

MODEL OF INFORMATION ASSURANCE WITH EUROPEAN SAFETY REQUIREMENTS FOR LIFTS

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Abstract

The essential safety requirements for lifts under the Directive 2014/33/EC are analyzed. Their conforming characteristics and norms from harmonized standards are determined. Types of essential requirements and links to harmonized standards are systematized. Basic structural elements of lifts and their corresponding safety requirements from the harmonized standards are determined. Groups of requirements from the harmonized standards are separated. Links and interdependences between structure elements of the lifts and groups of requirements are created as well as the links between systematized essential requirements, structure elements of the lift and norms from harmonized standards are made. Based on the analysis of the essential safety requirements, the separate elements of lifts, harmonized standards and specific norms, the model of information assurance of lifts with European safety requirements is created. That model can be applied in the realization of an expert system for ensuring European safety requirements of lifts.

Keywords - Information assurance, safety of lifts, harmonized standards, European safety requirements.

1 INTRODUCTION

Problems for assurance the European requirements for safety of machines are not yet found their solution in Bulgaria and in the European Union. Based on a detailed analysis and evaluation of the implementation of the European requirements the goals and tasks are defined in [1] to address them. Analysis and systematization of these requirements and safety norms relative to product groups and appropriate formalization in order to incorporate and use the data in the information system is timely and necessary task not only for Bulgaria but also for the European Union. As a result of expert analysis in Directive 2006/42/EC in [2] product groups and related harmonized standards are summarized. To restrict the scope of the research an important for ensuring safety group of lifts is studied. For this purpose it is necessary to analyze the essential safety requirements for lifts according to Directive 2014/33/EU to identify the corresponding requirements of the harmonized standards and the specific norms providing the requirements. Based on the research a model of information assurance of lifts with European safety requirements can be composed to serve as a basis for the implementation of an information system for ensuring European requirements and norms for safety of lifts.

2 ANALYSIS OF ESSENTIAL REQUIREMENTS FOR SAFETY OF LIFTS ACCORDING TO THE DIRECTIVE 2014/33/EU

Directive 2014/33/EU Lifts and safety components for lifts, sets out essential requirements for lifts permanently serving buildings and structures which are intended for the transport of the

people; people and goods; and goods alone, provided that the carrier is easily accessible and is equipped with tools to manage within it [3]. The essential requirements for the lifts are listed in Annex I of [3]. If the risk(s) that are not covered by [3] pursuant to item 1.1. Annex I of [3] the essential requirements of Annex I of Directive 2006/42/EC [4] should be applied. The requirements to the following items are determined in [3]:

- Carrier
- Means of suspension and means of support
- Control of loading (including overspeed)
- Machinery
- Controls
- Risks for persons outside the car
- Risks for persons in the car
- Other risks
- Marking
- Instructions

As in [3] is given only lighting in the cabin; ergonomics in terms of maintenance work and adjustment; danger of falling or ejected objects during installation, maintenance, repair and dismantling; hazards of fire, explosion, noise, vibration and radiation; access to jobs and service locations and more the requirements that should be taken into account by Directive 2006/42/EC refer to [5]: principles for ensuring safety; materials and products; lighting in the engine room; shaft and other special areas.

3 SYSTEMATIZATION OF ESSENTIAL REQUIREMENTS AND CONNECTIONS TO HARMONIZED STANDARDS

Depending on the nature of the drive, the lifts may be divided into electrical and hydraulic. Main harmonized standards for lifts with this drive within the scope of [3] are EN 81-1 Safety rules for the construction and installation of lifts - Part 1: Electric lifts and EN 81-2 Safety rules for the construction and installation of lifts - Part 2: Hydraulic lifts. In addition to these standards the following standards can be applied:

- EN 81-28 (Remote alarm on passenger and goods passenger lifts)
- EN 81-58 (Landing doors fire resistance test)
- EN 81-70 (Accessibility to lifts for persons including persons with disability)
- EN 81-71 (Vandal resistant lifts)
- EN 81-73 (Behaviour of lifts in the event of fire)
- EN 81-77 (Lifts subject to seismic conditions)
- EN 12015 (Electromagnetic compatibility - Emission)
- EN 12016 (Electromagnetic compatibility - Immunity)
- EN 13015 (Rules for maintenance instructions)
- EN ISO 12100 (Risk assessment and risk reduction)

Initial research covers only electric elevators. Harmonized standards relevant to the essential requirements for electric lifts are analyzed and norms from the specific standard corresponding to the requirements are systematized. Extract from the results of the research are shown in Table 1.

Tabl. 1

| Directive 2014/33/EC Essential requirements | Harmonized standard | Norm of the harmonized standard |
|---|-----------------------|--|
| Annex I, 1.2. Carrier | EN 81-1:1998+A3:2009 | 8.2.1., 8.2., 8.1.2., 8.1.1., 8.1., 8.2.2., 8.2.3., 8.4., 8.4.1., 8.4.2., 8.4.3., 8.5., 8.13., 8.13.1., 8.13.2., 8.13.5. 8.13.6., 8.14., 8.15. |
| | EN 81-70:2004 | 5.2., 5.2.1., 5.2.3., 5.3.1., 6. |
| | EN 81-71:2005+A1:2007 | 5.4., 5.4.1., 5.4.1.1., 5.4.1.2. |

| | | |
|---|-----------------------|--|
| | | 5.4.1.3., 5.4.1.4., 5.4.1.5. 5.4.1.6., 5.4.1.7., 5.4.1.8. 5.4.1.9. |
| Annex I, 1.3. Means of suspension and means of support | EN 81-1:1998+A3:2009 | 9.1., 9.1.1., 9.1.2., 9.1.3., 9.1.4., 9.2., 9.2.1., 9.2.2., 9.2.3., 9.2.3.1., 9.2.3.2., 9.2.4., 9.2.5., 9.3., 9.4., 9.4.1., 9.4.2., 9.4.3., 9.4.4., 9.5., 9.5.1, 9.5.1.1., 9.5.1.2. 9.5.2., 9.5.3., 9.5.4., 9.6., 9.6.1., 9.6.2., 9.7., 9.7.1., 9.7.2. |
| Annex I, 1.4. Control of loading (including overspeed) | | |
| Annex I, 1.4.1. | EN 81-1:1998+A3:2009 | 14.2.5., 4.2.5.1., 14.2.5.2., 14.2.5.3. |
| Annex I, 1.4.2. | EN 81-1:1998+A3:2009 | 9.9., 9.9.1., 9.9.2., 9.9.3., 9.9.4., 9.9.5., 9.9.6., 9.9.6.1. 9.9.6.2., 9.9.6.3., 9.9.6.4. 9.9.6.5., 9.9.6.6., 9.9.6.7. 9.9.7., 9.9.8., 9.9.8.1., 9.9.8.2., 9.9.8.3., 9.9.9., 9.9.10., 9.9.11., 9.9.11.1., 9.9.11.3., 9.9.12. |
| Annex I, т. 1.4.3. | EN 81-1:1998+A3:2009 | 12.8., 12.8.1., 12.8.2., 12.8.3., 12.8.4., 12.8.5. |
| Annex I, 1.4.4. | EN 81-1:1998+A3:2009 | 9.2.1., 9.2.2., 9.2.3., 9.2.3.1., 9.7., 9.7.1. |
| Annex I, 1.5. Machinery | | |
| Annex I, 1.5.1. | EN 81-1:1998+A3:2009 | 6.5.2.2., 6.5.2.1., 6.5.2., 6.5.1., 6.5., 6.4.1.2., 6.4.1.1., 6.4.1., 6.4., 6.1., 6., 12.1., 12. |
| Annex I, 1.5.2. | EN 81-1:1998+A3:2009 | 6.7.1.3.3., 6.7. d), 6.4.7.2., 6.3.4.3., 6.3., 15.4., 15.4.1., 15.5., 15.5.1. |
| | EN 81-71:2005+A1:2007 | 5.2., 5.2.1., 5.2.2., 5.2.3., 5.2.4., 5.2.5., 5.2.6., 5.2.7. |
| ... | ... | ... |
| ... | ... | ... |

Summary results of the research can be represented by the scheme shown in Fig. 1:

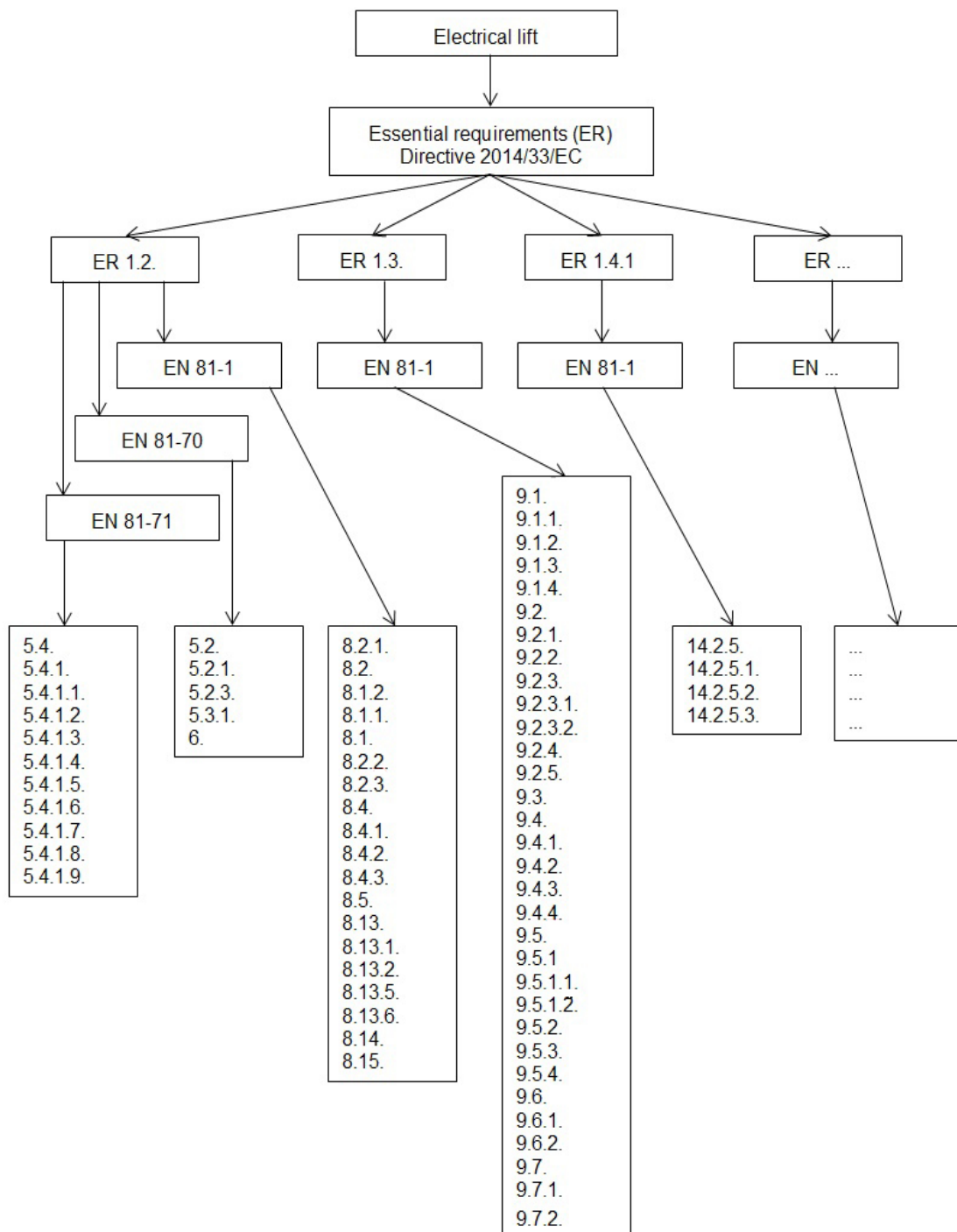


Fig.1 Scheme of the connections between the essential requirements of Directive 2014/33/EU and norms from corresponding harmonized standards relating to electric elevators

4 COMPONENTS OF THE LIFT AND THEIR RELATIONSHIP WITH THE ESSENTIAL REQUIREMENTS

By performing analysis:

essential requirement → harmonized standard → norm from harmonized standard
 can be identified and classified the components of lift, the corresponding essential requirements and norms from the relevant harmonized standard. Fig. 2 presents a diagram depicting the

relationship between the components of the lift, the essential requirements and harmonized standards.

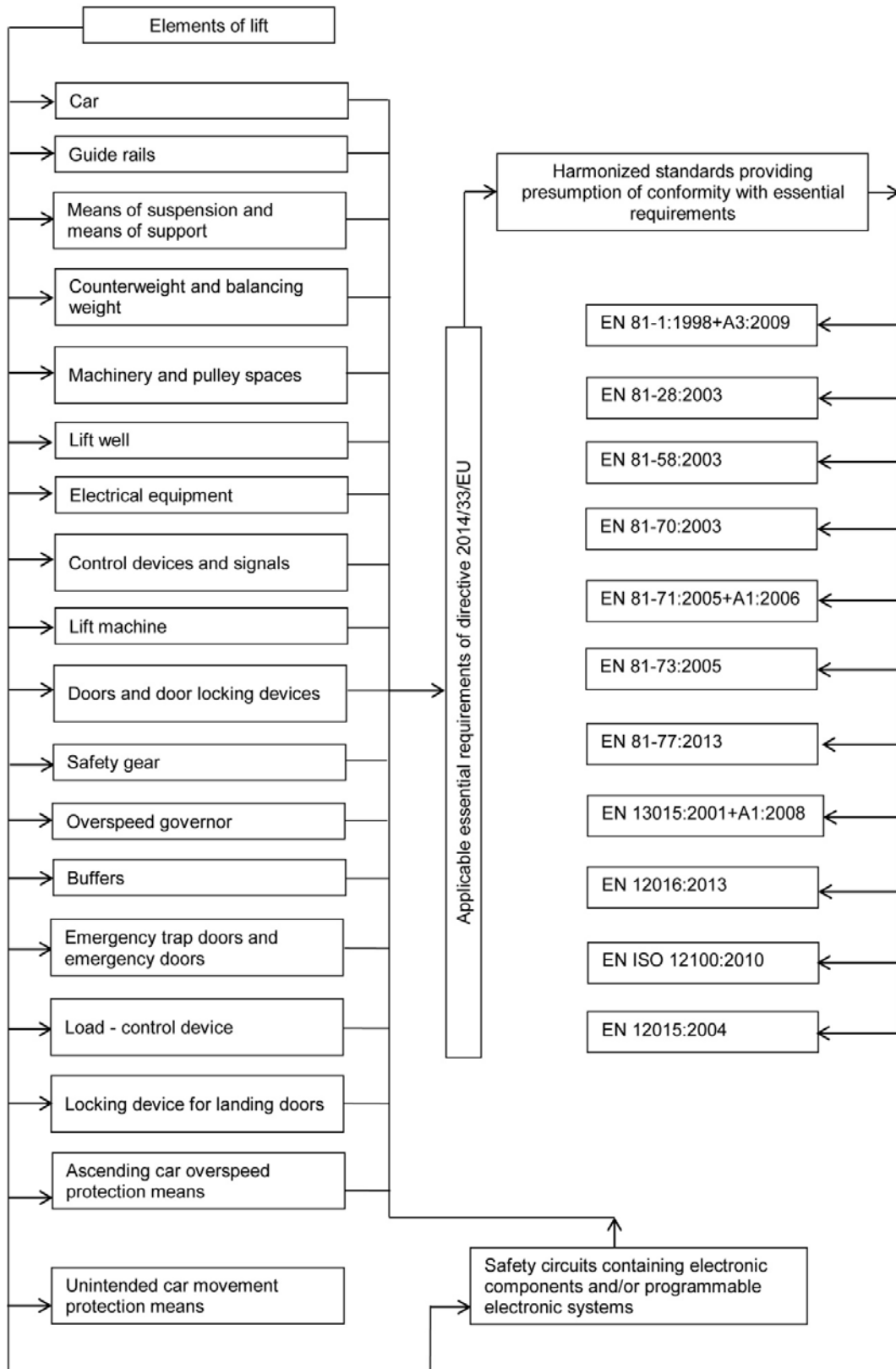


Fig. 2 Components of the lift and their relationship with the essential requirements

5 MODELS FOR INFORMATION ENSURING LIFTS WITH THE EUROPEAN REQUIREMENTS FOR SAFETY

The analyzes of the essential requirements for safety of lifts according to Directive 2014/33/EU and systematizing of essential requirements, connections to harmonized standards and their norms relative to the components of the lift, give a reason to propose a formalized definition of requirements and norms for safety of lifts. The main steps of the process of formalization are:

- 1) determination of directives covering the product;
- 2) analysis of the essential requirements of the directives and links to essential requirements of other directives;
- 3) determination of the components of the lift, to which there are safety requirements;
- 4) systematization of the essential requirements of the directives and referring to the components of the lift;
- 5) review and analysis of harmonized standards referred to the essential requirements of the directive and to the components of the lift;
- 6) determine the norms of the harmonized standards relating to the essential requirements of the directive and to the components of the lift;
- 7) summarize of the analyzed and systematic information and making connections between the essential requirements and/or components of lifts, harmonized standards, norms of harmonized standards.

Based on these steps for the formalization a model of information assurance of lifts with European safety requirements can be established. The model for the directive 2014/33/EU is as follows:

$$SL = \{ER, S(SN)\} \quad (1)$$

where,

SL are safety requirements for lift under the directive 2014/33/EU, presented by the set of essential requirements and norms from harmonized standards;

ER = {ER_i} (i=1÷n) is set of n essential requirements of the directive 2014/33/EU;

S(SN) = {S_k(SN_i)} (k=1÷p), (j=1÷q) is set of p harmonized standards with q number of norms for safety

The model can be represented by the components of the lift:

$$SL = \{LE, (ER, SN(S))\} \quad (2)$$

where,

SL are safety requirements for lift under the directive 2014/33/EU, presented by the set of components of the lift, essential requirements of the directive 2014/33/EU and norms from harmonized standards;

LE = {LE_i} (i=1÷m) is set of m components of the lift;

ER = {ER_j} (j=1÷n) is set of essential requirements of the directive 2014/33/EU;

SN(S) = {SN_k(S_l)} (k=1÷p), (l_j=1÷q) is set of p norms from q harmonized standards SL.

6 CONCLUSIONS

Based on the analysis and systematization of requirements and safety norms of lifts a model of information assurance of lifts with European safety requirements is composed. The results obtained allow the proposed model to be applied to implementation and use of data in an information system that is timely and necessary task not only for Bulgaria but also for the European Union.

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In the reference list, use the alphabetical order as proposed herein:

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