

ANNALS of Faculty Engineering Hunedoara – International Journal of Engineering

Tome XIV [2016] – Fascicule 4 [November]

ISSN: 1584-2665 [print; online]

ISSN: 1584-2673 [CD-Rom; online]

a free-access multidisciplinary publication
of the Faculty of Engineering Hunedoara



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WORK ACCIDENTS IN THE ELECTRONICS INDUSTRY

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ABSTRACT: The electronics industry is a specific segment among other industries. By the development of science and technology it is conquering more and more space, although public opinion is that, from the point of the evolution of work accidents, people can work by extremely safe conditions at a company manufacturing electronic products. Outside observers may consider the threat factors low, including occupational injury which is very rare and the outcome of minor severity. This article tries to reveal the real situation and present it to the reader.

Keywords: work accident, work accident with loss time, work injuries, type of injury, damage analysis

1. INTRODUCTORY

These days electronics industry is developing rapidly. This is related to the growing proliferation of electronic products in almost every area of life. The large number of electronic manufacturers are employing great number of human labors, while also strive for automation. The factory where we performed the analysis of occupational accidents is a manufacturing plant, which means that electronic products are manufactured according to the customer's requirements in mass production.

2. THE PRODUCTION METHOD

The necessary components are supplied according to the customer's requirements. The components and raw materials are delivered to the warehouse, by air and road freight, with the support of an external transport company. The offloading, which is performed by a forklift, however the company has been responsible for. The components and raw materials to be carried to the production line by manufacturing handcarts and rolling storage racks. At this stage manual loading and manual handling is characteristic. The printed circuit boards and "implant", called panel, soldered tiny electronic components on plastic strips placed equidistant from the strips of plastic parts manufacturer spindles winder. The spindles places it after the pick and place machine operator to the feeder, which is part of the pick and place machine is the implanting turn into a pick and place machine that parts from the conveyor, technologically prepared (solder paste on the surface), printed circuit boards are placed automatically, without human hand intervention. The pick and place machine is also forwarded to the conveyor panels brazing furnace where the brazing takes place panel parts. This process is automatic. Gases and vapors, generated during the soldering stage are removed by the central extraction system. The finished printed circuit boards will be double checked: on the one hand, a so-called automatic optical inspection machine, and on the other hand, the quality inspector - check the finished panel in qualitative terms - by visual inspection. If all is well, the panel will be send to Backend for further use and installation. If the panel for any reason is defected (usually soldering defect), it is taken to one of the colleagues at the repair department, who - if the panel can be improved - fix the problem by manual soldering. The manual soldered stations are also equipped with a central exhaust system.

At the Backend, in the assembly cells, the assemblers (operators) carry out the assembly of products by electric hand tools. After the completion of assembly an operation inspection (test) takes place when the final product functionality, and other electrical parameters are tested and

monitored. In case the product is adequate, packing is to follow, which is made by hand. After collecting packages to the pallet wrapping machine foils it. In this case, pallets are moved by a hydraulic hand forklift machine.

Transportation is handled by a contract company that is operating by his own fleet. Loading is processed through the loading docks carried out by a forklift.

3. WORK ACCIDENTS

An accident is always the “result” of a process. The process is triggered by cause or causes. The reason is the existence or development of the hazard. In this case, the option of the accident is always there to happen, and a root cause, called the direct cause can trigger it at any time. The accident itself can only be avoided by removing the source of danger. The human factor has a crucial role in the development of a hazard, to some extent can be revealed during the investigation of the accident to human error. The human error can happen to the victim part, but also on behalf of another person.[1]

According to the definition of Act XCIII of 1993 on Labor Safety:

- ≡ Accident: an one-time external effect on the human body which occurs irrespective of the will of the injured person, suddenly or within a relatively short time, and causes injury, poisoning or any other (physical or mental) health damage, or death.
- ≡ Workaccident: an accident suffered by an employee in the course of or in connection with organized employment, irrespective of its place and date, and the extent of contributory responsibility of the employee (injured party). [2]

Analyze the conceptual definition of an accident and thought through, it becomes clear that:

1. it is a single, external influences
2. it happens independently of the will of injured person
3. it occur suddenly or during a relatively short time
4. it may cause injury, poisoning or other (physical or mental) health damage or death

The external effect means that the occurrence of certain external risk factors, therefore it is not internal, human body changes are the underlying factors (Internal effects can be a sudden rise in blood pressure, which may result death, but that is not to be considered as an accident). Risk factors may be physical, chemical, biological or psychic.

Nonrecurring does not need to be explained, as on the one hand no injured person intend to repeat the accident. Besides after the investigation of each accident is necessary to take preventive actions. On the other hand, the consequences of the repetitive impact can rather be the sign of a start of disease. The accident occurs independently of the will of the injured. If someone intentionally causes an injury or health damage to himself, it needs to be tested by a psychiatric examination or to be investigated under criminal procedure.

The term of “occurs suddenly or over a relatively short period of time” may be the subject of a debate, especially because the judgement of “the relatively short period of time” can be relative. In this case the expression of “suddenness” means that either the victim or his/her environment did not see the upcoming accident. On the other hand, it also refers to the short duration of timeliness as well.

Let's just think of the duration of a fall from a height which is only a few seconds. If you leave the drop former drag ignored, based on free-fall formula of account of the fall time of the term $t = \sqrt{2s/g}$ square root, where t is time, and the distance (height of fall) g is the acceleration due to gravity. Based on this facts, the period of the fall from a height of 6 meters is 1.2 seconds. That time lag, while saying that one.

The moot question is, what is considered to be a relatively short time. One second, one hour, one day? For us to be able to provide a rational answer to this question, we need to take some technical analysis.

Let us examine a poisoning case. The employee may suffer poisoning by inhaling low level toxic gases for long period of time and as a result of this he suffers health damage. In this case we are talking about development of occupational disease. Besides, it could happen that inhaling the same class, high concentrations gas will cause him pulmonary edema within 20-30 minutes. This health damage is considered to be an accident.[3]

4. STATISTICS OF OCCUPATIONAL INJURIES

During the analysis of the injury factors I have taken into account the criterias of the European Statistics on Accidents at work (ESAW) by choosing criterias according to my own ideas.[4]

I have examined the following criterias

- ≡ Gender of injured person
- ≡ Type of injury
- ≡ Distirbution of injuries by body parts
- ≡ Time of injury(shift)
- ≡ Job activity at the time of accident

I have used five years (2010-2014) of accident statistics to the analyses.

Gender of injured person

Based on the actual figures the assumption, states that women are more vulnerable than men, appears not to be significant. In case of work accidnets with loss time (LTA) and and of the other injuries (Non-LTA) datas are showing that men are “ahead” of women. The following graphs show us ,that having analyzed the work accidents with loss of working days, in the total number of cases 58% are men and 42% are women. About the same percentage we get in case of other injuries. Men: 61%, women 39%. (Figure 1)

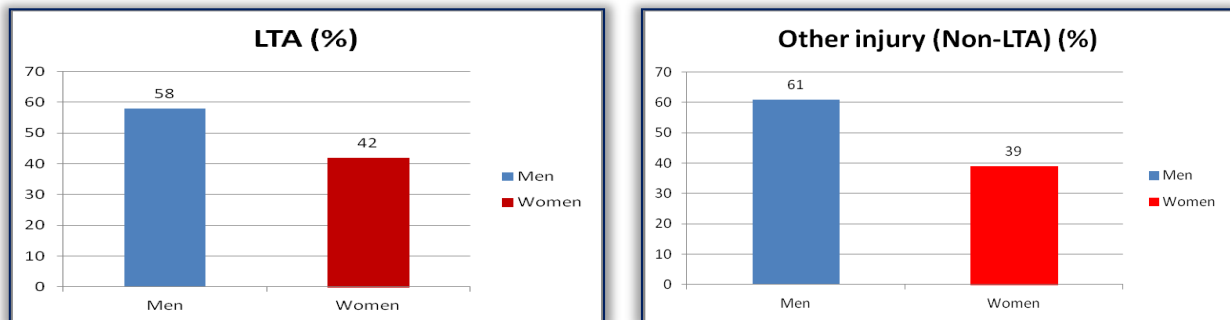


Figure 1. Distribution of injuries by gender of worker

Having examined the reasons there would probably be such opinions as women

- ≡ do easier and safer jobs
- ≡ more careful, more cautious, more attentive and more disciplined than men

Undoubtedly, there is some truth in this reasoning, but this can easily be refuted by the case of the electronics contract manufacturing. On the one hand it is true that there are certain jobs that only men to perform, such as material suppliers who move the necessary ingredients to the warehouse by using a hand truck for delivery to the production lines, so much of the manual handling is also their responsibility. Delivery within the warehouse is carried out by electric forklifts and manual hydraulic forklifts. These are excusively performed by men. On the other hand, in the manufacturing process women fully participate as equal partners. Almost the same numbers of women ,than men, can be found smong machine operators, assemblers, those who do quality inspection or repair and the warehouse staff. We can also take into consideration as part of justice – based on their role within the family and the society – that women are usually more careful, more cautious, more attentive and more disciplined than men.

Type of injury

To analyzee the types of injuries in case of accidents with loss time we can find that injuries are mostly (50%) bruise and the cuts (19.1%) and, sprain injuries (18.2%). In case of other iinjuries withine loss timebruise injuries (35.6%) get the first place, the second goes to cuts (34.3%), the third is to bruises (10.3%). (Figure 2)

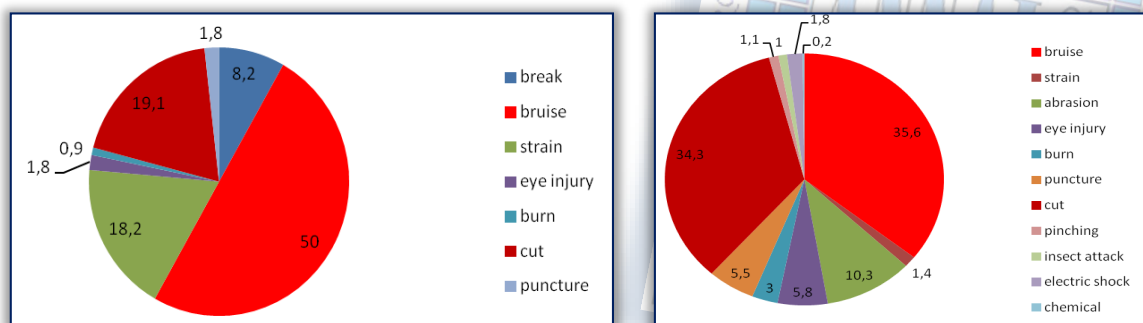


Figure 2. Types (%): a.accidnets with loss time (LTA); b.other injuries

Both diagrams show that bruises and cuts are the most significant of injuries. Bruising type of injuries are usually caused by space limitations, the importance of the time factor (high output

requirements, short breaks during working time) and carelessness have to be mentioned here also. On the one hand lacerations are caused by the workpieces and materials, and secondly (and this is the major part) hand knives, scissors. The hand knives are mainly used by warehouse workers, material suppliers to open cartons and other packages and also to cut into peaces packaging waste cardboard boxes.

Distirbution of injuries by body parts (Figure 3)

The distribution of injuries by body parts is showing clearly the nature of electronic production. In particular, some of the work is characterized by the complete mechanization, as the implantation (soldering) of the components on the printed circuit boards are carried out by a special production line, however, the exploration of manufacturing defects, the assemblage of products, and packing do require almost entirely manual work. The same applies to the in warehouse activities. Typically fork-lift trucks or fork lift hydraulic machines are used for loading from vehicle-to-vehicle. But the material suppliers ship the raw and auxiliary materials on various hand-operated wagons and rolling storage racks. Loading to the wagons, storage racks is done manually.

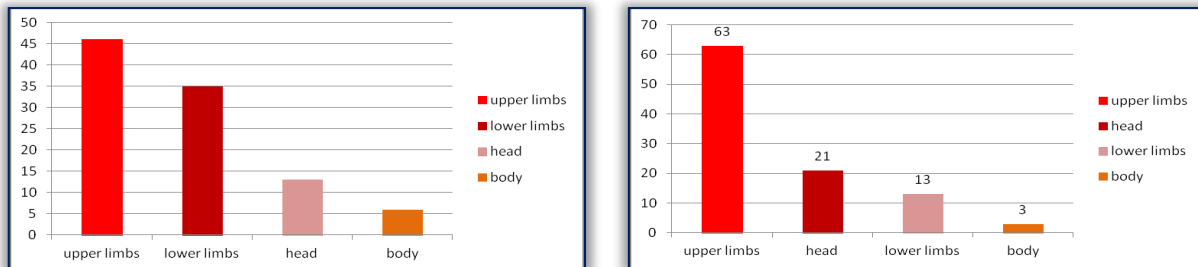


Figure 3. Injured part of body (%): a. accidnets with loss time (LTA); b. other injuries

The manufacturing area is literally trying to utilize every inch of space, so the work, traffic approaching an area of more or less than the lower limit prescribed by law. Due to the limited movement and traffic space there is a significant proportion of the limbs and head injuries. During the manual labor, contusions, bruises and cut injuries are very common, but fracture may also happen.

Time of injury

The electronics factory I have examined are using four shifts. This means that the production is non stop, the plant shuts down only on holidays. A 12-hour work-shift involves a total of 45 minutes break. During the break times workers can relax and refresh him/herself from the monotonous work, dine, smoke or use a restroom.

The four-shift work schedule is as follows: 3 day shift, from 6 am to 18 pm in the evening, followed three days home resting and then three night shifts from 18 am to 6 am next morning. It sounds good at first glance, because three days off comes after three-day working days.

But if you try this, you shortly realize that your body will get tired very quickly, and one must spend the majority of these days by relaxing, otherwise the body will eventually run out of energy. As a consequence of this, the person will not be able to effectively work, paying attention to everything. As a direct consequence of this that workplace injuries are becoming increasingly more likely.

Along EHS professionals it is generally believed that most of the injuries happen close to the start and to the end of the working day. The reason of this because at the beginning of the working day the worker is not able to catch up the rhythm of work; in the morning he/she is still sleepy. As the working time is ending, the person both in spirit and in reality is ready to go home therefore the attention is divided. The accident statistics show

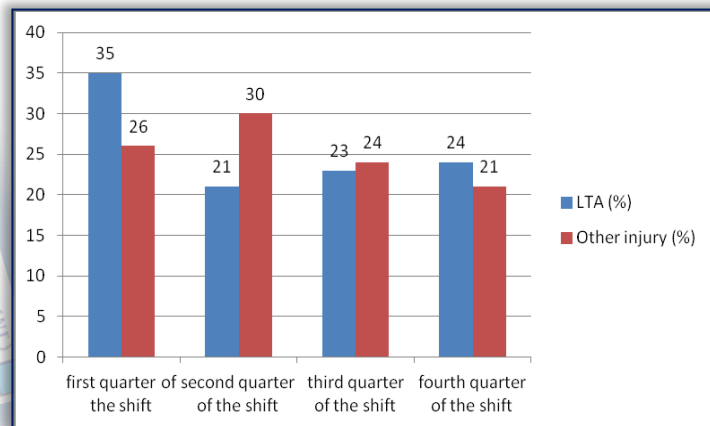


Figure 4. Temporal distribution of injuries (%)

that 35% of the work accidents with loss time (LTA)has occurred in the firs quarter of the shift, 21% in the second, 23% in the third, and 24% in the fourth quarter. In case of other injuries

within loss time (when the injured person continued to work after medical care), these percentages are 26%, 30%, 24% and 21%. (Figure 4)

According to the graph, the majority of work accidents involving loss time occurs in the first quarter of the shift, while the rest of the shift can be considered evenly distributed. This contrasts with the category of other injuries because in this case the initial number increasing in the second quarter comparing to the first quarter of the shift, and further distribution is almost even.

Later on we will deal with this topic, nearly half of those work accidents resulting loss time linked to injuries of pedestrian traffic occur while workers moving out of the dressing room or going to the dressing room or during break time. On the one hand it shows that people are in a hurry arriving and leaving their workplaces; here we can also mention the short breaks. This clearly leads to injury sooner or later.

The increased numbers of cases in the second quarter of the shift, in case of other (non-LTA) injuries, indicates that the number of minor injuries during continuous working increases.

Job activity at the time of accident

Having analysed the accident statistics it can be ascertained that most of the accidents resulting loss time (Figure 5) were suffered by pedestrian traffic (23.9%). This scope includes walking activity directly related to the court, the production area and the corridors. Accidents of pedestrian traffic during the breaks were classified in the “break” category. In the second place we can find the manual handling (17.4%). The third place includes additional work-related activities (ie not directly in connection with the technology). We can mention here the example of hits to objects in the work environment, sudden movements, inattentive and undisciplined work, work equipment failure, etc. It is noteworthy that those work accidents ,occur during break time, causing loss time take 10.1% of this total. They are mainly occurred during pedestrian traffic between the workplace and the dining area, toilet, smoking area and the use of these sites.

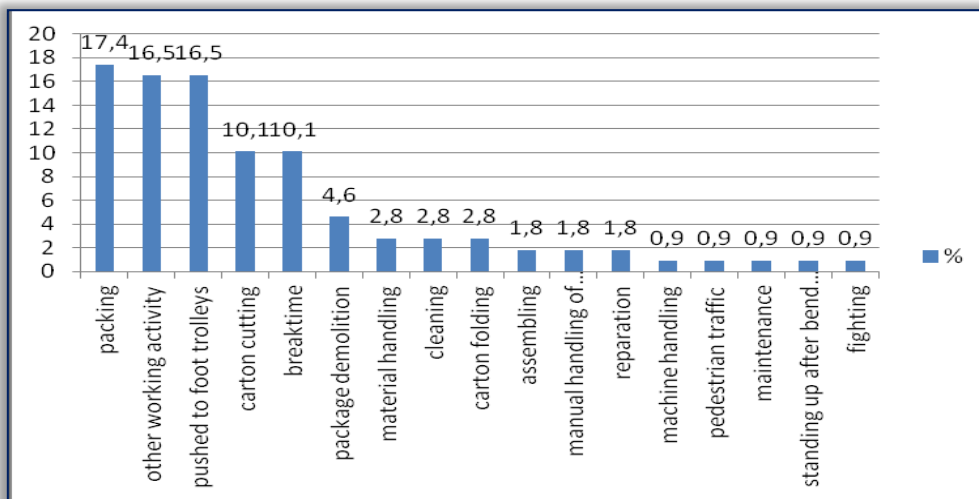


Figure 5. Job activity LTA (%)

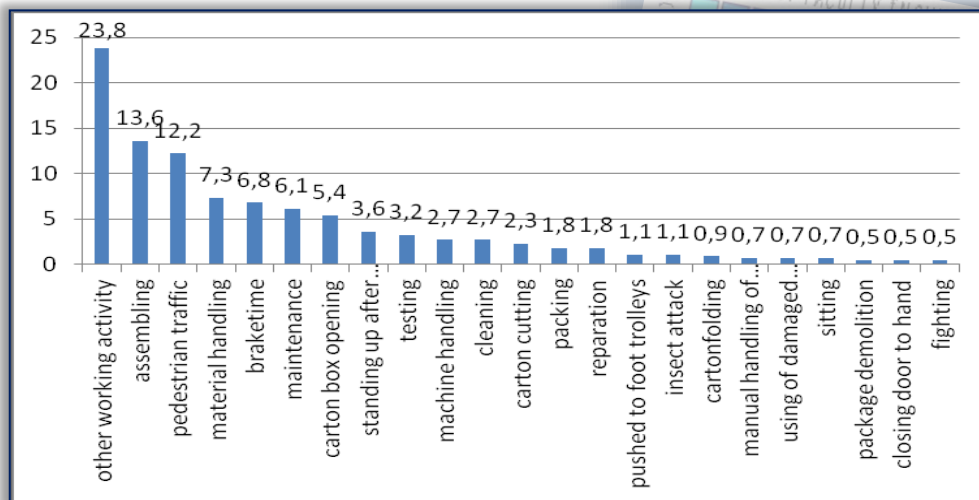


Figure 6. Job activity other injuries (%)

In the case of other injuries (non-LTA) (Figure 6) the main activity, at time of the accident, is the addition work activity that is directly related to the driving task. Second one is assembly, the third one is walking, followed by manual handling.

5. SUMMARY

It is apparent from the analysis described above that as for the electronics industry it was not an accidental classification of occupational activities of the three categories in Annex II category. The increased pace of work, the pressure to perform, the monotony of the long working hours, short breaks during working time, work in crowded areas and enhance all other threats, such as a source of potential accident appearance in the workplace. If we add the employee turnover, we can see that, compared to other industries, despite fancier work environment, unfortunately, there is a potential worker injury to life and limb. The EHS responsibility is to reduce these injuries using security measures and after a careful assessment of workplace risks to a minimum.

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