. Aggregate net benefits on an annual basis could amount to about \$625 million to about \$2,300 million.

(j) *Least burdensome requirement that would adequately reduce the risk of injury.* (1) The Commission considered less burdensome alternatives to the rule addressing blade-contact injuries on table saws and concluded preliminarily that none of these alternatives would adequately reduce the risk of injury.

(i) *No Action Alternative.* The Commission considered not taking any regulatory action. Under this alternative, table saws would continue to use existing passive safety devices, such as blade guards, riving knives, and anti-kickback pawls. Additionally, table saws with the AIM technology are already available for consumers who want and can afford them. However, not taking any action would leave the unreasonable risk of blade-contact injuries on table saws unaddressed.

Based on the severity of injuries and recurring hazard patterns of blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries on all table saws.

(ii) *Defer to the Voluntary Standard for Table Saws.* The Commission considered deferring action to allow the voluntary standard for table saws, UL 987, to develop AIM technology.

Although the CPSC has supported recent changes in the voluntary standard with requirements for newer blade guard systems and riving knives and considers these to be a significant improvement over earlier systems, there is little evidence that improvements in these passive safety devices have effectively reduced injuries.

Additionally, voluntary standards committees have twice rejected initiatives by UL to adopt provisions that would require AIM systems. Consequently, it does not appear that the voluntary standards process is likely to lead to a requirement for the AIM technology in the near future.

(iii) *Later Effective Dates.* The rule would require an effective date that is 3 years after the final rule is published in the **Federal Register**. The Commission considered a later effective date. An effective date later than 3 years could further reduce the impact of the rule on small manufacturers because it would allow them additional time to spread the costs of developing or negotiating for the rights to use an AIM technology, modify the design of their table saws to incorporate the AIM technology, and retool their factories for the production. For manufacturers that might choose to exit the table saw market, the additional delay might provide them with more time to consider alternative business opportunities. However, later effective dates could also delay the introduction of table saws with AIM technology into the market and discourage manufacturers from introducing table saws with AIM technology earlier than the effective date, and possibly, put those manufacturers at a competitive disadvantage. Accordingly, the Commission believes that a 3-year

effective date from the issuance of a final rule is an appropriate length of time.

(iv) *Exempt Contractor and Cabinet Saws from a Product Safety Rule.* The Commission considered whether to exempt cabinet and/or contractor saws used by professional, commercial, or industrial users, or based on certain size, weight, power, and electrical specifications of the table saw. However, based on the severity of injuries and recurring hazard patterns of blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries on all table saws. Moreover, there is no clear dividing line between consumer and professional saws, except at the very highest levels of price and performances.

(v) *Limit the Applicability of the Performance Requirements to Some, but Not All, Table Saws.* The Commission also considered limiting the scope of the rule to a subset of table saws to allow manufacturers to produce both table saw models with AIM technology, and models without AIM technology. However, based on the severity of injuries and recurring hazard patterns of blade-contact injuries, coupled with the high societal costs of these injuries, the Commission believes that a performance requirement is necessary to reduce the unreasonable risk of blade-contact injuries on all table saws.

(vi) *Information and Education Campaign.* The Commission also considered whether to conduct an information and education campaign informing consumers about the dangers of blade-contact hazards, and the benefits of the AIM technology. Although such a campaign could help inform consumers, without a performance requirement, that approach would not be sufficient to address the unreasonable risk of blade-contact injuries on table saws.

(2) [Reserved].

**Alberta E. Mills,**  
*Acting Secretary, Consumer Product Safety Commission.*

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