La Sapienza
Università degli Studi di Roma

Safety of Industrial Plants

Lecture 10
Mechanical Risks

Contents and Goals

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Prevention and Protection

The are two types of intervention that can be implemented to safeguard the safety of a workingplace:

Prevention, namely the reduction of the probability of occurrence of the event that can produce damage;

Protection, namely the limitation of the negative effects of a harmful event.

The Risk

- The risk can be expressed as the product of the probability of occurrence of the unfavorable event (the accident), and the magnitude of its consequences. This magnitude, therefore, is closely related to the prince magnitude in Statistics, the probability.

- the probability that the negative event occurs (p);

- the magnitude of its consequences (M);

$$R = p * M$$

The Risk

- **The Risk:**

It is a quantity that has to do with the damages

- ✓ It is a quantity related to non-deterministic phenomena
- ✓ **It is a fuzzy quantity**

The risk factor

- The risk factor or hazard is the objectification of a risk situation.

- For the purposes of identification of risks is helpful to take into account the classifications proposed in literature:
  - **Risks for safety**
  - **Risks for health and environmental hygiene**
  - **Risks of environmental nature**
  - **Risks of organizational and transversal nature (human factors)**

The Risk

Prevention and Protection actions determine a risk reduction

i.e. the shift from a iso-risk curve to another characterized by a lower value of the parameter

- ✓ The intervention of protection reduces the risk of a certain incident, limiting the severity of its consequences.
- ✓ Prevention intervenes by reducing the probability of occurrence of the negative event.

The risk factors

The Identification of risk factors is the first activity of the more general risk analysis, which is represented by:

- **Actions of inspective nature**
- **Actions of designing nature**

✓ systematic and predefined methodologies have to be used, for example:

- **top down**
- **bottom up**

Protections

All the organs of the machines that can generate a potential hazard condition must be protected, both in normal operation and in case of anomaly.

High risk: inaccessibility of the dangerous element
Prevent physically access to dangerous areas

If this is not possible, provide with an emergency stop system

Mechanical risk

1. Come into contact with the machine, or be trapped between the machine and the parts connected to the machine or other fixed structures;

2. Get caught in a machine element;

3. Being struck by the moving parts of the machine or any material projected by the machine.

Machine organs movement

- Rotary movements,
- Alternative movements ,
- Translation movements,
- Oscillator movements

Rotary movements

- Conveying and dragging
- Entanglement
- Entrapment

Fan blades
Pulleys

Rotary movements

- Cutting
- Crushing
- Abrasion

associated damages

Translation and Alternative Movements

- Crushing
- Shearing

Oscillator Movements

- Entrapment
- Entanglement

Pendulum Saw

Protections

- Mechanical
- Electric
- Hydraulic

Aims of Protections

- Never come in contact with organs or dangerous parts of the machine
- Adequate signaling between a maneuver and the subsequent one
- Dangerous parts only with a secured plant
- Faults and defects have not to cause any damage to the operators
- In case of emergency the machine can be put in safety quickly and easily

Types of Protections

- Fixed protections (removable by special keys)
- Assertive protections
  - Starting only with protection on
  - Removing protection only when the machine is off
- Automatic protections
  - Operation after the employee has left
- Spacers
- Adjustable guards
- Interception devices, and block (UNI EN 999)
- Timed blocks

Types of Protections

Locking device - Historical principle (DPR 547/55 Art. 72)

The removable protective devices of the working organs, of the operation areas and other dangerous parts of the machines, when it is technically possible and it is required the elimination a serious and specific risk, they must be provided with a ***locking device*** *connected to the starting and movement control elements of the machine such that:*

a) *prevents the guard from being removed or opened when the machine is running, or causes the machine to stop immediately the removal or the opening of the guard;*
b) *does not allow the machine to be started if the guard is not in the closed position.*

Fixed Protections

- Fixed protections (removable by special keys)

Assertive protections

- Starting only with protection on
- Removing protection when the machine is off

Interception devices

- Infrared barriers

- Optoelectronic barriers

Block devices

- Blocks

- Timed blocks

Control systems

- Positioning
- Identification (e.g. STOP in red color)

  - Management systems
    - Start;
    - Stop;
    - Two-hands control;
    - Man-present Command;
    - Emergency
  - Control systems

Control systems

Maintenance

- The protections must not be removed while in movement
- Machinings when the machine is off
- Visual inspections
- Instrumental checks

The Machinery Directive

89/392 CEE - 91/368 CEE - 93/44 CEE

The new Machinery Directive 2006/42/CE

Published on 09/06/2006, in the Official Journal of the European Union series L 157/24.

Field of Application

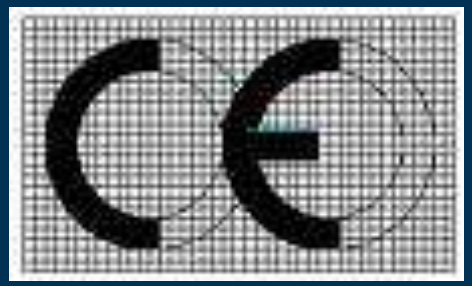
The "Machinery Directive" refers to the machines and their safety components placed on the market in isolation. It replaces Directives 89/392 / EC and 93/44 / EC, for the approximation of the laws of the Member States relating to machinery, as amended by Directives 91/368 / EC and 93/68 / EC

Goals

- The "Machinery Directive" defines the objectives or "essential requirements" in the field of health and safety to be met by the machines and safety components, on the occasion of their manufacture and before they are placed on the market.

EC Marking

- The machines must be in possession, before being placed the market, of the "EC" declaration of conformity and of the "EC" marking of conformity.



Machine

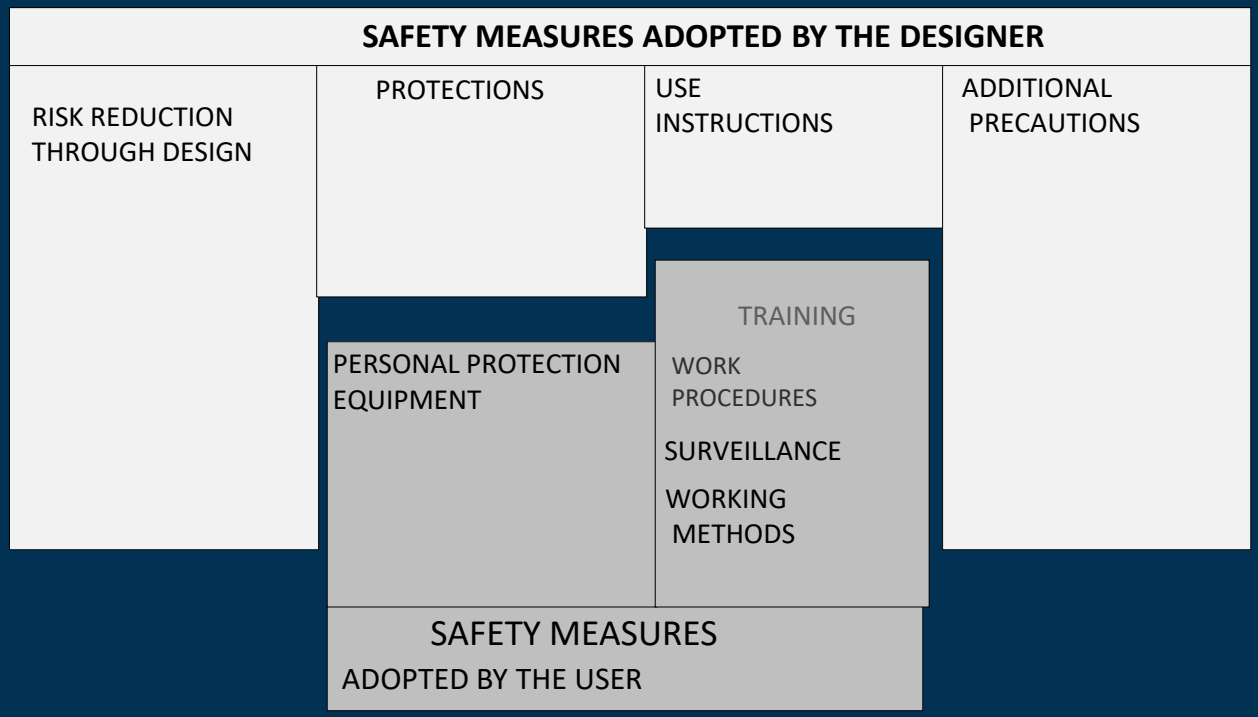
- ***MACHINE*** ***=*** ***set of units connected together, of which at least one mobile, joined together for a specific application***

Essential Safety Requirements

The machines, the elevators and the safety components which comply with the Machinery Directive and the Lifts Directive, or in accordance with the essential safety requirements in them reported, can freely move

Annex I - RES

Safety Integration



SAFETY INTEGRATION:

THE ROLE OF THE DESIGNER AND THE ROLE OF THE USER

The technical file

- Wiring, hydraulic and pneumatic diagrams
- **Risks Analysis**
- The list of applied standards
- The results of the tests and the calculation notes
- The description of the adopted measures
- **The instructions for use**

The Harmonised Standards

- **The harmonised Standards:**
  - they are not mandatory
  - they activate the so-called attivano il cosiddetto "**principle of presumption of conformity**"
  - they reduce the burden of **demonstrating the effectiveness** of the solutions adopted.

The instructions for use

- **the set of media, such as text, words, signs, signals, symbols or diagrams,** used separately or in combination to transfer instructions to the user
- **They have become essential for safety.** They are no longer solely aimed at meeting customer needs in terms of the good use of the machine for production purposes
- **They constitute a complex and important function of prevention and safety**