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ANALYSIS OF THE PROPER FUNCTIONING OF FORKLIFT BRAKES

Abstract: The aim of this paper is to analyze the safety of forklift brakes. The research methodology used to analyze forklift brake safety is presented using the checklist descriptive method. The study was conducted on 127 forklifts with an average age of 15 years, where it was found that about 10% of the forklifts did not have a proper parking brake and that about 2% of the forklifts had defective service brakes. Finally, the results obtained from the research on brake safety have been discussed and further research has been proposed.

Key words: forklift, brake, methodology, research, analysis, checklist.

INTRODUCTION

Packaging is a technological process of putting a box around a product, sealing and marking a product which has been packed [1]. Three types of packaging goods are shown in Figure 1 [2].

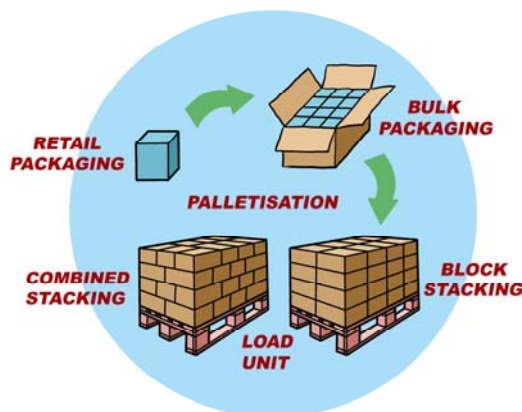


Figure 1. Types of goods packaging
(adapted from Vladić, 2005)

According to [3], after palletization, the product (pallet + cargo) is wrapped with stretch foil. According to [4], it is additionally secured to prevent cargo from being shattered as well as to increase the stability, thus maintaining complete safety during transport, storage and handling.

The technical base of the palletizing system consists of forklifts and pallets [5]. The pallet is a wooden base, made of boards of standard dimensions, to which various types of goods are loaded. This is how a compact and solid pallet unit is being formed. As stated by [6], a pallet without a forklift would be a static unit, like a wagon without a locomotive. The pallet unit is easily and simply transferred and stacked with a forklift.

Forklifts are powered industrial trucks, which are used in warehouses, factory halls, cargo terminals and other

workspaces for handling various types of cargo.

It is a well-known fact that collisions and rollovers are the most common causes of death when working with forklifts. In line with [7], official data released by the OSHA (Occupational Safety and Health Administration) indicate that 96,785 forklift accidents occur in the USA, including 61,800 minor accidents, 34,900 serious accidents and 85 fatal accidents. Comparing the total number of forklifts (855,785) in the US with the total number of occupational injuries, we have found that 11% of forklifts are expected to be involved in minor or major accidents.

The common fatal injuries when operating forklifts are: crushed by tipping vehicle (42%), crushed between a vehicle and a surface (25%), crushed between two vehicles (11%), being struck or run over by a forklift (10%), struck by falling material (8%) and fall from a platform on the forks (4%) [7,8].

Forklift trucks, as self-propelled vehicles used for indoor transport, shall be subjected to periodic inspection and testing not later than three years from the date of the previous inspection and check. A legal entity certified to perform inspection and testing of work equipment, after inspection and check of the forklift truck must provide an expert opinion on forklift safety and prescribed occupational safety measures.

For safe operation of forklifts, it is necessary to examine parking and service brakes, light and sound signaling, the limit switch with a retractable overhead guard, tires, wheels and hydraulic control system. The parking brake must be applied when loading, unloading, lifting and lowering loads to achieve greater stability and to prevent the forklift from tipping over. In case you have to park a lift truck on an incline, it is essential to use the parking brake and secure the forklift against self-propelling forward or backward.

The service (foot) brake is a casual brake designed to slow down and stop the forklift.

RESEARCH METHODOLOGY

DEFINING THE PROBLEM

The problem with the research is the lack of current knowledge about the implementation of protective measures in forklifts, and especially those related to brake malfunction or inefficiency. Based on previous experience, it has been observed that common forklift dysfunction or brake malfunction can significantly increase the potential risk of accidents due to collisions or tipping over. No available research has been found in domestic and foreign literature covering the previously highlighted problem.

RESEARCH OBJECTIVE

The main objective of the research is to determine the percentage of forklifts with defective or inefficient brakes (parking and service brakes) compared to the total number of forklifts analyzed in the company. A specific aim of the study is to determine the causes of parking and service brake malfunctions.

RESEARCH HYPOTHESIS

The assumption is that, within the group of analyzed forklifts, a more pronounced problem would be the failure or inefficiency of the parking brake compared to the service brake.

RESEARCH METHODS

The existing checklists in the Republic of Serbia mostly offer YES / NO answers, with YES being answered for dangerous conditions and NO in other questions, so

there is a problem of transparency. It has been suggested that the newly created checklist should contain answers such as "dangerous", "not relevant" and "safe", which even by a quick inspection can easily and quickly identify the number of dangerous conditions in a given checklist. After completing the checklist, appropriate corrective actions must be proposed if the answer is "dangerous" [9,10]. Based on the daily forklift truck checklist [10,11,12,13] and expert findings for periodic forklift truck inspections, there are additional questions on forklift truck safety in the new checklist. A descriptive method was used to prove or disprove the research hypothesis. An example of a completed checklist for the safety analysis of the front forklift truck is given in Table 1. In this paper, there will be additional comments only for questions 8 and 9, referring to the analysis of parking and service brakes.

RESEARCH SAMPLE

The study involved a sample of 127 forklifts, with an average age of about 15 years. The data on brake safety and functionality were collected and analyzed. The survey was conducted in 46 enterprises in the municipalities of Novi Sad (83 forklifts), Beoġej (25), Temerin (12) and Beoġin (7), with the duration of two months (May-June 2017). Diesel forklift trucks comprised almost 50% (62 trucks), while there were 34 electric and 31 gas-powered forklifts.

Table 1. The analysis of counterbalanced forklift safety (D – dangerous, N/R – not relevant, S – safe)

THE ANALYSIS OF COUNTERBALANCED FORKLIFT SAFETY						30	15.05.2017.
Employer's name and headquarters							
Activity (the area of work)		Metal processing industry					
Type of equipment	Counterbalanced forklift	Drive	Electric				
Manufacturer	Nissan	Production year	2005.				
Type / model	NO 1L 15 HQ	Load capacity in tons	1,5				
No:	The question	Comment	D	N/R	S	Recommended corrective measures	
1.	Overhead Guard / Roll Over Protection Frame	Overhead Guard is in a good state. No visible damage and cracks.					
2.	Access to the driver's seat (3-point contact - steps and grab handles)	There is a handrail on a part of the frame structure. The floor is low - there is no step, but it can be accessed safely. Steps and grab handles are in good condition and clean.					
3.	Load handler (forks or other, fork lock - spring/pin) and telescope	The forks and telescope were not distorted or cracked. The forks are properly positioned, there are fuses with studs for the L/R forks.					
4.	Control mechanisms	Prevention of unauthorized - a key removed from the ignition switch.					
		All control commands are appropriate.					
		The emergency shutdown device is not installed.					
		There is an undamaged sticker with legible command marks.					

5.	Lift assembly (chains, limit switches)	The limit switch is in operation, it automatically stops lifting the forks upon reaching extreme upper position.				
6.	Sound signaling	The forklift is equipped correct sounding siren.				
		Reversing beeper exists and is operational.				
7.	Light signaling	There is a correct rotary light.				
		There is a functional headlight and tail light.				
		There is a proper STOP light.				
		There are flashing lights.				
8.	PARKING BRAKE	The parking brake does not work.				Repair the parking brake
9.	SERVICE BRAKE	The service brake is operational. The forklift stops by pressing the service brake (mechanical brake principle) and release the gas pedal.				
10.	Hydraulic system (hydraulic cylinders, hoses, connections)	The hydraulics for lifting and moving the forks, as well as for changing the slope of the mast, work flawlessly.				
11.	Load capacity chart	There is a graphical representation of the load capacity chart - the metal plate is damaged and the date is unreadable.				Place load capacity chart
12.	General and technical data plate	The metal plate is damaged, but the data is legible.				
13.	Signs - Notification, Warning and Prohibition (Labels)	Labels are legible and not damaged.				
14.	Safety belt	The belt is embedded and is correct.				
15.	Tires and wheels	The solid tires are damaged. It has three wheels, which is in good working order, there no distortion. All nuts secure and in place.				Replace tires.

RESULTS AND DISCUSSION

The research results on forklift brakes safety are given in Table 2. Based on these data, it is evident that the hypothesis was proved. In analyzed forklifts, a more

pronounced problem was the lack of proper parking brake (11.02%) in comparison to the malfunction of service brake (1.57%).

Table 2. Results of the analysis of forklift brakes reliability

		Number of forklifts						
		Municipality of Novi Sad	Municipality of Bečej	Municipality of Temerin	Municipality of Beočin	Total number of forklifts/ answers	Number of negative (dangerous) answers	%
		83	25	12	7			
BRAKES	Parking	10	2	1	1	127	14	11,02
	Service	1	1	0	0		2	1,57

Of the 127 analyzed forklifts, 13 had a defective or inefficient parking brake, while one forklift did not have a parking brake. Two forklifts were found to have a malfunctioning service brake.

Forklifts that have a malfunctioning or inefficient parking and/or service brake become potentially more dangerous for indoor transport, due to the possibility of collisions with stationary objects or workers.

The most common causes of malfunction or inefficiency of the forklift parking brake are malfunctions of the parking brake system and the hand cable cracks. The most common causes of service

brake malfunction are mechanical damage to the cylinder (brake wheel cylinder and master brake cylinder), wear of the brake lining or brake drum, lack of brake oil, and oiled brake lining.

In order to extend the service life of the forklift brakes, it is necessary to check the brakes regularly by an authorized service center, as well as to avoid abrupt braking by the operator/driver. It is proposed to install an electronic speedometer to limit the maximum speed of forklifts used within the plant and the warehouse (limited to 5 km/h) and forklifts used in the outside area of the plant (limited to 10 km/h). The installation of an electronic speedometer enables the simultaneous

reduction of the brake pad length and the brake system wear.

CONCLUSION

A descriptive research, relying on a newly developed checklist for the safety assessment of the observed sample is a significant contribution to obtaining data about the functionality and safety of parking and service brakes.

The objective of this research was achieved through the analysis of brake safety on a selected sample of 127 forklifts, where it was found that 11.02% of the observed forklifts had a problem with malfunction or inefficiency of the parking brake, and that 1.57% of the total number of forklifts had a problem of service brake malfunction.

Further research should be directed towards analyzing the functionality of forklift brakes on a much larger sample. Also, research should be extended to the remaining questions from the new checklist for Forklift Safety Analysis.

Injuries at work, resulting from a forklift collision or overturns, can be prevented with the help of efficient preventive measures. Forklift trucks safety is achieved by investing in forklift maintenance and by organizing professional training for employees. Routine inspections should ensure that a forklift truck has proper parking and service brakes, audible alarms, steering mechanism, and a hydraulic system. In order to reduce the number of work injuries, the forklift driver/handler must take care of the forklift load, the way it is stacked and secured to the load, as well as to avoid sharp aggressive turns, excessive speeds and sudden braking/acceleration.

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Dušan Gavanski was born in Novi Sad, Serbia, in 1973. He is a Professor at the Higher Education Technical School of Professional Studies in Novi Sad, Serbia. He received his BEng and MEng from the Faculty of Technical Sciences, University



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ANALIZA ISPRAVNOSTI KOČNICA KOD VILJUŠKARA

Dušan Gavanski, Azra Korjenic

Rezime: Cilj rada je analiza ispravnosti kočnica kod viljuškara. Prikazana je metodologija istraživanja koja se koristila za analizu ispravnosti kočnica kod viljuškara, i to metodom deskripcije pomoću ček-liste. Istraživanje je sprovedeno na uzorku od 127 viljuškara prosečne starosti 15-tak godina, pri čemu je utvrđeno da na oko 10% viljuškara ne postoji ispravna parkirna kočnica, a na oko 2% viljuškara su neispravne radne kočnice. Na kraju su prodiskutovani dobijeni rezultati istraživanja ispravnosti kočnica kod viljuškara i predložena su dalja istraživanja.

Ključne reči: viljuškar, kočnica, metodologija, istraživanje, analiza, ček-lista.