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Commentary

The New ANSI Nail Gun Standard: A Lost Opportunity For Safety

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Pneumatic nail guns have been shown in published studies to cause injury and death to both workers and consumers, but those equipped with sequential trigger mechanisms provide much greater safety protection against unintentional discharge than those equipped with contact triggers. In 2015 the American National Standards Institute (ANSI) approved a revision to its 2002 nail gun standard, but failed to require sequential triggers. Substantive and procedural deficiencies in the ANSI standard's development process resulted in a scientifically unsound nail gun safety standard, detracting from its use as the basis for a mandatory national safety standard and ultimately from its ability to protect worker and consumer users. Am. J. Ind. Med. 60:147–151, 2017. © 2016 Wiley Periodicals, Inc.

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NAIL GUNS AND SAFETY

Nail guns are easy-to-use tools designed to quickly drive nails into work surfaces. Pneumatic nail guns became commercially available in the 1960s and are now the most popular type of nail gun used by both workers and consumers. Pneumatic nail guns are able to drive any size nail into wood or other materials, from a small finishing nail to a 3.5 inch long nail, in a fraction of a second [Lipscomb et al., 2003]. Pneumatic nail guns use compressed air to drive the nail into the work surface. A constant supply of compressed air is most commonly provided by a separate air compressor, and air flows through a hose into the nail gun's air reservoir. When the nail gun trigger is pulled, compressed air drives a long piston and blade downward and expels a nail out of the chamber. Some pneumatic nail guns are capable of firing up to nine nails per second and at velocities of 1,400 ft/s [Baggs et al., 2001]. Pneumatic nail guns are rapidly replacing hammers on construction sites especially in residential construction because they reduce the workload from hammering nails, thus significantly reducing project delivery time, and resulting in fewer wasted nails, lowering construction costs.

Although useful to workers in residential construction and to consumers at home, nail guns are responsible for a significant number of serious injuries to both user groups and bystanders [CPSC, 2002]. Unintended nail discharge is a common cause of injury and, in one study, two-thirds of workers compensation claims for nail gun injuries involved unintended discharge or misfire [Dement et al., 2003]. Workers without training are at greatest risk of injury from pneumatic nail guns [Lipscomb et al., 2006] and consumers are at similar risk [Lipscomb and Schoenfisch, 2015]. Although nail gun injuries have decreased from previous years [Lipscomb and Jackson, 2007], the frequency of these injuries still remains high. From 2006 to 2011,

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approximately 14,000 worker and 11,000 consumer nail gun injuries per year required emergency medical treatment [Lipscomb and Schoenfisch, 2015]. Most nail gun injuries are puncture wounds to the hands and fingers, but nail guns also cause bone fractures, internal injuries, and even death. Nine of 18 pneumatic nail gun injury investigations conducted by the Occupational Safety and Health Administration (OSHA) from 1985 through 2012 in the construction industry involved fatal nail gun incidents [Lowe et al., 2016].

The most important aspect of nail gun safety involves the actuation system which is also called the control trigger. A sequential activation trigger ("sequential trigger") was developed over 40 years ago to reduce injury risk from nail guns [Burke et al., 1972]. A sequential trigger requires the following steps in order: (i) the nail gun is pressed against the surface that will receive the nail; and (ii) the user activates the trigger to discharge the nail. This sequence must be repeated after each discharge. An alternative mechanism is the contact activation trigger ("contact trigger") for which no specific sequence is required. Rather, the nail gun will fire a nail when pressed against the surface that will receive it and the trigger is activated. With a contact trigger, nails can be discharged as long as the trigger remains activated which allows rapid "bump firing." This design increases the risk of double firing and accidental discharge. The overall risk of injury is twice as high using pneumatic nail guns with contact triggers compared to using pneumatic nail guns with sequential triggers [Lipscomb et al. 2006, 2008, 2010a].

Intervention studies have shown that use of the sequential triggers can effectively reduce the rate of nail gun injuries to apprentice carpenters by 31% [Lipscomb et al., 2008]. In nail gun injury cases investigated by OSHA, they found that 53–71% of injuries were preventable with the use of a nail gun having a sequential trigger [Lowe et al., 2016]. Over a decade of research has shown clearly that injuries and fatalities are preventable through the use of a pneumatic nail guns equipped with a sequential trigger [Albers et al., 2015]. The injury prevention findings from these and other studies led the federal government in 2011 to produce a guide for construction contractors about how best to achieve nail gun safety at the worksite.

The *Guide for Construction Contractors* was issued jointly by the National Institute for Occupational Safety and Health (NIOSH) and OSHA with the input of labor, tool manufacturers, construction contractors, and subject-matter experts. In the *Guide*, OSHA and NIOSH made clear that the "sequential trigger is always the safest trigger mechanism for the job" and recommended its use as the first step in ensuring nail gun safety [DHHS and DOL, 2011]. The *Guide* emphasized that sequential triggers reduce the risk of unintentional nail discharge and double fires, including injuries caused by "bumping into co-workers" [DHHS and DOL, 2011]. Although voluntary, the *Guide* represents an authoritative statement that the safest pneumatic nail guns are those equipped with a sequential trigger.

ANSI NAIL GUN STANDARD DEVELOPMENT

The *Guide for Construction Contractors* is not the only set of recommendations for ensuring nail gun safety. Other recommendations for pneumatic nail gun safety have been approved by the American National Standards Institute (ANSI). Founded in 1918, ANSI is one of a number of private sector organizations that oversees the development of voluntary consensus standards in the United States. ANSI standards are voluntary, but have on occasion been incorporated by reference in mandatory OSHA standards. ANSI does not actually develop the standards it ultimately approves. Rather, ANSI relies on over 235 member organizations that it accredits to develop ANSI standards.

ANSI-accredited standards developers must adhere to ANSI's set of Essential Requirements: Due process requirements for American National Standards to ensure procedural fairness or "due process" [ANSI, 2016]. Select Essential Requirements for the standards developer include the following: (i) open notice of meetings and disclosure of consensus body members; (ii) balance in consensus body membership, such that no single interest category constitutes more than one-half of members for non-safety standards, but can only constitute one-third of the membership for safety standards; (iii) consideration of views and objections of all participants; (iv) demonstration of consensus by a vote of the development consensus body members; (v) a right to appeal to ANSI by anyone whose interests are directly and materially affected by the standard; and (vi) compliance by standard developers with ANSI policy and administrative procedures, including periodic revision or reaffirmation of an ANSI standard [ANSI, 2016]. According to the 2016 ANSI Essential Requirements, Section 4.7.1 indicates that standards addressing safety and health topics should be revised or reaffirmed on a schedule not to exceed 5 years [ANSI, 2016].

ANSI-accredited standard developers use two different methods to develop a standard—the committee method and the canvass method. The committee method involves multiple face-to-face meetings where dialogue between members plays an important role in crafting the standard. In the canvass method, the standards developer commonly writes the initial draft of the standard and then uses a letter ballot (more often using electronic mail) to determine if consensus exists among members. The canvass method reduces travel costs for members, but thorough discussion of issues is lacking.

The first set of ANSI recommendations pertaining to safety requirements for portable, compressed-air-actuated

fastener driving tools was developed in 1983 and revised in 1993 and 2002 [ANSI, 2002]. The standard developer accredited by ANSI for the 1983, 1993, and 2002 versions of the ANSI safety recommendations was the International Staple, Nail and Tool Association (ISANTA). ISANTA is an international trade association formed in 1966 and composed of approximately 25 companies that manufacture, distribute, and sell nail guns and similar products.

ANSI's 2002 nail gun standard called for framing pneumatic nail guns to be shipped with safer sequential triggers. However, manufacturers remained in compliance with the standard even if they included the contract trigger by citing user preferences [Lipscomb and Schoenfisch, 2015]. The 2002 nail gun standard excluded frequently used coil nailers, which are similar to other types of nailers except that the nail supply magazine is shaped like a coil rather than a stick and has a higher nail capacity. The 2002 nail gun standard also failed to require tool manuals or labels that would provide information about the relative safety advantages of sequential triggers to users [Lipscomb and Schoenfisch, 2015].

In January of 2010, ISANTA developed a set of procedures that would govern revision of the 2002 ANSI standard using the canvass method, and ANSI accepted ISANTA's procedures. ISANTA then assembled a consensus body, developed an updated version of the nail gun standard, and sent it to consensus body members for voting in October of 2011. This balloting resulted in approval of the draft standard in November of 2011. Non-industry nail gun safety experts from NIOSH and from two universities participated in the consensus body as members and voted not to approve the revised draft standard because it failed to recognize that the sequential trigger has been shown to be significantly safer than the contact trigger [Lipscomb et al., 2008, 2010b; Albers et al., 2015]. These consensus body members also provided comments describing important safety deficiencies that existed in the revised standard along with references to the best available scientific evidence. Per procedures, ISANTA then developed and balloted a second draft standard which was again approved by the necessary majority of consensus body members in 2012.

However, the changes made by ISANTA did not embrace the key evidence-based findings about how best to prevent nail gun injuries through use of sequential triggers. The non-industry nail gun safety experts again voted against the draft standard and again provided scientific evidence to support their reasons for not approving the draft standard. Following the second ballot approving the draft standard, the nail gun safety experts lodged a procedural appeal with ISANTA in 2012 based on ISANTA's failure to adhere to ANSI's Essential Requirements. Specifically, the appeal argued that the nail gun standard was not evaluated by ANSI in accordance with its status as a safety standard and violated the 5-year revision/reaffirmation cycle; the required membership categories did not include all materially affected groups; ISANTA's classification of consensus body members undermined ANSI's Essential Requirements for balance of interests; and the technical issues were not afforded due process [Gillen et al., 2015]. The appeal was unsuccessful. The revised ANSI standard for safety requirements for portable, compressed-air-actuated, fastener driving tools or pneumatic nail guns were approved by ANSI and released by ISANTA in April 2015 [ANSI, 2015].

A LOST OPPORTUNITY

The ANSI 2015 voluntary consensus nail gun standard represents a lost opportunity to protect pneumatic nail gun users—both workers and consumers—from injury and death for several reasons. First, the exemption provided for coil nail guns from the requirement that a sequential trigger be provided by the manufacturer, and the singling out of certain construction operations exempting them from trigger safety requirements represent a step backwards in the effort to improve nail gun safety for workers and consumers [Lowe et al., 2016]. Second, the revised ANSI 2015 nail gun standard makes only minor changes to the 2002 version, chiefly providing additional explanation of the types of trigger systems. The failure of the 2015 revised standard to require clear language on all packaging, labeling, and product manuals stating that sequential triggers are the safest type of triggers forfeits any claim that ANSI might make that its safety standards are based on the best available and most timely scientific evidence. While these deficiencies found in the ANSI 2015 nail gun standard, together with the failure of the revised standard to reflect the best available scientific evidence about the harm from pneumatic nail guns with contact triggers, provide little value for a national injury prevention strategy, a more important question is how this type of private sector, consensus standard-setting failure can be prevented in the future.

Ensuring that the participants in private-sector standard-setting represent all of the stakeholders involved in the issue, and that balance exists among stakeholder interests so that no one group can dominate the other participants is an important first step [Shapiro, 2003]. For example, industry orientation tends to weigh costs and product liability more heavily than safety or health [Hamilton, 1978].

As an ANSI standard developer whose responsibility should be the safety of all users, a conflict of interest may exist as ISANTA's mission is to advance "safety and quality standards for the pneumatic tools and fasteners industry *on behalf of its members*" (italics added) [ISANTA, 2016]. Granted ISANTA members have an interest in the safety of their products, but when a conflict between the interests of ISANTA members and the interests of workers and consumers arises over a safety issue, balance, and vigorous

dialogue among members of a consensus body developing the standard is crucial to resolving the conflict fairly. In the case of ANSI 2015 nail gun standard, an appropriate balance on the consensus body was lacking. It is not enough to give lip service on paper to the concept of balance as provided in ANSI's Essential Requirements. Balance must be achieved and enforced *in reality* among participants on consensus standard bodies to prevent one group's self-interest from being reflected in the final product. This is especially true when the issue the standard purports to effectuate is worker and consumer safety as opposed to technical specifications for a product. Similarly, requiring a 5-year cycle for revision or reaffirmation of a safety standard is a reasonable time frame for this activity, but it means very little if not followed or enforced.

Safety is a partnership among workers, consumers, manufacturers, employers, distributors, and government. This approach provides for equal voices for workers, consumers, industry, and government helping to ensure that the views of each partner in safety is ultimately reflected in labor and consumer standards and in shaping policies, programs and practices that represent all interests fairly. In the case of the ANSI 2015 nail gun standard, the ISANTA consensus body that revised the 2002 standard lacked balance proportionate to all of the interests that are essential to an effective worker and consumer safety standard. Furthermore, use of the canvass method compared to the committee method provided for fewer opportunities for safety experts to explain to other consensus body members the scientific rationale to support the use of nail guns with sequential triggers. In addition, the lack of interaction among canvass members can make problems related to balance, dominance, and conflict of interest less apparent to the participants compared to what occurs in the committee method.

The ISANTA consensus body was composed of a total of 44 members who self-identified as being in one of three ANSI-required categories: producers (i.e., designers and manufacturers), users (i.e., owners, employers, employee supervisors, and operators), and general interest (i.e., distributors, safety professionals, and others with an interest) [ANSI, 2015]. Eleven members or 25% represented producers or manufacturers. Twelve members or 27% represented construction contractor/employers or contractor/employer associations. 20 members or 45% represented general interest participants of which six were distributors. Only one labor union, representing 2% of the total members, self-identified in the user category. No consumer representatives were included in the consensus body.

Concerning safety, it is often the case that the interests of producers/manufacturers align more closely with construction contractor/employer users than with the interests of worker/labor union/consumer users. In the case of the ANSI 2015 nail gun standard, 52% of consensus body members represented producers/manufacturers and contractors/employers versus 2% representing labor. Under this analysis, the contrast in membership categories is stark just looking at the worker user category. Given that nearly 2,000,000 workers use nail guns [BLS, 2016a], and approximately 13% of worker nail gun users are building trade union members [BLS, 2016b], the interests of worker users were underrepresented, and were, in fact, dominated by interests aligned with the producer/manufacturer and employer user groups. The lack of appropriate balance in the consensus body that voted on the revised standard, coupled with a perceived conflict of interest by the standard developer itself and the lack of opportunity for face-to-face dialogue related to use of the canvass method may have all contributed to the safety content deficiencies in the 2015 revision of the ANSI standard.

These procedural and substantive deficiencies associated with ANSI 2015 nail gun standard detract from its utility for government standard-setting purposes [OMB, 2014], detract from its value as a respected voluntary, consensus-based safety standard, and detract from its use as the basis for a mandatory national safety standard. Developing effective safety and health standards is a unique and challenging task—much more challenging than developing a technical product specification standard. It is a task that should always be done by a standard developer who values and understands the importance of advancing safety for workers and consumers based on sound scientific evidence. The unfortunate experience of ANSI 2015 nail gun standard should serve as an important case study of how ANSI can improve its Essential Requirements and related procedures for developing and approving safety standards, and not just as a lost opportunity for safety.

AUTHORS' CONTRIBUTIONS

All authors made substantial contributions to the conception or design of the paper; or the acquisition, analysis, or interpretation of data for the paper. All authors drafted the paper or revised it critically for important intellectual content. All authors provided final approval of the version to be published. All authors agree be accountable for all aspects of the paper in ensuring that questions related to the accuracy or integrity of any part of the paper are appropriately investigated and resolved.

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