DOI: https://doi.org/10.53052/9788366249981.20

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REDUKCJA RYZYKA NA ETAPIE PROJEKTOWANIA MASZYN

Streszczenie: Cel zmniejszenia ryzyka może być osiągnięty przez wyeliminowanie zagrożenia lub przez obniżenie każdego z dwóch czynników określających odpowiednie ryzyko, takich jak rozmiar urazu spowodowanego przez dane zagrożenie oraz prawdopodobieństwo wystąpienia urazu, oddzielnie lub jednocześnie.

Słowa kluczowe: maszyny, ryzyko, budowa, bezpieczeństwo

REDUCING RISK IN MACHINERY CONSTRUCTION

Summary: The objective of risk reduction can be accomplished by eliminating the hazard or by lowering each of the two factors that determine the relevant risk, such as the severity of the injury caused by the hazard in question and the likelihood that the injury will occur, separately or simultaneously.

Keywords: machinery, risk, construction, safety

Introduction

The safety of machinery is the most important part of every machine, device and system in modern developed society where some part of it performs mechanical movement. This is a set of measures to prevent contact/collision of the machine during this movement with any part of the human operator.

The issue of ensuring the safety of machines and equipment is not at all simple. It is necessary to deal with it at the beginning of the design of the project/application and then to include it as best as possible right from the beginning in the mechanical construction of the machines. Risks of danger that cannot be removed or suppressed by mechanical elements (machine structure, covers, etc.) must be treated/secured electronically. It is then necessary to point out the residual risk on the labels on the machines and in more detail in the documentation.

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Risk assessment

There is a presumption that the machinery's inherent dangers will eventually result in an accident if no safeguards have been installed on it. The use of machinery, the history of accidents and medical records, the technologies available to reduce risk, and the legal context in which the machinery is to be used must all be understood in order to apply the principles of safe design of machinery. [1]
If technological advancements enable the same machine to be created with less risk, a machine design that may be justifiable today must no longer be valid. It is recommended that a group of individuals carry out the risk assessment, although it may be expected that multiple groups evaluating the same machine may not arrive at the same conclusion. Risk assessment is an individualized process. Figure 1 shows the diagram of the entire risk assessment process. [2]

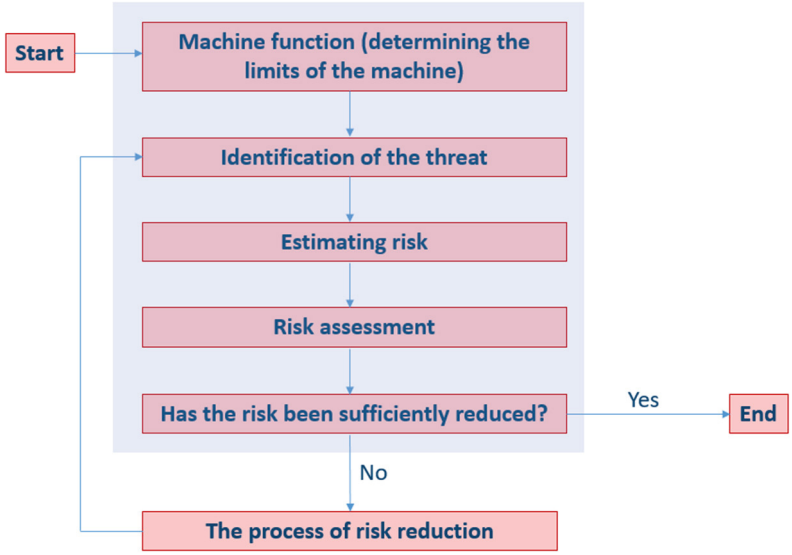

Figure 1. Process of risk assessment of machinery

1. Integrating safety into construction

If the risk assessment has identified the need for further measures to minimise the risk, the so-called 3-step method must be used, where the machine manufacturer is obliged to apply the following principles in the following order when selecting a measure:

1.1. Constructed-in safety precautions

By using the proper design elements of the machine itself and/or by interacting with exposed individuals and the machine, built-in design safety measures eliminate hazards or reduce risks. This is only one stage at which hazards can be eliminated,

thereby removing the need for further protective measures such as safety guards or supplementary protective measures. [3]

1.2. Safety protection and additional protective measures

Suitable safety protection and supplemental protective measures may be employed to reduce the risk, taking into account the foreseeable use and foreseeable abuse, if it is not practical to eliminate the hazard or to reduce its equivalent risk adequately through built-in design precautions. [3]

1.3. Usage information

If risks remain despite built-in design precautions, safety protection and additional protective measures taken, the residual risks must be identified in the information for use. This information shall include, but not be limited to, at least the following:

- working procedures for the use of the machinery appropriate to the expected ability of the operator using the machinery or of other persons who may be exposed to the hazards associated with the machinery,
- recommended safe working practices for the use of the machinery and training requirements described accordingly,
- sufficient information, including warnings of residual risks, for the various phases of the life of the machinery,
- description of any recommended personal protective equipment, including details of how to use it and what training is required to use it.

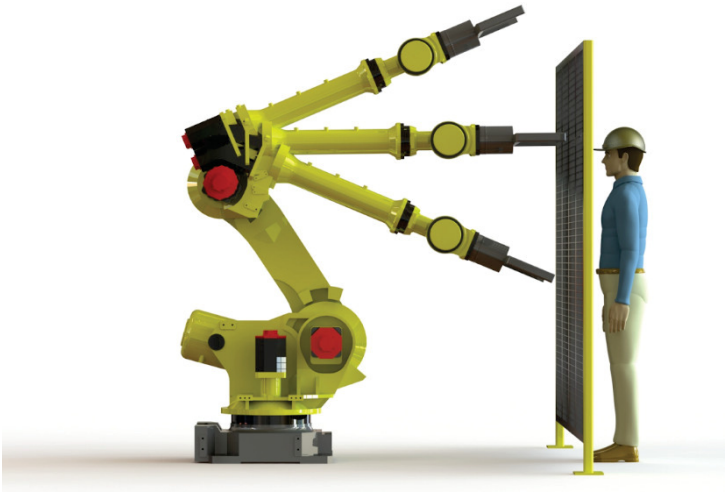

Figure 2. Illustrative security protection [4]

The information for use must not be a substitute for the correct application of built-in construction safety precautions, safety guards or supplementary protection measures. Appropriate safeguards associated with each operating mode and intervention procedures reduce the possibility of the operator, in the event of technical difficulties, to use dangerous technical interventions. [1] [[3]

2. Constructed-in safety precautions

The first and most crucial phase in the risk reduction process is incorporating safety measures into the design itself. This is due to the fact that the machine's intrinsic built-in protections are always effective, but experience has shown that even well-designed safeguards can malfunction or be bypassed and that usage instructions may not always be followed.

By choosing the right design characteristics for the machine itself and/or interactions between exposed people and the machine, built-in design safety measures are achieved by removing dangers or minimizing risks. The safety protection and supplemental protection methods that can be utilized to fulfill the risk reduction goals are described in chapter 6.3 of STN EN ISO 12100 if the built-in design safety measures are not sufficient (three-step process). [5] [6]

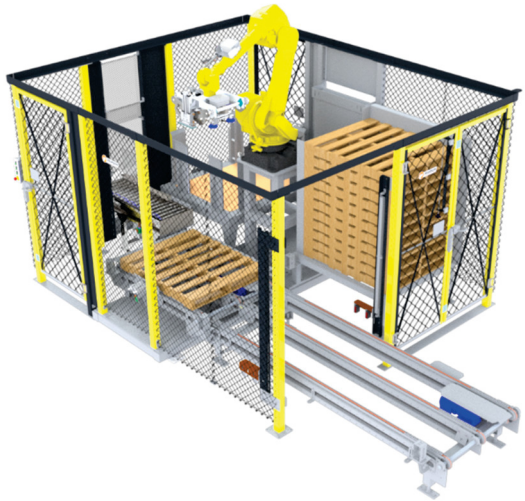

Figure 3. Safe robotic cell [7]

3. Safety protection and additional protective measures

Whenever a built-in design safety precaution hasn't been able to completely remove the risk or significantly minimize the risks, guards and protective devices must be implemented for the protection of people. Other devices, such emergency stop devices, could be utilized as additional safety precautions.

It is possible to prevent exposure to many hazards by using certain safety devices. As an illustration, a fixed guard that serves to lower noise levels and capture hazardous emissions can be utilized to barricade entrance to a space that has mechanical hazards. [5] [6]

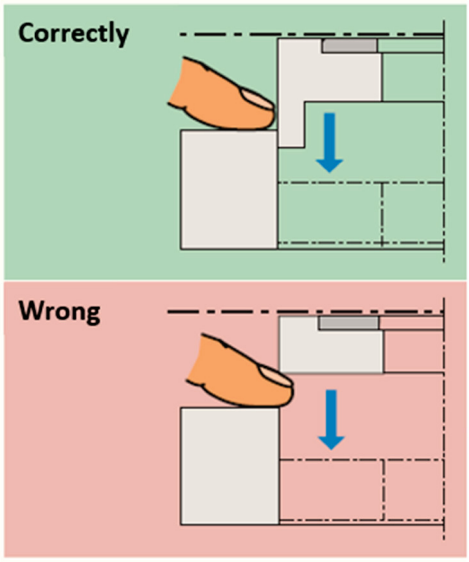

Figure 4. Example of cutting point elimination [1]

4. Usage information

Information design for use is a crucial component of machine design. The information is presented to the user through the use of communication tools like text, words, signs, signals, symbols, or diagrams, either alone or in combination. The usage guidelines are meant for both professional and/or recreational users.

Information on the machine's intended usage must be given to the user, taking into consideration all of its working modes.

All the instructions necessary to ensure the machine is used safely and correctly must be included in the literature. In this regard, it must inform and caution the user of the lingering risk.

The material must specify, as necessary, whether training is necessary, whether personal protective equipment is required, and whether extra guards or protective devices may be required.

It is necessary to warn users of the risks involved in using the machinery in ways other than those suggested in the information for use, especially if misuse is foreseeably occurring. Use of the machinery that can be reasonably expected based on its intended use and description must not be disallowed.

Transport, assembly and installation, commissioning, use of the machine (setting up, learning/programming or changing the process, operating the machine, cleaning, fault-finding and maintenance) and, if necessary, decommissioning, dismantling and disposal must all be covered in the information for use, either separately or in combination. [5] [6] [8]

Conclusion

It is not at all easy to ensure the safety of machinery and equipment. It is essential to address it at the outset of the project/application design and to include it as effectively as possible right from the start of the mechanical building of the machines. Risks of danger that must be handled or guarded electronically since they cannot be eliminated or suppressed by mechanical components (machine structure, coverings, etc.). The residual risk must therefore be described in greater depth in the paperwork and on the labels attached to the equipment.
While the requirements of ensuring safety against electric current are generally understood to be very important, safety against mechanical movements of machines has been quite often neglected for quite a long time, even though it can cause injuries as serious as electric shocks. The behaviour of modern automatic or semi-automatic machinery is not always predictable, because their movement is now usually controlled by the program of the control unit, the structure of which is known only to the manufacturer's programmer. Regardless of unexpected behaviour caused by errors or unresolved error states of the machine control. It is not always possible to use a purely "peasant approach": "When I am careful."

Acknowledgement

This work has been supported by KEGA project No. 009ŽU-4/2022

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