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Research paper

ANALYSIS AND COMPARISON OF INFORMATION ON LOAD LIFTING EQUIPMENT - ELECTRIC CRANES

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Abstract

Lifting equipment must be in accordance with safety standards that require conditions or the adoption or use of one or more practices, means, methods, operations, or processes that are necessary or appropriate to ensure safe and healthy workplaces. As a result, to guarantee the free flow of technical products, the European Commission proposed to the Council a new regulatory technique that includes: (1) a New approach to product regulation and (2) a Global approach to product conformity assessment. Three fundamentally new principles were introduced by approval of a new regulatory: (1) Standardization as support for legislation, (2) New type of directive, (3) Presentation of the conformity assessment policy. As part of the standards and directives, mandatory labeling of products with the CE mark (Conformité Européene) is introduced, which indicates that the product meets the requirements specified in EU directives and will not endanger the health or safety of users. All machines and devices that are placed on the territory of the EU/Republic of Serbia must have written warnings and information in a language that the user of the machine understands. Also, all information for operating the machine must be unambiguous, easy to understand, and must not be too extensive, so as not to overload the operator. The machine must contain all the necessary information relevant to its type and use. This research aims to show the significance of CE marking and the importance of machine information, where by choosing electric cranes as an example, the comparative analysis of manufacturers' manuals will be conducted. This will enable the identification of advantages and disadvantages and space for improvement of the given instructions and how much those instructions are by the general principles and content prescribed within the Directive on Machinery 2006/42/EC and the Machinery Safety Regulation.

Key words: *CE mark, Information, Electric Crane, Manufacturer Manual*

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1. INTRODUCTION

All lifting equipment must comply with safety standards that require conditions or the adoption or use of one or more practices, means, methods, operations, or processes that are necessary or appropriate to ensure safe and healthy workplaces [1]. Standards prescribe requirements that must be met to ensure that a particular product or activity is safe and secure, i.e. not dangerous [2].

Until 1985, the policy of the European Union (EU) was reflected in the removal of technical barriers through the harmonization of technical production specifications, which led to the introduction of many special measures whose content was largely related to the technical aspect, of fulfilling the special requirements for each product category. However, due to the excessive content of technical regulations, which are unsuitable for application due to the necessity of adapting the legislation to technical progress, this approach was increasingly difficult to maintain and develop. For this reason, and to ensure the free flow of technical products, on January 3, 1985, the Commission proposed to the Council a new regulatory technique that includes: a New approach to product regulation and a Global approach to product conformity assessment. By adopting the proposal by the Council, this resolution introduced three fundamentally new principles:

- Standardization as support for legislation;
- A new type of directive;
- Presentation of the conformity assessment policy [3].

The basis of the New Approach legislation is legal acts in the form of New Approach directives, which define essential health and safety requirements for products that can affect the health and life of people and domestic animals, as well as the interests of consumers and environmental protection. If a certain product complies with the requirements of the directive, it will have free access to the EU market. Each directive of the New Approach is accompanied by certain harmonized standards, which define all other requirements for products, to fulfill the basic requirements of the directives. The global approach to conformity assessment was adopted in December 1989 and provides conformity assessment through the institution of an independent "authorized body", which is authorized to carry out the conformity assessment procedure. This novelty was adopted to complete the New Approach so that harmonized methods for conformity assessment, and marking, as well as the adoption of a single doctrine for their implementation, would support the directives [4].

Another significant aspect of the "New Approach" directives [5] is reflected in the provision of a declaration of conformity, but also placing the CE mark (Conformité Européene) on the product as proof of conformity – where the product meets the requirements specified in EU directives and will not endanger the health or safety of users. The European legislation on CE marking is limited to the basic legal requirements written in the directives for large groups of products (eg toys or machines), and is an obligation for every manufacturer who places a product on the European market. The specific CE requirements take precedence over the general provisions set out in the General Product Safety Directive. The European Commission defines the general requirements that products must meet when they are placed on the European market within the framework of CE directives. These harmonized standards (at the European level) replaced various national laws and enabled the free movement of products within the Community, taking into

account safety requirements of general interest. This positive integration ensures that national requirements are harmonized with European laws [4].

Characteristic of the legislation of the New Approach is also ensuring the safety of European citizens from unsafe products and associated risks. The New Approach aims to protect public goals related to the safety and health of product users, but also to draw attention to potential hazards [6]. This increases consumer confidence in new products bearing the CE mark, which will lead to an increased volume of product purchases, but also more cost-effective development of new products and increased innovativeness of manufacturers [7]. On the other hand, market surveillance authorities have the right to withdraw unsafe products from the European market and the obligation to provide information on risks and unsafe products [6].

This research aims to show the significance of CE marking and the importance of machine information, where by choosing electric cranes as an example, the comparative analysis of manufacturers' manuals will be conducted. This will enable the identification of advantages and disadvantages and space for improvement of the given instructions and how much those instructions are by the general principles and content prescrtibed within the Directive and national regulations [8, 9]

2. CE MARKING

The CE marking symbolizes compliance with all the manufacturer's obligations relating to the product and the mark is not intended to be used for commercial purposes. Compliance is not only limited to essential requirements related to safety but also to general health and consumer protection. The CE marking is the only marking that certifies that products comply with directives based on a global approach. The CE mark is placed on a product that meets safety standards, which apply in all EU countries, and is designed to facilitate the free movement of goods within the EU [10].

Products that do not bear the CE mark and do not comply with the directives may be prohibited from sale or excluded from the European market. If non-conformities are found, or damages or injuries caused by the product occur, the company-manufacturer or anyone else responsible for selling the product on the European market may bear personal responsibility, that is, they may be prosecuted. The CE mark indicates that the manufacturer has adapted to the requirements of EU legislation and, accordingly, he can sell his products freely within the EU, without further modifications or testing. The CE mark is not a quality mark and does not show compliance with the standard, but rather compliance with the essential legal requirements of EU directives [3, 4, 10].

By placing the CE mark on the product, the EC declaration of the legal or natural person who placed the CE mark or is responsible for its placement, guarantees that the product is adapted to all applicable provisions of the EU directives and that it has been subject to appropriate conformity assessment procedures [4, 10].

All directives of the New Approach provide for the placement of the CE mark, however, in justified cases, the Full Harmonization Directive, which follows the provision 93/465/EEC, may provide for marking with another mark instead of the CE mark. Before placing the product on the market and putting it into operation, the manufacturer must place the CE mark on the product, unless other directives require otherwise. The obligation to place the

CE mark applies to all products covered by the directives, which are intended for the EU, which includes the following products:

- to all new products, manufactured in EU member states or third countries,
- on all used products imported from third countries,
- substantially modified products, which are subject to directives as new products.

Until the conformity assessment procedure is completed, the CE mark cannot be affixed. This is done to ensure that the product is in compliance with all provisions of the relevant directives. CE marking is usually done at the end of the production phase [3].

The CE mark is placed by the manufacturer or an authorized EU representative, directly on the product or on the data plate, although it can also be placed on the packaging or accompanying documentation. When installing, it is necessary to fulfill the requirement for visibility, that is, that it is easily accessible, legible, and indelible, so that it cannot be removed under normal circumstances without leaving visible traces. The minimum height of the sign should be 5 mm [4, 10].

The CE mark can be placed at any other stage of production if it is an inseparable part of the product or its component and if this is justified due to technical or other reasons (for example, the impossibility of meeting the minimum dimensions of the CE mark). In such cases and if the mark is placed on the packaging or accompanying documents, the manufacturer or the authorized body must equally verify the conformity of the product in the production control phase. It is forbidden to omit the CE mark from the product, or to move it to the packaging and accompanying documentation for aesthetic reasons Depending on the applied conformity assessment procedures, the authorized body may be involved in the design phase, the production phase, or in both phases, and the identification number of the authorized body will follow after the CE mark, if the authorized body is involved in the production phase [3]. After the conformity assessment, the notified body issues a certificate of conformity and based on it, an EC declaration of conformity is drawn up, based on which the CE marking is carried out. The last step is placing, that is, marking the product with the CE mark, which must have the shape and dimensions prescribed in the directive and be placed so that it is visible, legible, and indelible. The CE certificate [8, 9] must contain:

- name and address of the certification body,
- name and address of the manufacturer/authorized representative in the EU,
- product description,
- terms with which the product agrees.

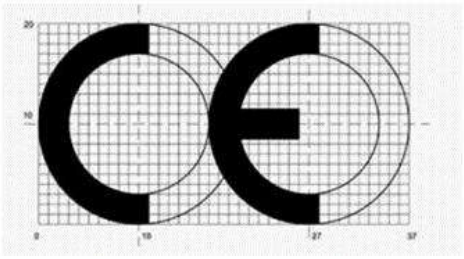

Figure 1. CE mark, source: https://www.paragraf.rs/propisi/t03_0168_s001.gif

3. IMPORTANCE OF MACHINE INFORMATION

According to the Directive and the national regulations [8, 9] information and warnings on the machine must be easily understandable, in the form of symbols or pictograms. All machines and devices that are placed on the territory of the EU/Republic of Serbia (RS) must have written warnings and information in a language that the user of the machine understands. Also, all information for operating the machine must be unambiguous, easy to understand, and must not be too extensive, so as not to overload the operator. Information devices, such as displays and other interactive means of communication between the operator and the machine, must be easy to understand and easy to use.

The machine must be equipped with sound and/or light signaling as a warning in the event that a failure of the machine, which is not under supervision, may endanger the safety and health of persons. Such devices must be unambiguous, and easily visible, and the operator must be provided with auxiliary equipment for checking the operation of the warning device. Warning devices must comply with the requirements of the regulations governing colors and safety signals [8, 9].

Every machine manufacturer is obliged to provide the necessary warnings about the remaining risks, including warning devices for such risks, when the design of the machine, safety protection, and appropriate supplementary protection measures do not eliminate all risks.

The machine must contain all the necessary information relevant to its type and use. The Directive and the national regulations [8, 9] mandate that each machine must be visibly, legibly, and indelibly marked with the following information:

- business name - the name and full address of the manufacturer's headquarters and, when applicable, the address of his representative;
- the marking of the machine;
- sign of compliance;
- series or type designation;
- serial number, if any;
- the actual year of production (ie the year when the production process was completed).

For machines intended for work and use in potentially explosive atmospheres, it is necessary to have the corresponding mark - "Ex" indicating the type of protection applied (eg Ex_D - for an explosion-proof device with impenetrable armor, Ex_E - for an explosion-proof device with increased security). If a part of the machine is handled using lifting equipment, the mass of that part must be marked legibly, unambiguously, and indelibly.

3.1 General principles and contents of the instructions

Every machine that is put on the market/put into use on the territory of the EU/RS must contain with it the original instructions of the manufacturer/its representative in the Serbian language with the indication "original instruction" or a translation of that instruction into the Serbian language with the indication "translation of the original instructions" together with the original instructions in the language of the manufacturer/its representative if the machine is imported into the territory of the Republic of Serbia.

The manual for the machine is drawn up by the manufacturer, and the translation of the manual is provided by the manufacturer/its representative or the importer. On the other hand, maintenance instructions intended for specialized personnel who are foreign nationals, employed by the manufacturer or its representative, may be written in one of the official languages of the EU member states.

The Directive and the national regulations also prescribe the necessary elements of the instructions for use, which must contain the following information:

- Business name, that is, the name and full address of the seat of the manufacturer and his representatives;
- The marking of the machine, which is indicated on the machine itself, except for the serial number;
- Declaration of conformity or other document containing data from the declaration of conformity where the characteristics of the machine are specified, except for the serial number and signature of the person who made the declaration of conformity;
- General description of the machine;
- Drawings, diagrams, descriptions, and explanations required for use, maintenance, and repairing the machine, as well as checking its correct functioning;
- Description of the workstation assumed to be occupied by the operators;
- Description of the intended use of the machine;
- Warnings regarding unauthorized use of the machine, which have been shown as possible based on experiences;
- Installation, installation and connection instructions, including drawings, diagrams, and means of attachment, as well as determining the base or installation to which it is attached the machine must set;
- Instructions related to the installation and assembly of the machine, to reduce noise or vibration;
- Instructions for commissioning and use of the machine and, if necessary, training instructions for handlers;
- Information on the remaining risks and in addition to the measures foreseen in the machine project, security protection and appropriate supplementary protection measures;
- Instructions on safety measures to be taken by the user, including, when appropriate, provision of personal protective equipment;
- Essential features of tools that can be placed on the machine;
- Conditions under which the machine meets the stability requirements during use, transportation, assembly, disassembly, when it is not in use, during testing, or for the time of foreseeable breakdowns, failures, or damages;
- Instructions for ensuring safe transportation, handling, and storage, with the indication of the mass of the machine and its different parts, when they are usually used and transported separately;
- Procedure in the event of an accident, breakdown, or damage, in the event of blocking, as and the procedure that enables safe unblocking of the equipment;

- Description of setup and maintenance procedures that must be performed by the user, as well as preventive maintenance measures to be taken into account;
- Instructions for safe setup and maintenance, including safeguards that should be undertaken during those procedures;
- Specifications of spare parts to be used when affecting health operator safety;
- Information on values of air-borne emissions,
- Information for the operator and exposed persons regarding the emission of radiation, when there is a probability that the machine will emit non-ionizing radiation that may cause harm to persons, especially persons with active or passive medical aids, information related to the radiation emitted for the operator and exposed persons [8, 9].

4. COMPARATIVE ANALYSIS OF INSTRUCTIONS

When a comparative analysis of instructions for electric cranes from different manufacturers - ISKRA, WOMAX, WORKSHOP, VILLAGER, STAR LIFTKET [11-15] is performed, with each other and with the content of the instructions [8, 9], significant advantages and disadvantages are recognized, based on which suggestions for improvement are given, which are shown in Table 1.

Table 1. Comparative analysis of electric hoist instructions

ELECTRIC CRANE	CONTENTS OF THE INSTRUCTIONS	
	ADVANTAGES	SUGGESTIONS FOR IMPROVEMENT
ISKRA Models: EV-125-250, EV 200-400, EV 250-250, EV 300-600	The sentences are short, clearly formulated, and concise, do not tire the user while reading, and the necessary information can be easily found	Reorganizing the content, more visual sketches, diagrams, and pictures are needed for a better understanding of the content A table with common failures, causes of those failures, and measures in case of failure is missing The section related to responsible behavior towards the environment, i.e. dealing with the product after the end of the device's working life, is missing Declaration of conformity is missing
WOMAX Models: W-SHZ 600, W-SHZ 1200 W-SHZ 1600	Excellently organized content Clear, short, meaningful sentences Extensive use of images, drawings, and diagrams, which makes the instructions easier to understand and apply	Given that there are no significant deficiencies, it can serve as an adequate example for the correction of other instructions

	A very well-structured table with an overview of the most common failures, causes and measures in case of failures	
WORKSHOP Models: PA 100/200, PA200/400, PA 400/800	The content is well-organized Sentences are clearly defined, understandable All necessary information is provided Clear and comprehensible insight into the most common faults, causes of faults, and assistance in case of faults	It is necessary to insert more illustrations, pictures, and diagrams to facilitate understanding
VILLAGER Models: VEH 250, VEH 500, VEH 800	The instructions are well-defined, and all sentences are clear and understandable. An insight into the basic types of failures, their causes, and practical solutions that must be implemented to repair is provided	A better organization of the content is needed, divided into appropriate subheadings for easier navigation and understanding, adapted to all users (both beginners and those who have been working with the given equipment for a long time) Given that there are certain technical terms that may be unknown to a wider range of users, it is necessary to add a glossary of terms for the technical terms used. Illustrations, drawings, pictures, and diagrams should be added to facilitate the understanding of the use of the equipment.
STAR LIFTKET	Very detailed data and instructions on assembly, use, and maintenance Technical - safety measures described in detail Sentences are clear, concise, well defined The importance of periodic checks and maintenance is emphasized A large number of illustrations for assembly and replacement of parts	Too much textual content, which can cause disinterest and fatigue in the reader of the manual It is necessary to insert pictures, drawings, and diagrams in the safety instructions, to facilitate understanding and clarity Extensive use of technical terms, so it is necessary to add a glossary of technical terms It is necessary to carry out a better overview of the types of failures, their causes, and solutions for eliminating them There is a lack of clearly specified procedures in cases where the equipment is not used in accordance with the instructions

Figures 2, 3 and 4 highlight the characteristic shortcomings of the given instructions, while Figure 5 shows a good example of the practice of creating operating instructions.

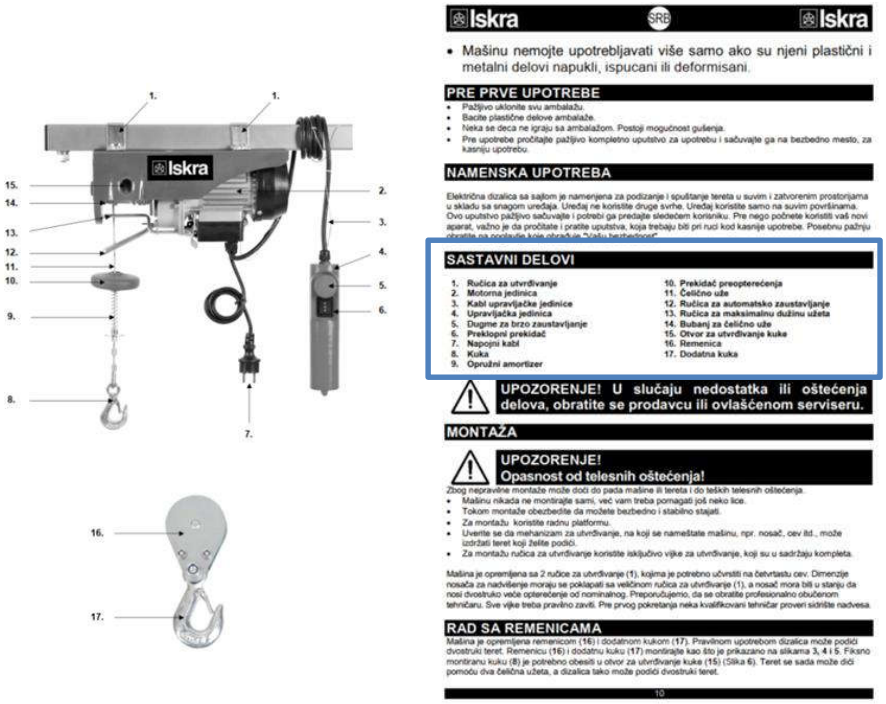

Figure 2. Instructions from the manufacturer ISKRA - The sketch of the marked parts of the electric hoist is at the very beginning of the instructions, while the meanings of those parts are only given at the end of the instructions (framed in blue)

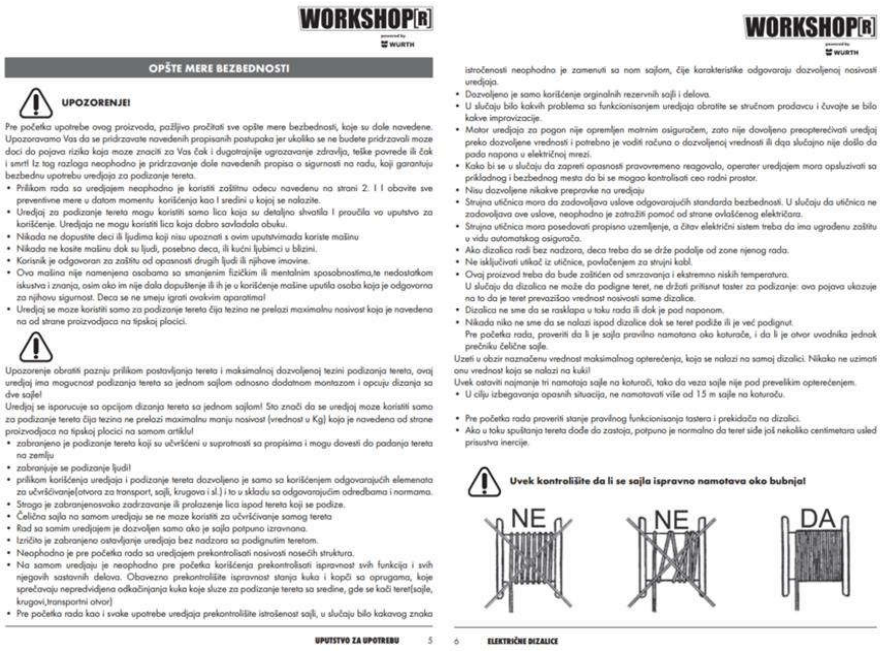

Figure 3. Instructions from the manufacturer WORKSHOP - Lots of textual content

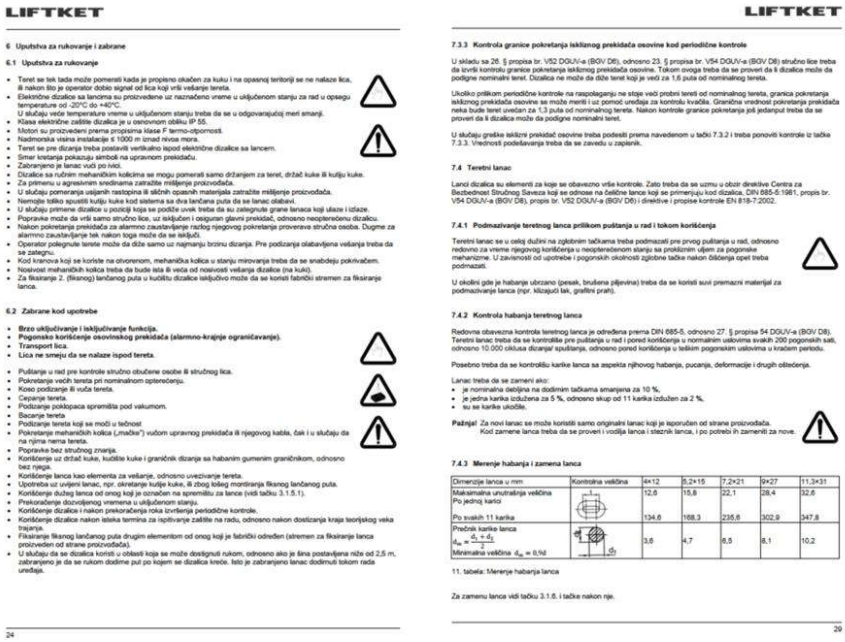

Figure 4. Instructions from the manufacturer STAR LIFTKET - In addition to the given textual content, it is necessary to include appropriate pictures and illustrations that would facilitate the safe use of electric hoists, there is also an overabundance of technical details and terms for which an adequate dictionary of technical terms is lacking.

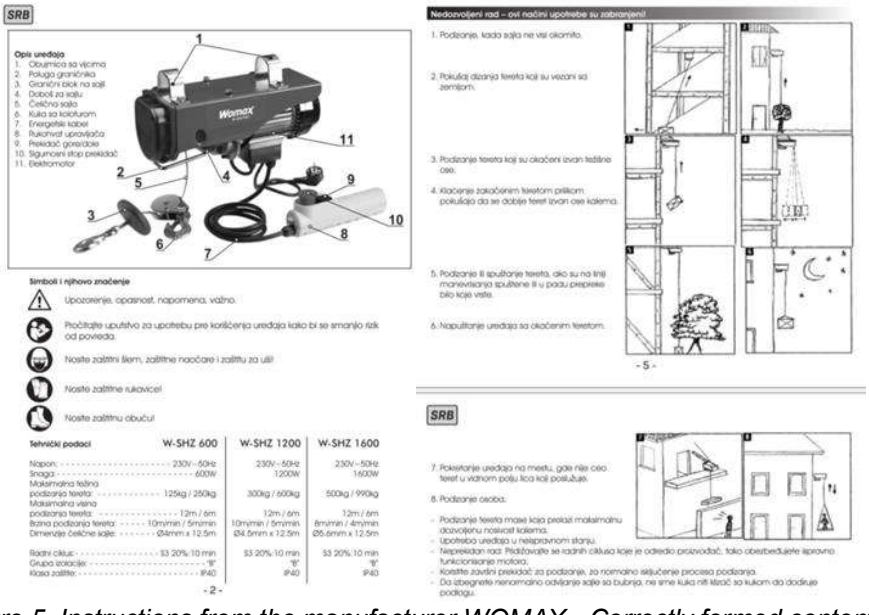

Figure 5. Instructions from the manufacturer WOMAX - Correctly formed content, meanings of parts with the sketch they represent, technical data at the beginning of the instructions (left), illustrations of illegal work - facilitate understanding and application (right)

Based on all of the above, as a conclusion from the comparative analysis of instructions for electric hoists from different manufacturers, the best-organized instruction is from WOMAX, for the reason that it is sufficiently concise, and clear, with all essential elements and by the aforementioned Directive. On the other hand, the instructions from the manufacturer ISKRA require a lot of reorganization, changes, and additions, in order to comply with the Directive [8]. Also, within the instructions from the manufacturer ISKRA, a formal non-conformity was observed - the lack of a declaration of conformity of the product and the CE mark, which represents a significant deficiency that requires immediate action by the manufacturer. Finally, it is important to point out that in all the instructions there is a lack of illustrations, pictures, and diagrams, the increase of which would have a significant effect on easier navigation and understanding when using the instructions for use.

5. CONCLUSION

The process of harmonizing lifting machines with the Directive and the national regulations, harmonized standards, and all other valid regulations in the given area is a key factor in ensuring the safety of lifting machines.

Special attention during the research was devoted to the analysis and comparison of instructions for the use of electric hoists from five different manufacturers (ISKRA, WOMAX, WORKSHOP, VILLAGER, and STAR LIFTKET), during which mutual comparisons were made of the quality of workmanship, content, organization of information, as well as comparisons with the basic principles and content of the instructions according to the Directive and the national regulations. Based on the comparison, it was concluded that certain manufacturers provide clear, structured, and illustrated instructions (e.g. WOMAX, WORKSHOP), while instructions from ISKRA require significant changes and improvements in terms of content reorganization and various additions (illustrations, tables), as well as removal of formal non-compliance (lack of Declaration of Conformity).

The research indicated that the Declaration of Conformity, CE marking, and correct preparation of instructions play an important role, both in fulfilling the requirements when placing the product on the market, and for increasing the safety of product users, better application of regulations, easier use of cranes and reducing the risk of injuries at work.

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