Profiles in safety and health: roofing and sheet metal work

Roofing, siding, and sheet metal work had the highest rate of occupational injuries and illnesses for a nonmanufacturing industry; falls were the leading cause of roofing injuries

Martin E. Personick

...When the bough breaks, the cradle will fall,
Down will come baby, cradle and all.
—*Mother Goose's Melody (c. 1765)*

In nursery rhymes and real life, falls sound an ominous note of human fragility, which, if unheeded, can lead to serious injury. Yet, despite the imminent danger, working at heights without adequate fall protection is fairly commonplace today, especially in the construction industry and, in particular, in roofing and sheet metal work.[1] This risky work practice goes far to explain why falls are the leading type of injury and illness in the roofing industry, constituting roughly three-tenths of all its serious cases of injury and illness reported.[2]

According to safety and health experts, most accidents in roofing work, as in other industrial settings, are preventable if employers and employees follow safe work procedures. To this end, government, labor, and industry have been working to reduce the risks of roofing injuries through stepped-up inspections and monitoring of worksite conditions and through comprehensive safety training. Their accident prevention efforts go beyond just reducing fall hazards in that they also address proper handling of equipment, materials, and industrial substances. But even with adequate protection from falls in place,[3] roofing industry workers would continue to face the potential hazards of material handling and other tasks commonly associated with construction (such as strenuous manual work performed under variable weather conditions and, often, against tight timetables).

Reflecting elevated job risks, the 1988 incidence rate of almost 20 occupational injuries and illnesses per 100 full-time workers in roofing and sheet metal work was well above that for all construction (under 15)—the most hazardous major industry grouping—and more than double that for private industry as a whole (under 9).[4] (See table 1.) In fact, incidence rates for roofing topped the list of nonmanufacturing industries that reported the highest rates of occupational injuries and illnesses.[5]

The severity of roofing accidents, moreover, often requires workers to take time off from their jobs or to be assigned to restricted work activity (light duties, shortened hours, and so forth).[6] Many of these disabling injuries, as might be expected, took the form of broken bones (fractures) and severe sprains from falls. Other kinds of injuries involving lost worktime included sprains from lifting heavy or unwieldy objects, heat burns from contact with hot asphalt or coal tar, and serious cuts incurred in using handtools and construction materials.[7] The following sections examine some characteristics of roofing and sheet metal work; analyze the injury and illness record of the industry in more detail; and summarize ongoing activities to improve working conditions.

The industry at a glance

From colonial times to the present, American roofers have tried and discarded a wide variety

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of materials, including thatch, wood, and assorted metals, searching for a long-lasting roofing agent that is watertight, fire-resistant, energy efficient, and, when so designed, aesthetically appealing.[8] Based on a 1988 National Roofing Contractors Association survey, the roofing material of choice for residential structures continues to be fiberglass asphalt shingles. For commercial structures, the preferred coverings consist of either single-ply sheets of synthetic rubber (or asphalt/synthetic compounds) or multi-ply membranes built up from alternate layers of roofing felt and bituminous products (asphalt or coal tar).[9]

Many of the disabling injuries took the form of broken bones and severe sprains from falls.

Today, more than 25,000 roofing, siding, and sheet metal contractors, employing some 200,000 workers, compete in a $12 billion market for exterior construction work.[10] Commonly, these contractors work on several types of structures, such as office buildings and stores. Often though, they garner 80 percent or more of their business from a single type of construction, particularly those who specialize in detached single-family houses.[11]

Small establishments (fewer than 20 workers) are numerically dominant in the roofing, siding, and sheet metal industry, constituting about nine-tenths of its 25,000 firms. Larger firms, although only one-tenth of the establishment total, account for roughly one-half of the roofing industry work force and a similar proportion, in dollar terms, of its business done.[12] Although firms of all sizes are geographically dispersed, the most heavily populated States have comparatively more roofing activity.[13]

A clear majority of the 200,000 workers in the roofing, siding, and sheet metal industry are classified as: experienced and apprentice roofers (two-fifths of the total); or roofers' helpers (one-eighth); or sheet metal workers (one-tenth). Several other job categories contained at least 5,000 roofing industry workers, although none was as much as one-twentieth of the industry job total. These included general managers and top executives; first-line supervisors; cost estimators; secretaries; general office workers; material recording, scheduling, and kindred workers; and carpenters.[14]

Safety and health measures

Injury and illness rates for roofing and sheet metal work date back to the mid-1970's, when the industry was one of five targeted for special study by the Occupational Safety and Health Administration.[15] After trending somewhat lower during the early 1980's, roofing injury and illness rates (as did those in construction) remained relatively stable during the second half of the decade, as the following tabulation illustrates using total case rates per 100 full-time workers:

	Annual average		
	1975–79	*1980–84*	*1985–88*
Construction	15.8	15.1	14.9
Roofing and sheet metal work	21.8	19.9	19.4

Thus, compared with all construction, working in roofing remains relatively hazardous.

Besides the overall injury and illness rate, there are other measures that the Bureau of Labor Statistics uses to gauge the *severity* of workplace incidents. These measures consistently show that lost worktime incidents are a serious problem in the roofing industry. (See appendix for definitions.) In 1988, such disabling incidents accounted for slightly more than one-half of the industry's cases (about 18,000 out of 33,000 injuries and illnesses). This translates into 11.0 lost workday cases per 100 full-time workers, a rate that is about 60 percent higher than the corresponding figure (6.8) for all construction. (See table 1.) Moreover, when seriously injured that year, roofing industry workers were away from their regular job, on average, 22 days per case; this was 3 days more than the private sector's figure for average number of lost workdays per lost workday case.

Injury and illness rates varied widely among the 15 States for which roofing data are available.[16] Table 1 shows, for example, overall roofing injury and illness rates ranging from under 15 per 100 full-time workers in Arkansas, Maryland, and the Carolinas to 26 in Utah and more than 37 in Washington State.

Overall rates, however, are not necessarily indicative of accident severity. One such measure—average lost workdays per case—was lowest in Utah and Washington and highest in Maryland in 1988. (For a variety of reasons, injury and illness estimates for roofing tend to be much more volatile from year to year for individual States than for the Nation as a whole. Thus, the 1988 data are more illustrative of geographic variability of rates than of longer term relationships among individual State rates.)

Injury and illness characteristics

The Bureau's annual survey reports on injury and illness rates by industry, but it does not provide information about the characteristics of those workplace incidents. Such information is available, to some extent, from another Bureau program—the Supplementary Data System—based on the State workers' compensation sys-

tems. Unlike the annual survey, the Supplementary Data System does not produce nationwide estimates and lacks a uniform treatment among States of what is a compensable workplace injury or illness.[17] However, despite several analytical and statistical limitations, the Supplementary Data System does help in spotting general patterns (or a lack thereof) in the characteristics of work-related injuries and illnesses involving lost worktime.

In 1987, about 9,100 current cases in roofing, siding, and sheet metal work were reported to 24 State agencies and the Virgin Islands — the participants in the Supplementary Data System that year. (Current cases are injuries and illnesses which involved lost workdays and which either occurred in 1987 or were reported to the State agencies that year.)[18] Separate analysis of roofing cases, and all cases in the Supplementary Data System in construction, reveal several differences in their profiles of case characteristics. (Such comparisons, however, are subject to the same types of limitations previously ascribed to the Supplementary Data System.)

In terms of principal physical characteristics, sprain and strain is the leading category under *nature of injury or illness*, accounting for about one-third of the roofing cases recorded by the Supplementary Data System. Next in frequency were fractures and cuts (including lacerations and punctures), each cited in about one-sixth of the roofing cases. Heat burns, the result of frequent exposure to hot asphalt and other searing substances, accounted for nearly one-tenth of the roofing industry's case total.

Under Supplementary Data System classifications, the back and other portions of the trunk (abdomen, shoulder, and so forth) were the *major parts of the body affected* by injuries and illnesses. Three-tenths of the roofing cases involved portions of the trunk, primarily taking the form of back sprains. Another one-half of the cases were divided about evenly between two other major body parts: the upper extremities (especially the fingers, hand, and wrist) and the legs and other lower extremities. About one-tenth of the roofing injury cases, among them some of the most severe burns, involved *multiple* major body parts.

Falls (especially from rooftops, ladders, and other elevations), the leading category under *type of accident or exposure*, constituted three-tenths of the cases recorded by the Supplementary Data System in roofing. Injuries due to falls were somewhat more prevalent in the roofing industry than in other branches of construction. Overexertion (commonly resulting in sprains and strains from lifting objects) ranked second among major accident types, accounting for almost one-fourth of the roofing injury case total. Other notable types of accidents included being struck by falling, flying, or wielded objects and being splashed by, or contacting hot asphalt or coal tar.

The ground and other working surfaces were the major *sources of injury or illness*, directly producing or inflicting the injury in about one-fourth of the roofing cases. A wide variety of other sources of injury were reported in roofing accidents, including fasteners and other metal roofing materials; heavy bundles, rolls, and containers; and asphalts and other petroleum products.

Predictably, roofer (journeyman and apprentice) was the dominant occupation of the injured or ill worker, accounting for slightly more than one-half of the recorded Supplementary Data System cases in the roofing, siding, and sheet metal industry. Another one-fifth of the industry's cases involved various types of handlers, laborers, and helpers, and most of the remainder involved sheet metal workers and carpenters.

Differing work activities, materials used, and work processes help explain some of the overall

Table 1. **Occupational injuries and illnesses by type of case, 1988 annual survey**

Industry	Incidence rates[1]				Average lost workdays per lost workday case
	Total cases[2]	Nonfatal cases without lost workdays	Lost workday cases	Lost workdays	
Private sector[3]	8.6	4.6	4.0	76.1	19
Construction	14.6	7.7	6.8	142.2	21
Roofing, siding, and sheet metal work, total[4]	19.7	8.6	11.0	239.6	22
Alabama	15.8	5.9	9.9	234.8	24
Arkansas	12.0	7.8	4.2	82.2	20
California	23.4	9.3	14.0	257.6	18
Florida	15.7	6.9	8.8	234.4	27
Indiana	18.1	9.3	8.7	166.5	19
Maryland	13.5	5.0	8.4	272.3	32
Michigan	16.8	6.5	10.3	234.5	23
Mississippi	21.0	9.4	11.6	238.1	21
Missouri	17.5	7.8	9.8	196.6	20
New Mexico	20.7	8.3	12.4	227.4	18
North Carolina	14.3	7.6	6.7	149.0	22
South Carolina	13.0	7.1	5.9	165.0	28
Utah	26.1	13.7	12.3	200.3	16
Virginia	18.3	8.6	9.7	190.3	20
Washington	37.2	15.6	21.6	364.3	17

[1] Incidence rates represent the number of injuries and illnesses per 100 full-time workers. See footnote 4 to text for method of calculation.

[2] Includes fatalities. Because of rounding, the difference between the total and the sum of the rates for lost workday cases and nonfatal cases without lost workdays may not reflect the fatality rate.

[3] Includes data for major industry divisions in addition to construction. Excludes farms with fewer than 11 employees.

[4] Includes data for States in addition to those shown separately.

variation in injuries sustained by roofing and sheet metal workers. The hazard of hot asphalt or coal tar, for example, accounted for one-tenth of the roofers' cases, but for none of the cases involving sheet metal workers. By contrast, structural metal and other metal items were the leading sources of sheet-metal worker injuries, constituting three-tenths of that occupation's case total; for roofers, the corresponding proportion was less than one-tenth. Both occupations, however, shared the danger of working at elevations, with resulting falls to a lower level cited in roughly the same proportion (nearly one-fourth) of the total cases for each.

Workers often cited "using safer work procedures on their part" as the way their accident could have been averted.

While the Supplementary Data System provides the basic characteristics on injured workers and their injuries, the Bureau also conducts, from time to time, small-scale studies of specific work injuries that focus on the circumstances surrounding an accident from the perspective of the injured worker. Requested by OSHA, these studies are useful in evaluating, revising, and setting safety standards, such as those covering personal protective equipment, and in developing educational and training materials. Two such studies—one on falls from elevations and the other, on heat burns—contain general findings pertinent to roofing accidents.[19]

In the BLS cross-industry study of falls from elevations, more than four-fifths of the 774 workers interviewed said that there was no fall protection in the area where they were working at the time of their accident. Even more revealing, most of those provided with fall protection either disconnected their safety devices to move around more easily or were not working in the immediate area where guardrails or similar fall protection were in place. Interestingly, workers often cited "using safer work procedures on their part" as the way their accident could have been averted. Several roofers mentioned that more care was needed in examining and positioning ladders and scaffolds and in working near skylights and other types of openings.

The BLS study of heat burn injuries found that most of the injured were wearing some type of safety gear at the time of their accident, but that the burn area typically was not covered by personal protective equipment. Even when the burn area was covered, the source of heat often went under or around the safety gear or otherwise penetrated the protective equipment. The following incidents involving roofers illustrate the importance of wearing appropriate gear and knowing the limitations of that gear:

- During hoisting, a bucket of hot asphalt hit the lip of the roof, splashing on the unprotected hands of the worker at the scene of the accident.
- While filling buckets with hot asphalt, a worker sustained burns from asphalt seeping below the cuff of his safety gloves.

Incidents such as these would concern safety and health professionals when they evaluate certain design features of safety gloves and shoes, such as the size and fit of the gear and their heat-resistant properties. Clearly though, a separate, indepth study of roofing would be required to track the underlying causes of current safety and health problems in the industry, including accidents resulting in falls and burns and those related to manual lifting and other activities.

Accident prevention

"Education, vigilance, and cooperation" continue to be watchwords for accident prevention in construction in general and for the roofing industry in particular.[20] Concerned with issues on industry safety, the National Roofing Contractors Association has developed a series of audiovisuals, workbooks, and related material on falls, back injuries, toxic chemicals, and other potential work hazards facing roofers.[21] On the labor side, the United Union of Roofers, Waterproofers and Allied Workers has assembled a comprehensive training manual designed to inform and alert workers about potential hazards on the job.[22]

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor regulates the safety and health of roofing and other construction workers through a host of specific standards relating to activities on rooftops, ladders, scaffolds, and so forth.[23] In a recent 2-year period, OSHA conducted more than 2,500 onsite inspections to observe how roofing operations conformed to current Federal safety and health standards. Looking to the future, OSHA has proposed to revise and consolidate its standards relating to the hazards of falls. Under the proposed rule, the employer would have more latitude in selecting the most appropriate type of fall protection for the particular circumstances.[24]

Besides OSHA, the National Institute for Occupational Safety and Health (NIOSH) continues to monitor working conditions in the roofing industry.[25] For example, it has identified worksites where workers were exposed to excessive levels of coal tar dust during the removal of old roofs. For the most part, the agency's recommendations for controlling worksite exposure levels for coal tar, asbestos, and other toxic substances are evident in reroofing activities.[26] □

Footnotes

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[1] Roofing and sheet metal work has been designated group number 176 in the *Standard Industrial Classification Manual*, 1972 edition, 1977 supplement of the Office of Management and Budget. The industry includes special trades construction contractors primarily engaged in the installation of roofing, siding, and associated sheet metal work. The latter industry does not include sheet metal work performed in the installation of plumbing, heating, and air-conditioning equipment; such contractors, outside the scope of this study, are classified in group number 171 of the same Manual.

Throughout this article, the terms "roofing and sheet metal work" and "roofing" are used interchangeably to denote all of the industry's workers, not just its roofers and sheet metal workers.

[2] This figure is based on the Bureau's Supplementary Data System as fully described in footnote 17. By comparison, falls were slightly more than one-fifth of all cases recorded in the Supplementary Data System in construction and one-sixth of those in private industries as a whole.

[3] Fall protection comes in three basic categories: (1) *motion-stopping systems*, such as guardrails, secured covers over roof openings, and anchored body harnesses; (2) *warning line systems*, commonly erected on belt-high stanchions that enclose a work area at a safe distance from the roof's sides/edges; and (3) *safety monitoring systems* that permit an experienced person to watch and warn all employees in a roofing crew, for example, when someone is working in an unsafe manner near the roof's edge.

[4] *Incidence rates* represent the number of injuries and illnesses, or both, per 100 full-time workers and were calculated as:

N/EH x 200,000

where

N = number of injuries and/or illnesses;

EH = total hours worked by all employees of the industry during the calendar year; and

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

A variety of useful incidence rates may be computed by making N equal to the number of injuries only, or the number of lost workday cases, and so forth. In each instance, the result is an estimate of the number of cases or days per 100 full-time workers.

[5] See *Occupational Injuries and Illnesses in the United States, 1988*, Bulletin 2366 (Bureau of Labor Statistics, 1990), table 1. Despite leading other nonfactory industries in injury and illness rates, roofing and sheet metal work fell below rates reported by BLS for several dozen individual *manufacturing* industries (meat products and motor vehicles, to cite two notable examples).

[6] According to the Bureau's 1988 annual survey of occupational injuries and illnesses, 56 percent of all roofing and sheet metal cases involved days away from work or restricted work activity. By comparison, the corresponding figure was 46 percent in all private industry and 47 percent in construction.

[7] Derived from the Supplementary Data System, as discussed later in the text.

[8] For a comprehensive chronicle of how the roofing industry evolved in the United States, see John N. Vogel, Theodore J. Karamanski, and William A. Irvine, *One Hundred Years of Roofing in America* (Rosemont, IL, National Roofing Contractors Association, 1986).

[9] A news release and accompanying charts on the 1988 survey are available, upon request, from the National Roofing Contractors Association (NRCA), O'Hare International Center, 10255 West Higgins Rd., Suite 600, Rosemont, IL 60018-5607. For a brief description of the various commercial roofing systems, see Robert Eiseman, "Selecting a roofing system," *Journal of Property Management*, November/December 1987, pp. 41–44.

[10] See *1987 Census of Construction Industries: Roofing, Siding, and Sheet Metal Work* (Bureau of the Census, 1990), tables 2 and 11. The $12 billion figure includes contractor receipts in this industry solely for roofing, siding, and sheet metal work; it excludes their receipts from other kinds of "incidental" businesses.

[11] *Ibid*, table 8.

[12] *Ibid*, table 5.

[13] The eight largest centers of roofing activity—the States of California, Florida, Illinois, New Jersey, New York, Ohio, Pennsylvania, and Texas—account for about one-half of the industry's firms and work force. This proportion is in line with the eight States' share of the Nation's population and nonagricultural work force totals.

[14] Occupational data for the roofing industry are available upon request from the Office of Employment and Unemployment Statistics, Bureau of Labor Statistics.

[15] For background on the Target Industry Program, see *The President's Report on Occupational Safety and Health* (U.S. Department of Labor, 1972), chapter 7.

[16] Another potential source of local information on roofing is the individual State agency that oversees workplace safety and health. See, for example, *California Roofing and Sheet Metal Work* (San Francisco, California Division of Labor Statistics and Research, 1982).

[17] The Supplementary Data System is not statistically representative of the Nation as a whole because the data cover only the jurisdictions participating in the system. In 1987, the latest year for which detailed information is available, these were the Virgin Islands and the following 24 States: Alaska, Arizona, California, Colorado, Hawaii, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Michigan, Mississippi, Missouri, Nebraska, New Mexico, Ohio, Oklahoma, Oregon, Tennessee, Virginia, Washington, Wisconsin, and Wyoming.

States differ, moreover, in the kinds of cases they require by law to be reported to workers' compensation agencies. While some States require reports for all occupational injuries and illnesses, regardless of length of disability, others require reports only for cases of sufficient duration to qualify for indemnity compensation payments, and still other States require reporting of cases involving a specific number of lost workdays, regardless of the indemnity "waiting period." Thus, the file of the Supplementary Data System is not a complete census of all "disabling" injuries and illnesses in the jurisdictions studied.

The Supplementary Data System, however, does standardize the classification of data using the *1972 Standard Industrial Classification Manual*, the *1980 Census of Population, Alphabetical Index of Industries and Occupations*, and the *1962 American National Standards Method of Recording Basic Facts Relating to the Nature and Occurrence of Work Injuries*, published by the American National Standards Institute (ANSI) and often referred to as the Z16.2–1962 Standards, or simply, Z16.2.

[18] The total for the 25 jurisdictions in the Supplementary Data System is one-half of the annual survey estimate of nearly 18,000 lost workday cases in the roofing industry in 1987. See footnote 17 for some limitations pertaining to the range of cases included in the Supplementary Data System.

[19] *Injuries Resulting From Falls From Elevations*, Bulletin 2195 (Bureau of Labor Statistics, 1984); and *Heat Burn Injuries*, Bulletin 2358 (Bureau of Labor Statistics, 1990).

[20] See the introduction to *Manual of Accident Prevention in Construction* (Washington, Associated General Contractors of America, Inc., 1952).

[21] At the present time, the following audiovisuals pertaining to safety and health are available from the National Roofing Contractors Association:

(1) Personal Protective Equipment: What's The Difference?; (2) Fire Safety: Don't Get Burned; (3) NRCA Substance Abuse Prevention Program; (4) Hazard Communication: Your Right To Know; (5) Fall Prevention: It's No Accident; and (6) Back Injury Prevention: Handle With Care. Additionally, the pocket-size booklet *Passport to Safety* is available in English and Spanish versions from the National Roofing Contractors Association, O'Hare International Center, 10255 West Higgins Rd., Suite 600, Rosemont, IL 60018-5607.

[22] See *Roofers' Safety and Health Manual* (Washington, United Union of Roofers, Waterproofers and Allied Workers, 1987). The *Manual* contains useful "resource appendixes" that list, by State, occupational health clinics, university education programs, OSHA consultative services, and so forth.

[23] See *Code of Federal Regulations, Title 29-Labor, Part 1920 to End* (Washington, Office of the Federal Register, 1985). Part 1926, subpart E, covers personal protective and life saving equipment; subpart L covers ladders and scaffolding; and subpart M covers, wall openings and stairways in the construction industries. Section 1926.450, for example, states that damaged or defective ladders "shall be immediately withdrawn from service." And the same section later discusses the proper angle, extension, and fastening of portable ladders to prevent their being displaced.

[24] See the notice of proposed rulemaking, "Safety Standards for Fall Protection in the Construction Industry," *Federal Register*, November 25, 1986. The final rule, slated to be issued later this year and to become effective in early 1991, will contain specific criteria to which the chosen fall protection system must conform. Among the pending changes, the new fall protection standards would extend to *steep roofs* (slopes steeper than 4 inches vertical to 12 inches horizontal), not now specifically covered.

[25] The National Institute for Occupational Safety and Health's interest in the industry dates back to the mid-1970's when the agency contracted for an indepth study of worker characteristics, equipment, and other factors associated with roofing accidents. The 1975 study, *Behavioral Analysis of Workers and Job Hazards in the Roofing Industry*, found the role of roofing foreman critical to roofing safety and also recommended upgraded training for apprentices.

[26] For examples of such recommendations from the Hazard Evaluations and Technical Assistance Branch of the National Institute for Occupational Safety and Health, see *Coal Tar Pitch Tear-Off and Asphalt Application*, HETA 82-067-1253 (Cincinnati, National Institute for Occupational Safety and Health, 1983). One common precaution in tear-off operations involves wetting the roof to control the release of dust from worn roofing felts.

APPENDIX: Work injury definitions

In this article, definitions of occupational injuries and illnesses and lost workdays conform to the recording and reporting requirements of the Occupational Safety and Health Act of 1970 and Part 1904 of Title 29, Code of Federal Regulations. Supplemental information pertaining to these definitions is in the booklet, *Recordkeeping Guidelines for Occupational Injuries and Illnesses* (Bureau of Labor Statistics, 1986).

Recordable occupational injuries and illnesses are:

1. occupational deaths, regardless of the time between injury and death, or the length of the illness; or
2. nonfatal occupational illnesses; or
3. nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid).

Occupational injury is any injury, such as a cut, fracture, sprain, amputation, and so forth, which results from a work accident or from exposure involving a single incident in the work environment.

Occupational illness is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or disease which may be caused by inhalation, absorption, ingestion, or direct contact.

Lost workday cases are cases which involve days away from work, or days of restricted work activity, or both.

1. *Lost workday cases involving days away from work* are those cases which result in days away from work, or a combination of days away from work and days of restricted work activity.

2. *Lost workday cases involving restricted work activity* are those cases which result in restricted work activity only.

The number of days away from work or days of restricted work activity does not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.