Machinery Safety and Risk Assessment

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BSH EV ALETLERİ SANAYİ VE TİCARET A.S.
BSH Group:

- 12,6 B € Sales T/O
- 14 Brands
- 56,000 Employees
- 80 Companies in 48 Countries
- 41 Production Facility in Europe, America, Latin America and Asia
- Ca. 3,500 R&D Employees
T-MEA-CIS Region

1. CIS (Russia, Belarus, Kazakhstan, Azerbaidjan), Ukraine, Georgia

2. Turkey

3. Middle East/ Near East (KSA, Iran, Irak, UAE)

4. Africa (Morocco, Algeria, Tunesia, Egypt, Kenia, Nigeria, Ghana, Angola, South Africa)

87 country
1.9 billion population
11 official language
12 time zone
Main Brands in BSH/TR

- **Bosch**
- **Siemens**
- **Gaggenau**
- **Profilo**
100 years ago, what was produced?
How was the production at the beginning of the industry?
How was the production yesterday?
How is the production today? -> Industry 4.0
For Sustainable Development…

from: Pilz-TR
Heinrich H.W Theory

- Fatal accidents
- Loss of limbs accidents
- Minor accidents with lost days
- First-aid accidents without lost day
- Non-Conformities
- Near Miss
- Dangerous Behaviors
- Work Accident
- Near Miss
- Dangerous Situation
- Non-Conformities
- Loss of limbs accidents
- Minor accidents with lost days
- First-aid accidents without lost day
- Near Miss
- Dangerous Behaviors
- Work Accident
- Near Miss
- Dangerous Situation
- Non-Conformities
Responsibilities in case of an accident on the machine

Some of machinery users generally think that;

“There is no user responsibility for new machinery, because of CE”
Responsibilities in case of an accident on the machine

- **Machine Manufacturer Responsibility (2006/42/EC)**
  - Manufacturers transfer responsibility to end-users as explained in their user manual

- **Risk Level of the machine**
  - Risk after revision by enduser
  - Missing Safety Application by manufacturer

- **BSH Responsibility as a machine user**
  - 89/391/EEC Frame Directive
  - Warning signs instruction trainings
  - Personal behavior control and observation against manipulation

**Risk after**

**100% risky**

**100% safe**

**EHSR**

**Residual Risk**
Reason of the accidents and Priorities for safety measures (hierarchy)

- 1. Physical Guards
- 2. Protection Devices
- 3. Personal Protection Equipments
- 4. Prohibits Instructions Trainings Registration
- 5. Observation Penalties

Technical Reason: 10%

90% Misbehavior or Organizational Reason
Safety Retrofit
- Implementation of Safety measures at existing machines

Before

After

from: Pilz-TR
Safety Retrofit

Planned Retrofit Steps

- Risk Assessment
- Safety Concept
- Safety Design
- Safety Implementation
- Safety Validation
EN ISO 12100 - Risk Assessment and Risk Reduction

Safety of machinery and equipment. Principles for safety ensuring while designing
EN ISO 12100 - Risk Assessment

Start

Determination of the limits of the machinery

Hazard identification

Risk estimation

Risk evaluation

Has the risk been adequately reduced?

Risk reduction

No

Yes

End
Determination of the limits of the machinery

Name: Lion
Date of Birthday: 2008-03-12
Size: 3 Meters Long
Weight: 150 Kg
Training: None
Instruction: None
Expected Life: 15 Year
Approach Speed: 55 km/h
Range of movement: 3 km
Raw Material: Meat, Bone

Risk estimation
Risk evaluation
Has the Risk been adequately reduced?

Yes
End

No
Risk reduction

from: Pilz-TR
EN ISO 12100 – Risk Evaluation

1. Determination of the limits of the machinery
2. Hazard identification
3. Risk estimation
4. Risk evaluation

Risk reduction

Has the Risk been adequately reduced?

No

Yes

End

Start

Risk estimation

Risk evaluation

Hazard identification

Determination of the limits of the machinery

from: Pilz-TR

Sharp Teeth
Eat you

Very High Risk

Low risk

Loudly Roar
Deafen you

Sharp Claws
Injure You

High Risk

Parasites
Infect you

Low Risk

End

Has the Risk been adequately reduced?
Risk Reduction Hierarchy

1 – Eliminate

2. Substitute

3 – Engineering Solution

4 – Administration Control

5 – Training

6- Personel Protection Equipment (PPE)

from: Pilz-TR
EN ISO 12100 - Risk Assessment

Start

- Determination of the limits of the machinery
- Hazard identification
- Risk estimation
- Risk evaluation

Risk reduction

- Has the Risk been adequately reduced?
  - No
  - Yes: End

Risk Analysis
Risk Evaluation

Hazard Rating Number system (HRN)

- Preferred Methodology used by BSH Çerkezköy for Risk Estimation
- Numerical values are assigned to the following factors in order to evaluate the risk related with a hazard

\[ HRN = LO \times FE \times DPH \times NP \]

- The likelihood of occurrence (LO)
- The frequency of exposure (FE)
- The degree of possible harm (DPH)
- The number of persons at risk (NP)

The HRN is used to decide if the risk is acceptable or not according to the predetermined acceptable level.

HRN factor goes between 0 and 13500
\[ HRN = \text{LO} \times \text{FE} \times \text{DPH} \times \text{NP} \]

**Likelihood of Occurrence**
- 0.033: Almost impossible
- 1: Highly Unlikely
- 1.5: Unlikely
- 2: Possible
- 5: Even Chance
- 8: Probable
- 10: Likely
- 15: Certain

**Frequency of Exposure**
- 0.5: Annually
- 1: Monthly
- 1.5: Weekly
- 2.5: Daily
- 4: Hourly
- 5: Constantly

**Degree of Possible Harm**
- 0.1: Scratch / Bruise
- 0.5: Laceration / cut / mild ill health effect
- 1: Fracture minor bone – fingers, toes
- 2: Fracture major bone – hand, arm, leg
- 4: Loss of 1 or 2 fingers / toes
- 8: Leg / hand amputation, partial loss of hearing or eye
- 10: Amputation of 2 legs / hands, total loss of hearing / sight in both ears / eyes
- 12: Critical or permanent illness
- 15: Fatality

**Number of Persons at Risk**
- 1: 1-2 persons
- 2: 3-7 persons
- 4: 8-15 persons
- 8: 16-50 persons
- 12: >50 persons
**HRN (Hazard Rating Number)**

<table>
<thead>
<tr>
<th>Key</th>
<th>HRN</th>
<th>Risk</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>0-1</td>
<td><strong>Negligible Risk</strong></td>
<td>Presents no risk to health and safety, no control measures required</td>
</tr>
<tr>
<td>2-5</td>
<td>2-5</td>
<td><strong>Very Low Risk</strong></td>
<td>Presents very little risk to health and safety, no significant control measures required, may necessitate the use of Personal protective equipment and/or training</td>
</tr>
<tr>
<td>6-15</td>
<td>6-15</td>
<td><strong>Low Risk</strong></td>
<td>Risk to health and safety is present, but low. Control measures should be considered.</td>
</tr>
<tr>
<td>16-50</td>
<td>16-50</td>
<td><strong>Significant Risk</strong></td>
<td>The risk associated with the hazard is sufficient to require control measures. These measures shall be implemented at the next suitable opportunity.</td>
</tr>
<tr>
<td>51-100</td>
<td>51-100</td>
<td><strong>High Risk</strong></td>
<td>Potentially dangerous hazards, which require control measures shall be implemented urgently.</td>
</tr>
<tr>
<td>101-500</td>
<td>101-500</td>
<td><strong>Very High Risk</strong></td>
<td>Control measures shall be implemented immediately, corporate management shall be notified.</td>
</tr>
<tr>
<td>501-</td>
<td>501-</td>
<td><strong>Extreme Risk</strong></td>
<td>Control measures shall be implemented immediately. Machine shall be stopped or the specific hazardous task shall not be performed until necessary safety measures are put in place. Corporate management should be notified.</td>
</tr>
</tbody>
</table>
## EN ISO 12100 – Example

<table>
<thead>
<tr>
<th>LO</th>
<th>FE</th>
<th>DPH</th>
<th>NP</th>
<th>HRN</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>160</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>0.5</td>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5</td>
</tr>
</tbody>
</table>

**Risk Assessment Breakdown:**
- **High Risk (HRN)**
- **Low Risk (LR)**
- **Acceptable Risk (AR)**
RA example for Mechanical Presses

- Safety Gate switch
- Emergency Stop Button
- Light Curtain
- Two-hand buttons
RA example for Mechanical Presses
RA example for Mechanical Presses
RA example for Mechanical Presses

EN 692

5.4.2.3 Where the provision is necessary for redundancy and monitoring of the clutch/brake control system, this shall conform to the following requirements:

a) the press shall be fitted with either at least two single valves or a double bodied solenoid operated valve which directly control the fluid to the operated clutch and brake, or the equivalent in the case of other forms of drive;

b) the valve solenoids shall be connected
RA example for Mechanical Presses
Thanks for your listening

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