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CONSUMER PRODUCT SAFETY COMMISSION
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Memorandum

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SUBJECT : Injuries Associated with Stationary Power Saws, 2001

This memorandum transmits a report on injuries associated with table saws, band saws, miter saws, and radial arm saws. The injury data is based on NEISS and its 2001 Special Study.

The Directorate for Epidemiology estimated that about 52,000 people were treated in U.S. hospital emergency rooms for injuries associated with table saws, band saws, miter saws, or radial arm saws in calendar year 2001. About 98 percent of the victims were saw operators. Contact with the saw blade was the major hazard to the operators followed by being hit by stock or cutting material. Almost all of the injuries were lacerations, amputations, fractures, or avulsions. Injuries to fingers accounted for about 83 percent of the total injuries. The rate of hospitalization was 5 percent. An additional 3 percent of injuries required overnight observation or were transferred to another hospital for observation.

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INJURIES ASSOCIATED WITH STATIONARY POWER SAWS

May 2003

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1. Introduction

Based on CPSC's National Electronic Injury Surveillance System (NEISS), an estimated 93,880 saw-related injuries were treated in U.S. hospital emergency rooms for the calendar year 2001. About 36,400 injuries (39%) were associated with stationary saws[1]: table saws were predominant, followed by band saws, radial arm saws, and powered hack saws.[2] About 17,240 injuries (18%) were associated with portable or hand-held saws[3]. The remaining 40,240 injuries (43%) were reported to be associated with unspecified saws. Therefore, the number of injuries associated with stationary saws could have been larger if those unspecified saws were identified. In order to obtain the distribution of stationary saws (from the unspecified saws), follow-up investigations of the injuries were conducted between October 1, 2001 and December 31, 2001. The investigations also included injuries reported in NEISS to be associated with table saws, band saws, radial arm saws, and powered hack saws to obtain the nature and probable causes of the injuries which generally are not available from the NEISS reports.

2. Data Description – National Electronic Injury Surveillance System (NEISS)

NEISS is an injury data collection system. It was comprised of a probability sample of about 100 hospitals stratified into 5 strata - small, medium, large, very large, and children's hospitals (where the first four strata were stratified by hospital size) for the calendar year 2001. The system serves the Commission primarily in two ways. First, the NEISS provides national estimates of the number and severity of injuries associated with, but not necessarily caused by, consumer products and treated in hospital emergency departments. Second, the system serves as a means of locating victims so that further information may be gathered concerning the nature and probable cause of the incident. Information gathered from the NEISS and other sources guides the Commission in setting priorities for selecting types of products for further investigation and/or actions that may eventually lead to product modification or development of safety standards.

The report of stationary saw-related injuries is based on information gathered from NEISS between October 1, 2001 and December 31, 2001. Victims with injuries related to the NEISS product codes: 0841 (table saws), 0842 (band saws), 0843 (radial arm saws), 0844 (powered hack saws), 0845 (saws, not specified), 0863 (other power saws), and 0872 (power saws, not specified) were automatically assigned for the follow-up investigations. Of the total 450 assigned cases, 317 cases (70%) were successfully contacted[4]. Based on the results of the follow-up investigations, "stationary saws" in the report are comprised of table saws, band saws, radial arm saws, and miter saws. Powered hack saws were excluded because the investigations indicated that the injuries associated with this product (during the 3-month investigations) were actually associated with portable, electrical hack saws.

[1] Excludes jigsaws and sabre saws because NEISS does not distinguish between stationary and portable reciprocating saws.
[2] NEISS does not have a product code for "miter saws" which are relatively new compared to other saws. The number of miter saws in the market has recently increased; they are very popular among non-professional users.
[3] Such as circular saws and reciprocating saws (jig or sabre).
[4] About 81 percent of the respondents participated while the remaining 19 percent only partially participated.

The weights from those cases that were successfully contacted during the follow-up investigations were adjusted for the non-responses (failure-to-contact cases) by stratum and product code. The adjusted weights were computed using the method of raking [1] where the NEISS estimated marginal total (for each product code across strata) was fixed. The annual and the 3-month estimates of injuries are based on these raking adjusted weights.

3. Product Definition [2]

A stationary saw is a powered tool that does not move because of its size or because of its type of operation. It is commonly bolted onto/mounted on/rested upon a stand or a base (as opposed to a hand-held, portable powered tool). The work is either fed into the blade (such as a table saw or a band saw) or the blade is moved onto the work (such as a radial arm saw or a miter saw) during the operation. Figure 1 – Figure 4 present a table saw, a band saw, a miter saw, and a radial arm saw, respectively.

Most power tools, especially stationary ones, are equipped with tool guards or safety devices that should be mounted following the manufacturer's instructions and maintained in good working order. The guard that covers the saw blade should be maintained so it lifts easily and allows work to pass while still covering the saw blade. Often, when a tool is designed for more than one job, the manufacturer makes available special guards to be used under particular circumstances. However, the data showed that the operators usually removed the guards when they did special cuts (other than simple cross cuttings or ripping).

A table saw has a saw blade projecting through a table on which the work is rested. The table has a laterally adjustable rip fence and is slotted to equip a wood rest/miter gauge. The wood rest/miter gauge keeps the stock at the proper angle to the blade during a cut. The operator holds the stock against the wood rest/miter gauge and advances both the gauge and the stock past the blade to make a simple crosscut. The rip fence is used in the procedure described as being a cut made parallel to/with the grain of the wood. A basic rip cut is done by placing the stock on the front edge of the table, flat down and snugly against the fence.

The typical band saw for use in a home workshop mostly has a size range of 10 to 14 inches. This dimension indicates the maximum depth of cut. The second capacity factor is the maximum distance between the table and the upper blade guides when they are at their highest point. This is the maximum thickness (height) of cut which, depending on the tool, can be anywhere between 4 and 6 inches. The saw is equipped with a continuous flexible blade or band, held taught around 2 or 3 wheels driven by a motor.

The typical miter saw is very much like a portable circular saw top mounted on its own stand. A pivot arrangement allows the tool to be swung down to saw material that is on the stand's table. That is why it is often called a "chop" saw. It is a tool usually used in miter cutting. It is not uncommon to find it used in industry and on a construction site to do cutoff on long pieces of material. The saw can be set for left-or right-hand cuts and most units have automatic stops for the most commonly used positions. The machine can be used to saw materials other than wood. With the proper blade, it can be used to cut metals or plastics.

The typical radial arm saw is a combination of a large stationary tool with the flexibility of a portable circular saw. With this machine the operator can swing, tilt, raise, lower the blade, and adjust the tool - stock relationship, comparable to hand held saw applications. On the radial arm saw, the work is set on the table against a fence. The saw blade is pulled through the stock to make all cuts.

Figure 1: Table Saw

Figure 2: Band Saw

Figure 3: Miter Saw

Figure 4: Radial Arm Saw

4. Types of Cuts[2]

A majority of the injuries reported in this study involved crosscutting or ripping; however, there were a few incidents that involved mitering, beveling, and dadoing. With the latter group of incidents, the operator usually took the blade guard off when performing these cuts in order to inspect his/her work closely. A description of the cuts that were performed by the operators (in this report) is presented below.

Crosscutting. A simple crosscut or cutting against the grain of the stock is made by placing the edge of the stock against a miter gauge and moving both the gauge and stock past the saw blade. The operator should be almost directly right behind the miter gauge so he/she will be out of line with the saw blade (as a safety precaution).

Ripping. A rip cut is performed by passing the stock between the blade and rip fence. Often, the procedure is described as being a cut made parallel to or with the grain of the stock. The basic rip cut is performed by placing the stock on the front edge of the saw table snugly against the fence and moving the stock past the saw blade.

Mitering. An angle cut that needs a miter gauge to facilitate the accuracy of the cut, such as cutting the stock for a picture frame. For this type of cut, the miter gauge was usually set at 45^{o} for cutting two matching segments of stock. When two such cuts are matched, the joint is called a miter. The actual cutting may be simple, but a high degree of accuracy is required for a good match.

Beveling. Most bevels are cut using the rip fence as a guide, while the blade (or table) is tilted to the angle required. Sometimes, the miter gauge is used when a cut is performed on a narrow stock because there is a tendency for the stock to move away from the fence.

Dadoing. This is done by setting a regular saw blade to less than the stock thickness and making repeated cuts to widen the normal kerf (channel/cut) and get a U-shaped cut that is a dado when done across the grain, a groove when done with the grain.

5. National Annual Injury Estimates[5]

Based on the investigations of the incidents occurring between October 1, 2001 and December 31, 2001 which allowed for the identification of "unspecified saws", the Directorate for Epidemiology estimated that there were about 52,000 injuries (CV = 0.12, n = 225)[6] treated in U.S. hospital emergency rooms associated with stationary saws for the calendar year 2001. (A data summary of the annual injury estimates and the victims' characteristics are presented in Table 1). About 38,000 injuries (73%) involved table saws, 7,640 injuries (15%) involved miter

[5] The word "injuries" in this report means "injuries treated in U.S. hospital emergency rooms".
[6] The weights from the successfully contacted cases were adjusted for the non-responses (or raked to the fixed marginal totals of the NEISS estimates by product code across strata). SUDAAN (Software for Statistical Analysis of Correlated Data)[3] was used to compute the coefficient of variations (CV).

saws, 4,060 injuries (8%) involved band saws, and 2,300 injuries (4%) involved radial arm saws[7].

Lacerations (68%), amputations (9%), fractures (9%), and avulsions (8%) were predominant and accounted for about 48,880 injuries for the calendar year 2001[8]. Most of the injuries were to fingers which accounted for about 43,160 injuries (83%)[9]. The rate of hospitalization was five percent[10] compared to the average rate of four percent associated with all consumer products reported through the NEISS system.

The average age of the victims was 51 years old with the youngest at 2 and the oldest at 91 years of age. About 7 out of every 10 victims were between 15 and 64 years old. About 1 out of every 4 victims were 65 years or older. Men accounted for about 95 percent of the total injuries. About 51,000 injuries (98%) were associated with the saw operators.

In the following sections, many of the estimates provided for finer characterizations of the data are based on small sample sizes (with asterisk), and therefore have large variability associated with them. However, these estimates provide information which is generally not available from the NEISS reports.

6. Special Study and Specific Information Related to Injuries

Based on the same follow-up investigations (October 1, 2001 – December 31, 2001), an estimated 14,300 injuries (CV = 0.12, n = 225) were treated in U.S. hospital emergency rooms for injuries associated with stationary saws: table saws (74%), miter saws (13%)*, band saws (9%)*, and radial arm saws (4%)* for this 3-month period.

Blade-contact incidents accounted for about 12,300 injuries (86%). The remaining 2,000 injuries (14%) involved incidents such as being hit by the stock/cutting materials (10%), being hit by flying debris (3%)*, and child playing or spurious contacts[11] (1%)*. Within the blade-contact incidents, about 11,800 injuries (96%) occurred while the saws were running, the remaining 500 injuries (4%)* occurred when the saws were just turned on/off or not running. The injuries associated with being hit by the stock/cutting materials or with flying debris occurred while the saws were running. The injuries associated with children playing and with spurious contacts occurred while the saws were not running.

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[7] The estimates for band saws and radial arm saws are based on small sample sizes, and therefore have large variability associated with them.

[8] The remaining six percent of injuries were distributed among contusions/abrasions, crushing, internal injuries, and foreign body.

[9] The remaining 8,840 injuries were to the hand, wrist, lower arm, lower trunk, upper leg, lower leg, head, face, eyeball, and neck.

[10] An additional 3 percent of injuries required overnight observation or were treated and then transferred to another hospital for overnight observation.

[11] Such as strains or sprains from using or helping with the saw.

* The asterisks used through out the report indicate that the estimated injuries are based on small sample size and should be used with caution.

Injuries associated with saw operators during the operating sessions accounted for about 12,000 injuries.[12](A data summary of the injuries is presented in Table 2). The following sections examine this group of injuries with respect to hazard patterns and contributing factors, use patterns, the type of saw used at the time of the incidents, the injured body parts, and the diagnoses.

6.1. Operators During the Operating Session (12,000 injuries, n= 191)

An estimated 9,400 injuries (78%) to the operators were associated with table saws, the remaining 2,600 injuries were associated with band saws (9%)*, miter saws (8%)*, and radial arm saws (5%)*. Contact with the saw blade accounted for about 10,300 injuries (86%), being hit by a stock/cutting material accounted for about 1,430 injuries (12%), and injured from flying debris accounted for about 270 injuries (2%)*.

Most of the injuries to the operators were to lower arms, wrists, hands, or fingers and accounted for about 11,400 injuries (95%). Within this group, fingers were the most frequently injured body parts and accounted for about 10,370 injuries (91%). The remaining 600 injuries (5%)* were to heads, faces, eyeballs, lower trunk, upper legs, and lower legs.

The injuries to fingers were lacerations, amputations, fractures, avulsions, crushing, or contusions/abrasions. However, the injuries to lower arms, wrists, or hands were lacerations only. The injuries to the lower trunk, upper legs, or lower legs were lacerations or contusions/abrasions. Finally, the injuries to heads or faces were internal injuries or contusions/abrasions, and to eyeballs were foreign objects. About 1,050 injuries (9%)* were treated and kept overnight for observation, treated and transferred to another hospital, or hospitalized.

The average age of the operators was 51 years old with the youngest at 12 and the oldest at 91 years of age. About 390 operators (3%)* were between 12 and 14 years old, about 8,480 operators (71%) were between 15 and 64 years old, and about 3,130 operators (26%) were 65 years or older. The operators' age distribution was similar to that of all the victims for the calendar year 2001. This is because most of the injuries associated with the saws were to the operators.

The next sections present detailed information on the incidents to the saw operators. This information is available only from the investigations. It is presented in the following order:

6.1.1. Operational activities at the time of the incidents,
6.1.2. Stock/cutting materials,
6.1.3. Characteristics of saws involved, and
6.1.4. Hazard patterns and the contributing factors.

[12] The remaining 2,300 injuries (16%) were to the operators (not in the operating sessions), helpers, or bystanders.
* The asterisks indicate that the estimated injuries are based on small sample size and should be used with caution.

6.1.1.Operational Activities of the Operators

1. The type of cutting operation the operator had been performing prior to/at the time of the incident and the number of injuries.

- The operator had been cutting the length of stock, with the grain (ripping) - 6,170 injuries (51%).
- The operator had been cutting the width of stock, against the grain (cross cutting) - 2,050 injuries (17%).
- The operator had been cutting at a 45 degree angle, cutting at an angle other than 45 degrees, or performing the dado[13] cut - 970 injuries (8%)*.
- The type of cutting operation was *unknown*[14] in the remaining 2,810 injuries (23%)[15].

2. The type of saw blade being used prior to/at the time of the incident.

- Combination blade (cross cutting or ripping) - 3,000 injuries (25%).
- Crosscut blade, carbide-tip blade[16], continuous flexible blade (for band saws), dado blade[17], and other (fine tooth finishing, plane, and hollow grind blade) - 2,710 injuries (23%).
- Rip blade - 2,400 injuries (20%).
- The type of saw blade was *unknown* -3,890 injuries (32%).

3. The operator had been using a different type of blade for a different type of cutting prior to/at the time of the incident[18].

- The operator used a different type of blade for a different cut - 4,440 injuries (37%).
- The operator used the same blade for a different cut - 3,960 injuries (33%).
- *Unknown* if different blade was used - 3,600 injuries (30%)

4. The position of the saw blade, with respect to the stock/cutting material, prior to/at the time of the accident.

- The blade had been positioned for straight up and down cut - 8,640 injuries (72%).
- The blade had been positioned for bevel (tilted) cut - 240 injuries (2%)*.
- The position of the saw blade was *unknown* - 3,120 injuries (26%).

[13] See footnote # 17.
[14] The respondents (operators or someone else) did not remember, did not know, or refused to answer.
[15] Does not add up to 100 percent because of rounding.
[16] Carbide-tip blade will stay sharp longer than a steel blade. The teeth of the blade cut smoother than steel blade teeth. There is as much variety in carbide-tip blades as in steel blades (combination, crosscutting, ripping, and even some mitering cut).
[17] Dado blades make a u-shaped cut when done across the grain and a groove when done with the grain.
[18] It was recommended that a certain type of blade should be used for a certain type of cut, for example, a crosscut blade is used for cross cutting while a rip blade is for ripping. Only a combination blade could be used for cross cutting or for ripping.
* The asterisks indicate that the estimated injuries are based on small sample size and should be used with caution.

5. The blade motion, with respect to the stock/cutting material, right before/at the time of the incident.

- Blade was inside a cut - 4,080 injuries (34%).
- Blade hit a knot, kicked wood up, or kicked back - 3,360 injuries (28%).
- Other (blade was above/resting against the stock not yet in a cut, caught on glove hand, or caught on hand that slipped off the stock – 1,890 injuries (16%).
- Blade caught/jammed on the stock - 1,320 injuries (11%)*.
- The blade motion was *unknown* - 1,350 injuries (11%).

6. The position of the left hand or right hand, with respect to the stock/cutting material, prior to/at the time of the incidents.

Table Saws and Band Saws (10,480 Injuries)

- Pushing/feeding the stock into the saw blade - 6,810 injuries (65%).
  Within this activity, a free-hand operation accounted for about 3,710 injuries, using a push block accounted for about 2,370 injuries, using a wood rest/miter gauge accounted for about 120 injuries,* the remaining 610 injuries* were unknown (whether a push block, a wood rest/miter gauge, or a free-hand was used when feeding the stock into the blade).
- Holding the stock, reaching across or over the blade, pulling stock, adjusting the blade/table angle, or turning the saw on/off - 1,830 injuries (17%).
- The position of the hand was *unknown* - 1,840 injuries (18%).

Miter Saws and Radial Arm Saws (1,520 Injuries)

- Holding the stock, lifting the saw arm/stock, pushing stock against the fence, or reaching across/over the blade – 1,170 injuries (77%).
- The position of the hand was *unknown* - 350 injuries (23%)*.

7. The status of the cutting operation, with respect to the stock/cutting materials, prior to/at the time of the incident.

- Part way through the cut - 4,190 injuries (35%).
- Stock coming out at the far end of the blade - 3,620 injuries (30%).
- Start cutting, about to cut, or just about finish cutting - 880 injuries (7%)*.
- The status of cutting was *unknown* - 3,310 injuries (28%).

8. The operators had been working at an average of 1 hour and 18 minutes, with a minimum of zero hour (just about to start cutting) and a maximum of eight hours, with the saw that day.

* The asterisks indicate that the estimated injuries are based on small sample size and should be used with caution.

6.1.2.Stock/Cutting Materials

1. The operator had been cutting the stock/material described below prior to/at the time of the accident.

- Wooden board - 8,520 injuries (71%).
- Paneling/siding, block of wood/log, plastic laminate material, wood molding, pipe/metal, bamboo/stick - 980 injuries (8%)*.
- The stock/material was *unknown* - 2,500 injuries (21%)

2. The shape and size (length, width, and thickness) of the stock/cutting material being cut prior to/at the time of the incident.

Shapes

- Rectangular - 7,200 injuries (60%).
- Square, triangular, octagonal, long and thin, round, or curved - 1,690 injuries (14%).
- The shape of the stock/cutting material was *unknown* - 3,110 injuries (26%).

Sizes

- The average length of the stock/cutting materials was about 2 feet
- The average width of the stock/cutting materials was about 6 inches
- The average thickness of the stock/cutting materials was about 1 inch.

3. The condition of the stock/cutting material being cut prior to/at the time of the incident.

- Nothing Unusual - 2,530 injuries (21%)
- Hard wood (mahogany, oak, or walnut) - 2,520 injuries (21%).
- Dry or wet wood - 2,250 injuries (19%).
- Smooth, soft (cedar or pine), knotty wood - 1,610 (13%).
- The condition of stock/cutting material was *unknown* – 3,090 injuries (26%).

4. How the stock/cutting material was supported prior to/at the time of the incident.

- The stock was resting on a table or on a table with an additional support - 8,160 injuries (68%).
- On a saw base, on a saw base with additional support, on the floor/ground, on a saw horse, or held in hand - 600 injuries (5%)*.
- The support of the stock/cutting material was *unknown* - 3,240 (27%).

5. Whether the whole surface of the stock/cutting material fit on the support.

- The whole surface of the stock fit on support – 5,800 injuries (48%).
- The whole surface did not fit on support - 2,770 injuries (23%).
- *Unknown* whether the whole surface of the stock/cutting materials fit - 3,430 injuries (29%).

6. Whether the stock/cutting material or the support was firmly anchored.

- The stock or the support was firmly anchored - 5,550 injuries (46%).
- The stock or support was loosely held or wobbled – 2,720 injuries (23%).
- *Unknown* whether the stock/cutting material or the support was firmly anchored - 3,730 injuries (31%).

* The asterisks indicate that the estimated injuries are based on small sample size and should be used with caution.

6.1.3 Characteristics of Saws Involved

1. Ownership of the saw.
- The operator owned and purchased saw new (74%) or used (26%) - 10,200 injuries (85%).
- The operator used someone else's saw or rented - 1,800 injuries (15%).

2. Saw Age.
- Ten years old or less (one out of every five saws involved were 1 year old or newer) - 5,050 injuries (42%).
- Over 10 years - 3,510 injuries (29%).
- The age of the saw was *unknown* - 3,440 injuries (29%).

3. Whether the saw had been changed or modified in any way since the operator obtained it.
- No, the saw had not been changed or modified - 8,280 injuries (69%).
- Yes, the saw had been changed or modified (mostly by the operators)[19] - 840 injuries (7%)*.
- *Unknown* whether the saw had been changed or modified - 2,880 injuries (24%).

4. Whether the saw was assembled when purchased or the owner assembled it after purchased.
- Assembled when purchased[20] - 6,240 injuries (52%).
- Assembled by owners/relatives - 1,920 injuries (16%).
- *Unknown* whether the saw was assembled when purchased - 3,840 injuries (32%)

5. Whether the blade had a safety switch (removable or stationary) such as a key lock that must be activated, in addition to the starter switch, before the saw could be turned on.
- Did not have a safety switch - 4,680 injuries (39%).
- Had a safety switch (either removable or stationary types) - 4,080 injuries (34%).
- *Unknown* whether the blade had a safety switch - 3,240 injuries (27%).

6. Whether the blade was sharp or dull[21] during the cutting operation.
- The blade was sharp or moderately sharp – 8,060 injuries (67%).
- Dull - 540 injuries (5%)*.
- *Unknown* whether the blade was sharp or dull - 3,400 injuries (28%).

7. Whether the blade guard was attached to the saw prior to/at the time of the incident.
- The blade guard was damaged, removed (including when making special cut such as dado or bevel cut) or guard broken off – 3,860 injuries (32%).
- The blade guard was attached to the saw – 2,600 injuries (22%).
- The saw never had one – 2,180 injuries (18%).
- *Unknown* whether the blade guard was attached to the saw - 3,360 injuries (28%).

[19] For example, blade guards had been removed, motors had been replaced, or rip fences had been added on.
[20] Less than one percent were partially assembled.
[21] Dull blades required more feed pressure, which presents a situation where the operator's hands might slip.
* The asterisks indicate that the estimated injuries are based on small sample size and should be used with caution.

8. Whether the anti-kickback[22] assembly attached to the saw prior to/at the time of the incident.

Table Saws or Band Saws (10,480 injuries)

- Did not come with one – 3,720 injuries (35%).
- Removed or did not put one on – 2,310 injuries (22%).
- Equipped with one - 950 injuries (9%)*.
- *Unknown* whether the anti-kickback assembly attached to the saw – 3,500 injuries (33%)[23].

Miter Saws or Radial Arm Saws (1,520 injuries)

Almost half of the saws had no information on the anti-kickback device. Of the ones with information, some were equipped with a device while others either had a device removed or were not equipped with one.

6.1.4. Hazards and the Contributing Factors

Hazards to the operators associated with stationary saws during the operation were contact with a saw blade (blade contact), being hit by stock/cutting material, or being hit by flying debris. The contributing factors to each of these hazards are presented below. The summary of the hazard patterns and their contributing factors are presented in Table 3.

Blade Contact (10,300 injuries)

The contributing factors to blade contact and the number of injuries are presented below.

- Stock/cutting material, tool, and hand interface[24] - 4,230 (41%).
- The saw or stock/cutting material kicked back[25] causing the hand or finger to come in contact with the blade - 2,580 injuries (25%).
- The saw blade jammed in stock/cutting material[26] (without kickback), hand slipped off stock, or the saw blade hit a knot in the stock - 2,100 injuries (20%).
- The operators reached over the blade and hit the blade - 1,390 (13%)[27].

Being Hit By Stock/Cutting Material (1,430 injuries)

The contributing factors to this hazard were the saw or stock/cutting material kicked back causing the stock to hit the operator or the blade jammed in the stock/cutting material causing the stock to buck/bounce and hit the operator.

Frying Debris (270 injuries)*

The contributing factors to flying debris were stock/cutting material breaking during the operation or the cut off piece caught in the saw teeth and was flung back (incidents in which the stock/cutting material split, broke, or fragmented were seen with all the saws). In most cases, eye injuries were sustained as a small piece of flying debris made contact with the eye. In other

[22] A mechanism that prevents the wood from kicking back.

[23] Does not add up to 100 percent because of rounding.

[24] For example, the operators were using a hand to guide the stock and failed to move the hand as it came into the path of the blade or the operators were trying to remove cut pieces without first turning off the saws.

[25] Kickback of the saw resulting in a blade contact is associated with miter saws or radial arm saws. The blades of these saws are mobile along the arm to which they are connected. The incident occurred when the operator held the stock loosely in his hand and when the saw suddenly kicked back, it threw his hand into the blade.

[26] One fatality is reported in the Commission's Injury or Potential Incident File (IPII) for the calendar year 2001.

[27] Does not add up to 100 percent because of rounding.

* The asterisks indicate that the estimated injuries are based on small sample size and should be used with caution.

cases, injuries to upper leg, upper trunk, face, and head were sustained as large pieces split or broke off and were flung away from the saw onto the operator.

6.2. Discussion

As stated in the introduction, the estimated injuries associated with stationary saws could have been larger if unspecified saws were identified. The follow-up investigation shows that the annual estimated injuries associated with stationary saws increased by 43 percent from about 36,400 injuries (identified by NEISS codes) to about 52,000 injuries (after the unspecified saws were identified) in the calendar year 2001.

Blade contact has been identified as a major hazard related to stationary saw use during this study period. Finger contact with the operating blade occurred most often in different scenarios. With table and band saws, the operator used a hand to guide the stock/cutting material; lacerations and sometimes amputations resulted when he failed to move his hand as it came into the path of the blade. In some incidents, the operator was pushing the stock and got too close to the blade and his/her gloved hand was caught in the blade. With miter and radial arm saws, the operator accidentally engaged the operating switch on the saw arm/handle which automatically started the blade, resulting in blade contact to the hand (which was holding the stock/cutting material). With all types of saws, the operator's hand which was holding the stock and/or guiding the stock slipped into the blade when the blade jammed in the stock. Also the blade contact occurred when the operator was trying to remove cut pieces from the table/base without first turning the saw off. In many of the blade contact cases, there was no blade guard in use at the time of the incident. Often the operator had removed the guard to get a clear view of his work, to do a special cut such as a dado, or to cut a very small piece of stock/cutting material.

Stock kickback was reported with some frequency. In these incidents the blade slowed or stopped momentarily as it bound or caught in the stock such as when it hit a knot or when it was pinched or jammed because the cut began to close behind the blade. This caused the stock to bounce out and hit the operator's hand as he tried to stop the stock from flying up and caused his hand to contact the blade. Some injuries occurred when the stock actually struck the operator as it was kicked out from the saw.

Saw kickback is a hazard which is associated with miter and radial arm saws. Saw kickback cases were similar to those that caused stock kickback, but in these cases the saw blade kicked back because it was mobile. The saw has been reported to bounce out of the cut and contact the users. For example, as the operator of the radial arm saw pulled the radial arm onto the stock too fast it bounced back from the stock and contacted the operator's hand (this is because radial arm saws are mobile along the arm).

A majority of the injuries related to the above hazards occurred when ripping hard boards such as mahogany, walnut, or oak. Other common causes of injuries were free-hand operation when guiding the stock into the blade and reaching across/over the spinning blade to remove cut pieces from the table.

Table 1
Estimated Annual Injuries Associated with Stationary Saws
Treated in U.S. Hospital Emergency Rooms Classified
By Products and Victims' Characteristics
January 1, 2001 – December 31, 2001

Description	Injury Estimate	Sample Size (n)
Type of Saw	**Total=52,000**	**n=225**
Table Saws	38,000	164
Miter Saws	7,640	36
Band Saws	4,060	18*
Radial Arm Saws	2,300	7*
Description of Victim and Injury		
Diagnosis	**Total=52,000**	**n=225**
Lacerations, Amputations, Fractures, Avulsions	48,880	212
Contusions/Abrasions, Crushing, Internal Injuries, Foreign Body	3,120	13*
Body Part	**Total=52,000**	**n=225**
Finger	43,160	186
Hand, Wrist, Lower Arm, Lower Trunk, Upper Leg, Lower Leg, Head, Face, Eyeball, and Neck	8,840	39
Disposition	**Total=52,000**	**n=225**
Hospitalizations	2,600	16*
Overnight Observations or Treated and Transferred	1,560	6*
Treated and Released	47,840	203
Victim (Age)	**Total=52,000**	**n=225**
0 –14	1,200	7*
15 – 64	38,300	161
65 or Older	12,500	57
Users	**Total=52,000**	**n=225**
Operator	51,000	218
Non-operator	1,000	7*
Gender	**Total=52,000**	**n=225**
Male	49,600	214
Female	2,400	11*

Source: CPSC, National Electronic Injury Surveillance System (NEISS) and Special Study of Stationary Saws, October 1, 2001 Through December 31, 2001, Directorate for Epidemiology, Hazard Analysis Division.

* Based on small sample size, therefore, the estimate is subject to large sampling variability and should be used with caution.

Table 2
Special Study of Stationary Saws
Operators and Activities During Operating Sessions
October 1, 2001 – December 31, 2001

Description	Injury Estimate	Sample Size (n)
Operator		
Age	**Total=12,000**	**n=191**
12 –14	390	5*
15 - 64	8,480	137
65 and Older	3,130	49
Body Part	**Total=12,000**	**n=191**
Lower Arm, Wrist, Hand, and Finger	11,400	181
Head, Face, Eyeball, Lower Trunk, Upper leg, Lower Leg	600	10*
Diagnosis	**Total=12,000**	**n=191**
Laceration, Amputation, Fracture, Avulsion, or Crushing	11,600	183
Contusion/Abrasion, Internal Injury, or Foreign Object	400	8*
Disposition	**Total=12,000**	**n=191**
Hospitalization, Treated and Overnight Stay, or Treated and Transferred to Another Hospital	1,050	18*
Treated and Released	10,950	173
Hazard Patterns[28]	**Total=12,000**	**n=191**
Blade Contact	10,300	162
Being Hit by Stock/Material	1,430	23
Flying Debris	270	6*
Saw Type	**Total=12,000**	**n=191**
Table Saw	9,400	148
Band Saw	1,080	15*[29]
Miter Saw	960	21
Radial Arm Saw	560	7*

* Based on small sample size, therefore, the estimate is subject to large sampling variability and should be used with caution.

[28] Detailed in Table 3
[29] Involved injuries that were treated in small, medium or large hospitals with large sampling weights.

Description	Injury Estimate	Sample Size (n)
Operational Activities		
Type of Cut	**Total=12,000**	**n=191**
Ripping	6,170	91
Crosscutting	2,050	33
Dadoing, Mitering, or Beveling	970	16*
Unknown	2,810	51
Saw Blade	**Total=12,000**	**n=191**
Combination Blade	3,000	47
Rip Blade	2,400	38
Cross Cut, Carbide-Tip, Continuous Flexible, Dado, and Other (fine tooth, hollow grind) Blade	2,710	40
Unknown	3,890	66
Different Type of Blade for Different Type of Cut	**Total=12,000**	**n=191**
Different Type of Blade	4,440	70
Same Blade	3,960	61
Unknown	3,600	60
Position of Saw Blade	**Total=12,000**	**n=191**
Straight Up and Down Cut	8,640	134
Bevel (Tilted) Cut	240	3*
Unknown	3,120	54
Blade Motion	**Total=12,000**	**n=191**
Inside a Cut	4,080	67
Hit a Knot in Stock, Kicked Wood Up, Kicked Back	3,360	56
Other (Above/Resting Against Stock, Caught Gloved Hand, Hand Slipped into Blade, etc.)	1,890	30
Caught/Jammed in Stock,	1,320	18*
Unknown	1,350	20
Position of Operator's Hands	**Total=12,000**	**n=191**
(1) Table and Band Saws	**Subtotal=10,480**	**n=163**
Pushing/Feeding Stock	6,810	103
Holding Stock, Reaching Over Blade/Pulling Stock, or Adjusting Blade Angle	1,830	26
Unknown	1,840	34

* Based on small sample size, therefore, the estimate is subject to large sampling variability and should be used with caution.

Description	Injury Estimate	Sample Size (n)
(2) Miter Saw and Radial Arm Saw	**Subtotal=1,520**	**n=28**
Holding Stock, Lifting the Saw Arm/Stock, Pushing Stock, or Reaching Across/Over Blade	1,170	21
Unknown	350	7*
Status of Cutting Operation	**Total=12,000**	**n=191**
Part Way Through the Cut	4,190	70
Coming Out At the Other End	3,620	56
Start Cutting or Just About to Finish	880	14*
Unknown	3,310	51
Stock/Cutting Material Type	**Total=12,000**	**n=191**
Wooden Board	8,520	130
Paneling/Siding, Block of Wood/Log, Plastic Laminate Material, Wood Molding, Pipe/Metal, Bamboo/ Stick	980	19*
Unknown	2,500	42
Shape	**Total=12,000**	**n=191**
Rectangular	7,200	108
Square, Triangular, Octagonal, Long & Thin, Round, or Curve	1,690	29
Unknown	3,110	54
Condition of Stock/Material	**Total=12,000**	**n=191**
Nothing Unusual	2,530	41
Hard	2,520	36
Dry or Wet	2,250	25
Smooth, Soft, or Knotty	1,610	23
Unknown	3,090	66
Stock Support	**Total=12,000**	**n=191**
Table or Table and Addition	8,160	122
Base, Base and Addition, Floor, Saw Horse, or Held in Hand	600	11*
Unknown	3,240	58
Stock Fit on Support	**Total=12,000**	**n=191**
Fit	5,800	80
Did Not Fit	2,770	47
Unknown	3,430	64
Stock Firmly Anchored	**Total=12,000**	**n=191**
Firmly Anchored	5,550	79
Loosely Held or Wobbled	2,720	48
Unknown	3,730	64

* Based on small sample size, therefore, the estimate is subject to large sampling variability and should be used with caution.

Characteristic of Saw	Injury Estimate	Sample Size (n)
Ownership	**Total=12,000**	**n=191**
Purchased New or Used	10,200	131
Used Someone Else Saw or Rented	1,800	60
Saw Age	**Total=12,000**	**n=191**
10 Years Old or Newer	5,050	81
Over 10 Years	3,510	54
Unknown	3,440	56
Modified or Changed	**Total=12,000**	**n=191**
No	8,280	128
Yes	840	11*
Unknown	2,880	52
Assembled When Purchased	**Total=12,000**	**n=191**
Yes	6,240	92
No	1,920	33
Unknown	3,840	66
Safety Switch	**Total=12,000**	**n=191**
Did Not Have	4,680	68
Have a Safety Switch	4,080	65
Unknown	3,240	58
Sharp or Dull Blade	**Total=12,000**	**n=191**
Sharp or Moderately Sharp	8,060	123
Dull	540	7*
Unknown	3,400	61
Blade Guard	**Total=12,000**	**n=191**
Damaged, Removed, or Broken off	3,860	62
Attached	2,600	43
Never Had One	2,180	28
Unknown	3,360	58
Anti-Kickback	**Total=12,000**	**n=191**
(1) Table and Band Saws	**Subtotal=10,480**	**n=163**
Did Not Come With Saw	3,720	49
Removed/Did Not Put It On	2,310	34
Equipped With One	950	15*
Unknown	3,500	65
2) Miter and Radial Arm Saws	**Subtotal=1,520**	**n=28**
Equipped, Removed/Didn't Put On/Didn't Come With One, or Unknown	1,520	28

Source: CPSC, National Electronic Injury Surveillance System (NEISS) Special Study of Stationary Saws, October 1, 2001 Through December 31, 2001, Directorate for Epidemiology, Hazard Analysis Division.

* Based on small sample size, therefore, the estimate is subject to large sampling variability and should be used with caution.

Table 3
Hazards and Contributing Factors
During the Operating Session
October 1, 2001 – December 31, 2001

Description	Estimated Injuries	Sample Size (n)
Hazards and Contributing Factors	**Total=12,000**	**n=191**
Blade Contact	**Subtotal=10,300**	**n=162**
Stock, Tool, and Hand Interface	4,230	82
Saw or Stock Kicked Back	2,580	32
Blade Jammed in Stock (no kickback), Hand Slipped Off Stock, or Saw Blade Hit a Knot	2,100	24
Reaching Over Blade	1,390	24
Being Hit By Stock	**Subtotal=1,430**	**n=23**
Saw/Stock Kicked Back or Blade Jammed in Stock	1,430	23
Flying Debris	**Subtotal=270**	**n=6***
Piece of Wood or Saw Dust	270	6*

Source: CPSC, National Electronic Injury Surveillance System (NEISS) Special Study of Stationary Saws, October 1, 2001 Through December 31, 2001, Directorate for Epidemiology, Hazard Analysis Division

* Based on small sample size, therefore, the estimate is subject to large sampling variability and should be used with caution.

References:

1. "Statistical Analysis with Missing Data", Little, Roderick J.A. and Rubin, Donald B., Wiley Series in Probability and Mathematical Statistics, pp.58-60.
2. "The Complete Book of Stationary Power Tool Techniques", De Cristoforo, R.J., Published 1988 by Stering Publishing Company, Inc., New York.
3. SUDAAN, Software for Statistical Analysis of Correlated Data, User's Manual, Volume 1, Shah, Babubhai V., Barnwell, Beth G., and Bieler, Gayle S.