

Analysis of Forklift and Pallet Jack Injuries in Wood-Related Industries

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Abstract

Many wood-based businesses rely on forklifts and pallet jacks to load, unload, or move product around facilities. The use of forklifts or other powered industrial trucks (PITs) to facilitate movement and storage of goods is expected to grow steadily over the next 10 years. Unfortunately, forklifts are known to be a common source of occupational injuries and fatalities. The purpose of this article is to examine severe injuries related to the use of forklifts and pallet movers in various segments of the wood-related industries. We used data from an Occupational Safety and Health Administration (OSHA) database to investigate all severe injuries related to forklifts or pallet jacks in the 5 years from 2015 to 2019. Our focus was on various wood products and paper manufacturers, as well as wood building material dealers and wholesalers; this provides a broad overview of the hazards associated with forklifts and pallet trucks across the spectrum of wood-related businesses. Results show there were 17 fatalities and 211 severe injuries during the 5-year period. Building material dealers saw the highest number of injuries, followed by a wood manufacturing segment. Fractures were the most prevalent type of injury, with the lower extremities being the most vulnerable to serious injury. The most prevalent injury event type was pedestrians hit by a forklift or other PIT. Improper use of PITs is a regular source of OSHA fines for wood-based businesses. Implications are drawn for businesses that use forklifts and pallet jacks to reduce the likelihood of injuries from this type of equipment.

Forklifts, pallet jacks, and related industrial vehicles are critical to the efficient movement and storage of goods in modern supply chains. As has been previously noted, “pallets move the world,” and the ability to move unit loads in an efficient manner is critical to supply chain functioning (White and Hamner 2005). Forklifts and pallet jacks are necessary to move loaded pallets, crates, and products in a variety of forms; they are extremely versatile and have the ability to raise, lower, and transport objects.

Unfortunately, forklifts are known to be a common source of occupational injuries. Occupational Safety and Health Administration (OSHA) data showed there were 234 forklift-related fatalities from 2015 to 2019 in the United States (OSHA 2020), and 1,021 from 1980 to 1994 (Collins et al. 1999). The most common events that these injuries were attributed to were forklift overturns, pedestrian struck by forklift, and worker crushed by forklift (OSHA 2020). The predicted growth in use of pallet trucks (Modern Materials Handling Staff 2020) will presumably add to the number of potential hazards for employees, and for customers who visit retail or wholesale locations where pallet movers are in use.

Many wood-based businesses rely on forklifts and pallet jacks to load, unload, or move product around facilities, but this combination presents danger in a wide variety of locations. Building materials dealers, for example, are dependent on pallet movers in areas frequented by both

employees and customers. Injuries are common in the large “big box” building material retailers and they are often the target of lawsuits and workers’ compensation claims (see for example *Miller v. Lowes Home Centers* 2015). Wood and paper manufacturers also depend on powered and unpowered vehicles to move raw materials, component parts, and finished goods around production facilities, warehouses, loading docks, etc. Improper use of forklifts is a common source of OSHA inspections and fines for wood-related firms, with maximum fines being greater than US\$100,000 (see “Results” section below for examples).

The purpose of this article is to examine severe injuries related to the use of forklifts and pallet movers in various segments of the wood-related industries. Our hope is that this analysis will illuminate the causes of such injuries so that more effective prevention measures can be taken.

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Conducting an analysis of severe occupational injuries will allow industry leaders and policymakers to set priorities for preventative actions such as training, facility layout, and technological advancements. This is the first known analysis of occupational injuries caused by powered industrial trucks (PITs) as seen in wood-related industries. OSHA's requirement that businesses report severe injuries took effect on January 1, 2015; thus, data of the type reported here did not exist prior to that date. This article is also unique in that it includes data on pallet jacks as a source of injury separate from other PITs like forklifts.

The wood-related industries are historically among the most dangerous for employees (Michael and Wiedenbeck 2004). OSHA records suggest working in a sawmill is one of the most dangerous jobs in the United States (OSHA 2002) and logging is historically considered the most dangerous occupation (Egan 1996, Bureau of Labor Statistics [BLS] 2018). Past research has focused on various wood-related industry segments and injury sources (Varonen and Matttila 2000, Evans et al. 2005, Rodrigues et al. 2015). Lumber wholesalers suffered the fourth highest injury and illness rates of all wholesalers, while among retail trade industries home centers and other building material dealers were first and third most dangerous, respectively (Anderson et al. 2011). Investigating injuries from forklifts and related industrial vehicles will add to our knowledge of incident analysis and injury prevention for all parts of the wood-based industries that utilize this equipment.

PIT Safety

OSHA places forklifts and lift trucks into a category called PITs. There are seven commonly used OSHA classes ranging from electric rider trucks to rough-terrain forklifts to electric hand trucks. Forklifts can be operated in a sitting position or in a stand-up configuration. Pallet jacks can be powered or unpowered (manual) and are widely used in nearly all warehouses and distribution centers.

OSHA has extensive regulations related to PITs that can help to guide industrial users; the general requirements fall under the 1910.178 standard (OSHA [n.d.]). Industry has many other sources to help guide in the use of PITs, including trade associations, state-level academic and government agencies, and for-profit training organizations. While many resources exist to help managers reduce the number of fatalities and severe injuries, PITs are still the source of life-changing injuries for many employees. There are a variety of known hazards for both PIT operators and nearby employees, including being struck by loads falling off a PIT, falling when being lifted by a forklift, and tripping over the forks (Janicak and Cekeda 2016). The most common events associated with severe injuries were forklift overturns, pedestrian struck by forklift, and worker crushed by forklift (Collins et al. 1999).

BLS data show the average annual number of nonfatal occupational injuries involving forklifts in the United States was approximately 8,500 from 2011 to 2017 (BLS 2019).¹ During this period 614 workers lost their lives in forklift-related incidents. Data from 2017 indicate the 9,050 nonfatal PIT-related workplace injuries resulted in a median of 13 days away from work (BLS 2019).

Safety issues related to freight handling, transport, and storage with PITs are well known in many parts of the developed world (Larsson and Rechnitzer 1994, Chae 2013, Goode et al. 2014). The United States is no exception, with PITs being one of OSHA's top-10 most frequently cited standards (Janicak and Cekeda 2016). More specifically, wood-based businesses are the source of many freight-handling injuries (White and Hamner 2005) and are often cited for violations (OSHA 2020).

Pallet jacks are valuable tools for warehouse and similar environments; they can carry heavy loads and help reduce workplace injuries by keeping employees from lifting and carrying heavy objects (Anderson 2014). While pallet jacks are regarded as safer than forklifts or other PITs, they can still be a source of injury (Nunen et al. 2018) that operators should be wary of. The National Institute of Occupational Safety and Health (NIOSH) has recognized the specific dangers associated with pallet jacks in retail environments (Anderson 2014). Unfortunately, government agencies do not keep track of pallet jack injuries to the same degree as forklifts, so there is a relative dearth of information on causes and preventative measures. However, OSHA statistics show that from 2002 to 2016 there were 56 severe injuries involving pallet jacks; these included four fatalities and eight amputations (Myers 2019).

Methods

We used data from an OSHA database to investigate all severe injuries related to PITs and pallet jacks in the 5 years from 2015 to 2019 for wood-related industry segments. OSHA currently requires employers to report all severe work-related injuries, defined as an amputation, in-patient hospitalization, or loss of an eye, but this requirement did not exist prior to January 1, 2015. The severe injury database provides information describing the incident, the name and address of the establishment where it happened, and the industry code based on the North American Industry Classification System (NAICS). Each case is coded according to Occupational Injury and Illness Classification (OIICS) codes for nature, body part, injury source, and event and exposure.

The NAICS system starts with broad, two-digit industry codes (e.g., 31 thru 33 = manufacturing). Four-digit codes provide further breakdown (e.g., 3211 = sawmills and wood preservation), and six-digit codes are the most focused groupings for businesses the establishments are engaged in (e.g., 321214 = truss manufacturing).

Our focus was on wood and paper manufacturers, as well as wood building material dealers and wholesalers; this provides a broad overview and quantification of the dangers associated with US wood-related industries. The NAICS four- and six-digit industry segments we analyzed are listed in Table 1. Cases from the OSHA database with the primary/secondary injury source of forklifts or pallet jacks (powered and nonpowered), and cases that contain "forklift" or "powered industrial vehicle" are included in the data analysis. We reviewed the specifics of each case, including the narrative provided for each, to ensure they should be included in the results below.

Results

Table 2 shows 1 year of OSHA PIT citation data for nine key wood-related industry segments; we provide 1 year as

¹ BLS and OSHA data may differ due to differences in reporting requirements and methods.

Table 1.—Wood-related industry North American Industry Classification System (NAICS) codes analyzed.

NAICS 4	Four-digit title	NAICS 6	Six-digit industry groups
3211	Sawmills and wood preservation	321113	Sawmills
		321114	Wood preservation
3212	Veneer, plywood, and engineered wood product manufacturing	321211	Hardwood and softwood veneer and plywood, engineered wood members and trusses
		321212	
		321213	
		321214	
		321219	
3219	Other wood product manufacturing	321911	Wood window and door, cutstock, planning, millwork, wood containers and pallets, prefab wood building manufacturing, all other miscellaneous wood product manufacturing
		321912	
		321918	
		321920	
		321991	
		321992	
		321999	
3221	Pulp, paper, and paperboard mills	322110	Pulp, paper, newsprint, and paperboard mills
		322121	
		322122	
		322130	
3222	Converted paper product manufacturing	322211	Corrugated and solid fiber boxes, folding paperboard, paperboard containers, paper bags, stationery, sanitary paper, all other converted paper products
		322212	
		322219	
		322220	
		322230	
		322291	
		322299	
4233	Lumber and other construction materials merchant wholesalers	423310	Lumber, plywood, millwork, and wood panel merchant wholesalers
4441	Building material and supplies dealers	444110	Home centers
		444190	Other building materials dealers
3371	Household and institutional furniture and kitchen cabinet manufacturing	337110	Wood kitchen cabinet and countertop manufacturing, upholstered household furniture manufacturing, nonupholstered wood household furniture manufacturing
		337121	
		337122	
3372	Office furniture (including fixtures) manufacturing (wood only)	337211	Wood office furniture manufacturing, custom architectural woodwork and millwork manufacturing
		337212	

illustration of the magnitude of the problem for each segment. We compiled OSHA data to illustrate that PIT violations are common in many wood-industry segments as seen in this table. For example, for “building material and supplies dealers” PIT violations resulted in the highest number of violations of all OSHA standards that these firms were cited for. PIT violations in the “other wood product manufacturing” segment ranked sixth in terms of most cited violations in 2018 to 2019.

By using OSHA fatality inspection data for the years 2015 to 2019, we found 17 fatalities related to PITs in the

nine industry segments shown in Table 2. There were six fatalities each in segments 3219 (other wood product manufacturing) and 4441 (building material dealers), with four in 4233 (lumber wholesalers) and one in 3211 (sawmill). Thirteen workers were killed when struck or crushed by a forklift; five of those were not operating the forklift. Three victims were killed by objects falling from a forklift, and one fell from a forklift.

There were 211 incidents available in the OSHA severe injury database from January 1, 2015, to December 31, 2019, for the nine industry segments we focused on. Table 3

Table 2.—Wood-related North American Industry Classification System (NAICS) codes by Occupational Safety and Health Administration (OSHA) citations for powered industrial trucks: October 2018 through September 2019.^a

NAICS code	NAICS four-digit industry group	Citations	Inspections	Penalties (US\$)
3219	Other wood product manufacturing	67	50	133,524
4441	Building material and supplies dealers	51	51	168,351
4233	Lumber and other construction materials merchant wholesalers	46	30	130,086
3371	Household and institutional furniture and kitchen cabinet manufacturing	27	16	35,985
3372	Office furniture manufacturing	15	10	31,516
3222	Converted paper product manufacturing	13	13	30,624
3221	Pulp, paper, and paperboard mills	12	7	60,034
3211	Sawmills and wood preservation	10	8	20,669
3212	Veneer, plywood, and engineered wood product manufacturing	9	6	15,382

^a Based on OSHA standard 1910.178 (OSHA [n.d.]).

Table 3.—Severe injuries by North American Industry Classification System (NAICS) codes: 2015 to 2019.

NAICS code	NAICS four-digit industry group	No.	Percentage
4441	Building material and supplies dealers	88	41.7
3219	Other wood product manufacturing	26	12.3
4233	Lumber and other construction materials merchant wholesalers	22	10.4
3222	Converted paper product manufacturing	22	10.4
3211	Sawmills and wood preservation	15	7.1
3371	Household and institutional furniture and kitchen cabinet manufacturing	12	5.7
3221	Pulp, paper, and paperboard mills	12	5.7
3212	Veneer, plywood, and engineered wood product manufacturing	9	4.3
3372	Office furniture manufacturing	5	2.4
	Total	211	100.0

provides a breakdown of these 211 cases, caused by both PITs and pallet jacks, by industry segment. Building material dealers saw the highest number of injuries (41.7% of total), followed by the “other wood manufacturing” segment. The high number of severe injuries for building material dealers reflects the high number of citations and fines as seen in Table 2.

Table 4 provides summary results broken down by injury epidemiology, nature, body parts injured, and event/exposure types for the 211 cases. OIICS numerical codes for nature, part of body, and event/exposure are given in the parenthesis. The BLS uses OIICS to code the case characteristics of injuries, illnesses, and fatalities. The frequency of injuries was spread out evenly across the years, with no clear trend toward fewer incidents. Given that all injuries in this database were categorized as severe, it is not surprising that more than 87 percent of the injured required hospitalization. However, even employees not hospitalized suffered serious injuries such as amputations of fingers, fingertips, and toes.

Fractures were the most prevalent type of injury, followed by nonspecified injuries. The nonspecified category should not be seen as minor injuries since those include serious crushing injuries. The lower extremities (i.e., feet, ankles, legs) were the most vulnerable to serious injury, followed by upper extremities. The narratives provided with each OSHA case illustrate how fingers are often amputated while using a forklift.

The most prevalent injury event type was transportation incidents: “pedestrian vehicle incidents” in which pedestrians were hit by a forklift or other PIT and “nonroadway incidents involving motorized land vehicles,” which essentially means the driver of the motorized PIT was the injured party. These types of injuries often occur when the forklift tips over and the driver falls out or when a forklift falls off a ramp or loading dock.

Pallet jack results

There were 13 severe injuries related to the use of pallet jacks in the results above. Six of the injuries involved amputations or crushing injuries, with three causing fractures. Half of the cases were from a retail or wholesale location. Pallet jack injuries are different than those involving PITs in part because it is nearly impossible to

Table 4.—Summary of severe injury cases.^a

Variables	No. (N = 211)	Percentage ^b
Year		
2015	45	22.3
2016	44	20.9
2017	40	19.0
2018	41	19.4
2019	41	19.4
Hospitalization		
Hospitalized	185	87.7
Nonhospitalized	26	12.3
Nature		
Fractures (111) ^c	92	43.6
Nonspecified injuries and disorders (crushing, soreness, pain, etc.) (197)	52	24.6
Amputation (131)	33	15.6
Others	34	16.1
Part of body		
Lower extremities (5)	90	42.7
Upper extremities (4)	50	23.7
Trunk (3)	27	12.8
Multiple body parts (8)	19	9.0
Head (1)	13	6.2
Others (2,6) and nonclassifiable (9999)	12	5.7
Event/exposure		
Transportation incidents (2)		
Pedestrian vehicle incidents (24)	69	32.7
Nonroadway incidents involving motorized land vehicles (27)	64	30.3
Contact with objects and equipment (6)	46	21.8
Falls, slips, trips (4)	29	13.7
Nonclassifiable (9999)	3	1.4

^a Results include all powered industrial trucks and pallet jacks.

^b Due to rounding, percentages may not always add up to 100 percent.

^c Numbers in parentheses are Occupational Injury and Illness Classification codes.

tip over a pallet jack. Another difference is that there appear to be fewer “pedestrian vehicle incident” injuries; only one of the employees injured by a pallet jack was not using the equipment at the time of injury. Three of the 13 cases involved the employee being injured by an object being moved by the pallet jack.

Discussion

Hazards associated with PITs are greatest for employees in the building material retailer and wholesaler categories. More than half of all severe injuries over this time period were seen at those facilities. Injuries in the various wood and paper manufacturing categories were spread out among the segments, but some segments obviously have very few severe injuries on an annual basis. Because we do not have data on numbers of PITs per industry segment it is impossible to know ratios such as injuries per hour of forklift usage.

Approximately one-third of fatalities were pedestrians being struck by a forklift. The percentage of severe injuries from a pedestrian–vehicle incident was very similar. Eight of the 13 crushed-by or struck-by forklift fatalities were suffered by nondrivers. The report narratives suggest that

most if not all of these fatalities occurred due to no fault of the pedestrian.

OSHA officials believed that as many as 50 percent of severe injuries were not reported by employers as mandated by the 2015 rule, and that the bias is toward smaller companies reporting less (Michaels 2016). This suggests that the actual number of severe injuries could be much higher than seen in our results. If this remains true 5 years after the start of mandated reporting, then the human toll is perhaps up to twice as high as what official data reflect.

Management implications and future research

It would seem that many event types seen in our results should be preventable with small changes to training and/or procedures. Moreover, previous investigations of forklift-related deaths suggest that involved employees were not following OSHA standards or those set by equipment manufacturers (NIOSH 2001). Pedestrians injured by contact with equipment or unit loads often underestimate the danger associated with working near pallet jacks, forklifts, and other PITs.

The simplest recommendation is therefore that all employees should be properly trained and follow safety rules while operating or working around PITs. Only trained and authorized persons should be permitted to operate a PIT or pallet jack. Drivers must be taught to watch for other personnel as well as for objects that could result in a collision. PIT operators must be trained and required to wear a seatbelt; tip-over incidents often result in a fatality or serious crushing injury if the driver falls or jumps out. In summary, employers should know and closely follow the OSHA Powered Industrial Truck standard (CFR 1910.178; OSHA [n.d.]). OSHA recommendations for tasks like moving unit loads into trailers or rail cars or inspecting truck floors to ensure they can support the weight of forklift plus load (Abrams 2018) were designed to reduce incidents and can be a helpful resource for industry.

The high percentage of incidents involving pedestrians suggests there is an apparent need for a focus on better layout planning for retail, warehouse, and manufacturing locations. For example, warehouse facilities should have clearly delineated travel lanes for forklifts with speed limits. Attention should also be paid to items like portable dockboards; these must be secured in place to prevent slippage that could result in injury incidents.

Future research should seek to determine how many severe injuries occur that are not reported to state or federal agencies. In-depth case studies could also be done to allow more fine-tuned analyses of why the most prevalent forklift injuries occur in our industries. Perhaps specific types of incidents occur with more regularity in circumstances unique to certain segments; future research should seek to determine if this in fact occurs and whether prevention efforts could better be tailored to each segment. Near-miss recording and analyses could be helpful in part because by rule they are supposed to force the operator to take refresher training. Finally, it would be interesting to know if incident rates change when using four-way versus two-way pallets.

Our results are somewhat limited in part because they come from secondary data using self-reports from industry participants. The actual number of severe injuries is not known and could be much higher. Also, our analyses did not cover all wood-related industry segments and thus there are likely injuries not captured in our results.

Conclusions

Forklifts and related equipment offer many benefits to supply chains; they increase productivity and also reduce the amount of manual handling of materials that would otherwise be necessary (Horberry et al. 2004). They are, however, a source of accidents at wood-related companies that have a variety of human and financial costs. This article provides the first known analysis of severe PIT-related injuries in wood-based industries since the new OSHA reporting requirement took effect in 2015.

This analysis of severe occupational injuries and fatalities helps provide priorities for prevention measures and points toward areas of future research. Government agencies should put more emphasis on educating managers about reporting requirements and helping industry participants avoid workplace hazards so that serious injuries are averted before they happen. Industry leaders should invest in training, updated equipment, and facility improvements. They should also set safety standards within their facilities and ensure that employees follow them.

While the number of fatalities and injuries tallied over the 5-year period may seem small, it should be noted that minor injuries and near misses are not counted in these figures. It is likely that the number of less severe injuries is much higher. Forklift and pallet mover accidents can be costly both in terms of fines and lost work time, but also in terms of the human costs associated with severe or even minor injuries. Industry leaders should endeavor to reduce the number of PIT-related injuries; many of them appear to be easily preventable with only small changes to behaviors and policies.

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