Documenting minimum requirements concerning Machines

Dokumentowanie minimalnych wymagań dotyczących maszyn

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The article presents an idea of a form of technical documentation for machines/equipment that allows to establish data in aspect of fulfilling the minimum requirements in accordance with the legal acts. Proper technical documentation is crucial in any enterprise – including handling, repairing and overhauling the machines, or usage of so called „home made" ones. This form shall allow maintenance services work more effective, especially in the context of modern organization of production.
KEYWORDS: minimum requirements for equipment, technical documentation, to use of machine

Documentation helps in ensuring the effective organization of production or running a business. It is an important element of production organization, useful both in the analysis of production results and in determining the optimal solutions. It allows to supervise the production process and helps to eliminate errors and to undertake the corrective actions. That is why, every organization should take care of the quality of documentation about the processes being carried out and the machinery/equipment used in the company. Technical information on the ways to meet formal requirements of the European directives and national legislation is always needed, especially in small and medium-sized manufacturing plants that do not have the staff to provide the necessary fast response.

The paper presents a checklist proposal, which applies to minimum requirements for machine users who do not have the manufacturer's documentation to the extent required by applicable laws. On the example of a centrifuge used in a small production company, it is presented the manner of filling this checklist.

Legal regulations

Machine safety (defined as the ability of machines to perform their functions and to transport, install, regulate, preserve, disassemble and dispose of them in accordance with the intended use specified in the instruction manual without causing injury or worsening health) imposes the obligation to think and act globally on the persons responsible for safety [3].

Makers of machinery safety regulations have adopted a contractual date from which all new machines introduced for the first time on the European Union market must meet the increased safety requirements, so-called *essential requirements*. The provisions of the Machinery Directive 2006/42/ EC [4], published on 17 May 2006, entered into force on 29 December 2009. It is addressed to all operators placing machines on the European market, i.e. manufacturers and distributors, including importers. Its provisions apply to all machines first introduced into the EU market, i.e. all new machines manufactured in EU countries in series or in units and self-made machines, and all machines (including used ones) imported into the EU from the third World's countries. The directive specifies technical requirements, so-called *essential requirements*, and the procedure for assessing the conformity of machines with the essential requirements at the design and production stage. The deadline for adapting the used machine park to the applicable legal requirements expired on January 1, 2006.

Only a machine that does not pose a hazard or creates an acceptable level of risk, as defined by European standards on the health and safety of users, third parties, pets and property, may be marketed in accordance with the Machinery Directive. Polish law provisions of the directive were implemented by the Act of 30 August 2002 on the conformity assessment system - currently the law of 13 April 2016 on the conformity assessment and market surveillance system [16] - and the Regulation of the Minister of Economy of 21 October 2008 on essential machine requirements [13].

The minimum health and safety requirements for the use of machines are the main concern of the employers whose employees use machines at work, while essential requirements for machine - manufacturers. The assessment of the machine's compliance with the minimum EHS requirements for the use of machines by employees at work is carried out by the employer, while the assessment of compliance with the essential requirements for machines - the manufacturer of the machine concerned. Minimum requirements are therefore realized at the stage of use of the machine introduced into production.

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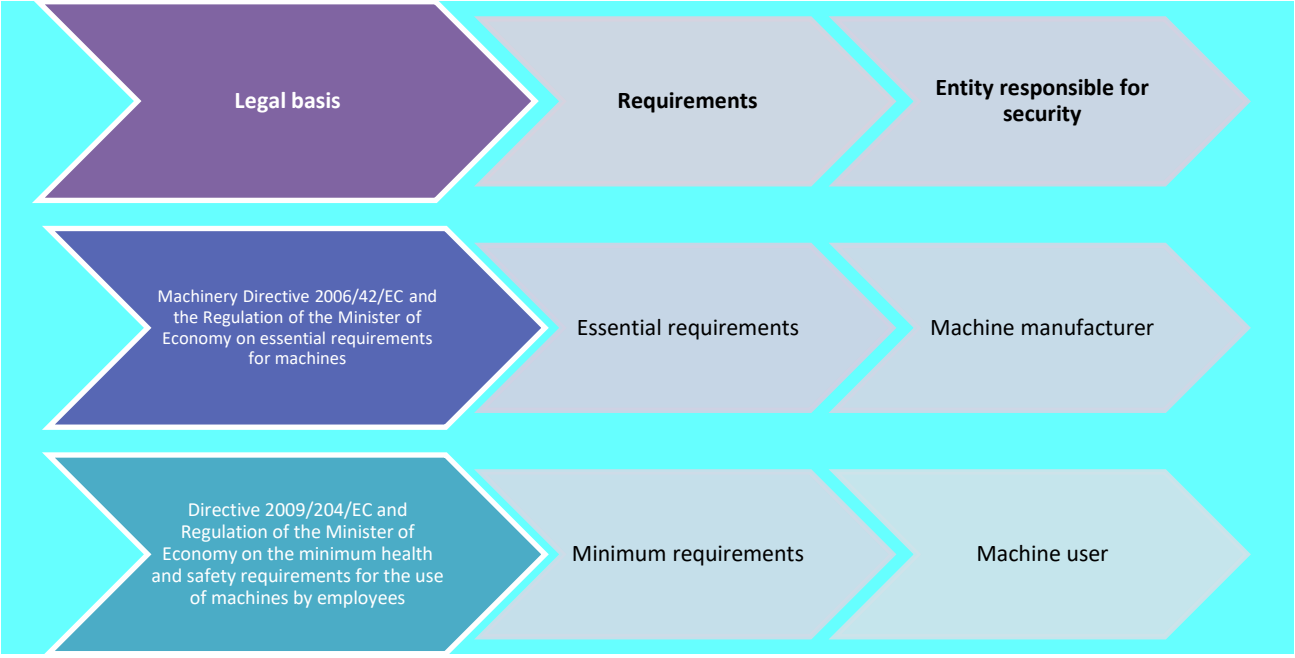

Old machines, i.e. manufactured or introduced into the Polish market before 1 January 2003, which were already operating in the EU, should meet the minimum requirements. The Tool Directive (89/655/EEC and 95/63/EC) was introduced into the Polish legislation by the Minister of Economy Regulation of 30 October 2002 on the minimum health and safety requirements for the use of machines by workers at work [13] - its provisions have been in effect since 1 January 2003. The Tool Directive 2009/104/EC [5], binding since 23 October 2009, has merged all previous amendments but has not obliged Member States to amend existing national legislation implementing Directives 89/655/EEC, 95/63/EC and 2001/45/EC. In Poland, provisions of the Regulation of the Minister of Economy of 30 October 2002 on the minimum health and safety requirements for the use of machines by workers at work [2, 14] are still in force. The Regulation [14] specifies the rules for the use and control of all machinery, regardless of the date of their placing on market (date of manufacture). In addition, Chapter 3 of the Regulation sets out the minimum technical requirements that must be fulfilled by all machines placed on the market (manufactured) before May 1, 2004. According to the regulations, the machine park was to comply with the applicable requirements until 1 January 2006.

Checklist

Minimum requirements, in many cases, have a very general form - the regulations indicate only the type of threat but do not specify the individual technical solution that needs to be met to fulfill the requirements. The correct solution depends on the hazards associated with the particular machine in a workplace. The Regulation of the Minister of Economy of 30 October 2002, which obliges employers to adapt machines to the minimum requirements, does not require written documentation of this fact (only the results of all inspections are recorded and stored in accordance with Chapter 4 of the Regulation), and in consequence does not specify the form of the document confirming the adaptation of machines to these requirements. This means that these types of documents can have any form. The Regulation does not indicate the validity of the documents certifying the conformity of a machine with minimum requirements. Adapting the machines to the minimum requirements can be a one-time action, that is, unlimited or multiple - then the timing of the subsequent action depends on the date of validity of the evaluation. The validity of this evaluation depends on the stability of the adaptation changes of the machine and actual working conditions of the machine and requirements that underlie the assessment. On the other hand, subsequent machine inspections should be carried out periodically in accordance with Article 27 of the Regulation [14].

In summary, documentation on the minimum requirements fulfillment by the machine may take any form, in accordance with applicable law. An example may be a form that specifies the procedure for dealing with a machine, which is doubtful as to whether it meets the requirements of the Regulation [14]. The proposed form contains four headings:

- area of requirements,
- minimum technical requirements,
- meeting the requirements and the way of fulfilling the requirements,
- legal requirement (legal basis) and adjustment measures.

Nineteen requirements areas [6, 14] have been identified and each describes the minimum technical requirements contained in the Regulation. The method of meeting the requirements of each machine or external specialist is described according to the state of the knowledge [16].

Presented form was prepared for a centrifuge, for which the trader did not have the required documentation. According to this form, the centrifuge needs to perform several adaptations to the minimum requirements, but after completing the deficiencies, it will be able to operate safely. On the other hand, the user will have a document proving that the centrifuge fulfills the minimum safety requirements.

Minimum requirements form [1, 2, 4-13]

Machine/device name	CENTRIFUGE				
Place of installation	Room No. 3			**Inventory number**	123/p
Year of production	2015	**Serial number**	1/2015	**Launch date**	2016
Installed power	2,2 kW	**Total mass**	0,86 Mg	**Dimensions**	805 × 635 × 1050

1. A legal requirement or standard under the "Requirement ..." box in the form of a number in brackets according to the number in the list below:
2. PN-EN 13849-1: 2016-02. Machine safety - Safety-related control elements - Part 1: General principles of design
3. PN-EN 61310-1: 2009. Safety of machinery - indication, marking and control - Part 1: Requirements for visual, acoustic and tactile signals
4. PN-EN 61310-2: 2010 Safety of machinery - indication, marking and control - Part 2: Marking requirements
5. PN-EN 61310-2: 2010 Safety of machinery - indication, marking and control - Part 3: Requirements for the location and operation of controls
6. PN-EN ISO 14120: 2016-03. Safety of machinery - Guards - General requirements for the design and construction of fixed and mobile guards
7. Regulation of the Minister of Economy of 30 October 2002 on the minimum health and safety requirements for the use of machines by workers at work (Dz.U. No. 191, item 1596, as amended).
8. Regulation of the Minister of Labor and Social Policy of 26 September 1997 on general health and safety at work regulations (Dz.U. of 2003, No. 169, item 1650, as amended).

Area of requirements	1) Controls	**Requirement met**	**Yes**

Minimum technical requirements: Controls that affect the safety of workers should be visible and identifiable and properly labeled. These elements should be located outside the hazard zones in such a way that their operation does not cause additional hazards; They can not create any risks as a result of accidental triggering

Legal requirement, method of compliance and adjustment -
Microprocessor RTC 125, START-STOP switch, safety button (no yellow border - to be completed). The mushroom-shaped element allows any part of the body to act on it. Around the emergency stop button should be a yellow rim. In any case, the generated emergency stop signal should cause reliable (effective) contact openings and lock the control and keep it in this state until unlocked. Unlocking the emergency stop should not cause the machine to start itself

Area of requirements	2) Warning before starting machine	**Requirement met**	**No**

Minimum technical requirements: Where necessary, the operator should be able to check from the main control panel that no one is in the danger zone. If the check is not possible, the safety system should automatically send an acoustic or optical warning signal before starting the machine. An exposed worker should have time or means to avoid the risk of starting or stopping the machine

Legal requirement, method of compliance and adjustment –
No warning before starting machine. Placing the control panel in such a place that the operator has the ability to observe whether nobody is in the danger zone

Area of requirements	3) Control systems	**Requirement met**	**No**

Minimum technical requirements: Machine control systems should ensure safety and be selected taking into account the possible damage, defects and limitations that can be foreseen under the intended conditions of use of the machine.

Legal requirement, method of compliance and adjustment –
There is no limit at the centrifuge cover. Machine control system - the system should be selected taking into account potential damage, defects and limitations that can be foreseen under the intended operating conditions. Appropriate selection of safety categories in accordance with the requirements of standard (1) to exclude the possibility of dangerous operation of the machine

Area of requirements	4) Running	**Requirement met**	**Yes**

Minimum technical requirements: Startup of the machine should only be possible by means of a deliberate operation on the control system for this purpose. These requirements apply to: restarting the machine after stopping - regardless of the reason for stopping, steering, in case of significant changes in machine performance, especially speed and pressure, if restarting the machine or changing its operating parameters does not pose a hazard . The above provisions do not apply to re-starting or changing machine operating parameters, as long as they are due to the correct working cycle of the automatic device. Machines should be equipped with easily distinguishable and properly marked disconnect devices from all energy sources. Turning on the power supply can not endanger operation

Legal requirement, method of compliance and adjustment –
Program selection on time relay and on inverter and rotary speed on inverter (access inside control box) - START-STOP switch. Use of a control system of such a structure, which prevents the machine from accidentally starting the machine

Area of requirements	5) Normal stop	**Requirement met**	**Yes**

Minimum technical requirements: The machines are equipped with a control system designed for complete and safe stopping. Each workstation is equipped with a control unit designed to hold the entire machine or parts of it, depending on the type of danger, so that the machine is safe. The control system intended to stop the machine should take precedence over the control system intended for its startup. The power supply of the respective machine drives is disconnected when the machine or its dangerous parts are stopped. Each machine should be equipped with a control unit for its complete and safe stop

Legal requirement, method of compliance and adjustment –
Machine equipped with standard control system for complete and safe stopping

Area of requirements	6) Emergency stop	**Requirement met**	**No**

Minimum technical requirements: Due to the hazards posed by the machines, they are fitted with an emergency stop device, depending on the time they are stopped. When it is necessary in view of the hazards posed by the machine and its nominal stopping time, the machine shall be equipped with an emergency stop device

Legal requirement, method of compliance and adjustment – The machine must be equipped with an additional safety plug attached directly to the centrifuge for emergency shutdown. The machine should be equipped with at least one emergency stop to eliminate the existing or potential danger			
Area of requirements	7) Protection against dangers caused by thrown objects and emissions of gas, vapor, liquid or dust	**Requirement met**	**No**
Minimum technical requirements: Machinery is equipped with protection against the hazards of the emission or disposal of substances, materials or objects. Machinery posing a risk of falling or throwing objects shall be provided with appropriate security measures for the risks involved. Hazardous gas, vapor, liquid or dust emitting machines shall be fitted with appropriate enclosures or hoisting equipment located near the source of danger.			
Legal requirement, method of compliance and adjustment – Mechanical protection of the flap against opening during operation required. Appropriate selection of protection, insulation, tool and workpiece fixings. Use of covers, casings, screens			
Area of requirements	8) Stability	**Requirement met**	**Yes**
Minimum technical requirements: Machines and parts thereof, if necessary to ensure the safety and health of workers, shall be fixed by means of suitable catches or similar devices to ensure their stability.			
Legal requirement, method of compliance and adjustment – Vibro-insulation pads under the centrifuge feet were used. Stability of the machine - attachment of appropriate hooks, devices to ensure stability, e.g.: screws, anchors, holders to secure the machine to the ground			
Area of requirements	9) Protection against hazards arising from the detachment or disintegration of machine parts	**Requirement met**	**Yes**
Minimum technical requirements: If there is a risk of the machine parts tearing apart or disintegrating, causing danger to the safety and health of workers, the employer should apply appropriate protective measures			
Legal requirement, method of compliance and adjustment – The unit is in a separate room to which no service during operation. Place warning inscriptions against entering the room during the operation of the centrifuge. Selection of parts made of materials providing the required properties: strength, corrosion, abrasion, etc. Use of shields, screens, enclosures of required strength			
Area of requirements	10) Protection against moving parts	**Requirement met**	**No**
Minimum technical requirements: Where there is a risk of direct contact with moving parts of machinery capable of causing accidents, guards or other protective devices shall be used to prevent access to the danger zone or to stop the movement of dangerous parts. Protectors and protective devices: they should have a strong (durable) construction; cannot pose a threat; cannot be easily removed or excluded from use; Should be located at an appropriate distance from the danger zone; Should not limit the field of vision of the machine; They should allow for the purpose of attaching or replacing parts and enabling maintenance - leaving only limited access to the area where work is to be carried out - as far as possible without the need to remove covers and safety devices; They should limit access only to the hazardous working area of the machine. Movable parts and other parts of machinery which, when exposed to them, present a hazard, shall be protected to a height of at least 2.5 m from the floor level or other effective protective devices - except where such requirements are met. It is not possible due to the machine function. Shields used on machines should prevent direct access to the danger zone			
Legal requirement, method of compliance and adjustment – Clearly mark the safety zone, remove unnecessary objects from the danger zone. Select adequate protection against moving parts of the machine parts according to (5). Carry out the selection of protective construction to prevent impact of machine parts, objects, broken tools, discarded solid or liquid materials. The construction of the enclosure should be stable, resistant to deformation, without sharp, protruding edges and corners. The location of the covers should include safe distances. Take into account the appropriate type of guard: fixed, movable, control, locking with locking device			
Area of requirements	11) Lighting of workplaces and positions or machine maintenance	**Requirement met**	**No**
Minimum technical requirements: Workplaces and sites or machine maintenance are illuminated according to the activities performed. Irrespective of the daytime lighting in the work premises, electrical lighting with parameters complying with the Polish Standards should be provided			
Legal requirement, method of compliance and adjustment – Bring the correct lighting fixture. Illuminance is appropriate. Proper lighting depending on the type and location of work - local lighting is possible			
Area of requirements	12) Protection against burns and frostbite	**Requirement met**	**Not applicable**
Minimum technical requirements: Parts of machines with high or very low temperatures are protected to avoid the risk of touching or approaching them			
Legal requirement, method of compliance and adjustment – Not applicable			
Area of requirements	13) Warning devices - signs and safety signals	**Requirement met**	**No**
Minimum technical requirements: Machine warning devices should be unambiguous, easily recognizable and understandable. Machines are equipped with easily recognizable devices for disconnecting from energy sources; Reattaching the machine to energy sources must not endanger workers; Warning signs and markings necessary to ensure the safety of workers. Solutions should be provided to ensure safe access and occupancy of workers in production areas and machinery setting and maintenance zones. The signs and signals used should be legible, visible and audible			
Legal requirement, method of compliance and adjustment – Equip the machine with visible machine operating indicator. Properly use light and acoustic signals. Correct color selection of light signals. Use of proper marking (pictograms, inscriptions, signs, prohibitions and warnings), safety signs (in places where hazards exist)			
Area of requirements	14) Use the machine as intended	**Requirement met**	**Yes**
Minimum technical requirements: Machines are only used in the processes and conditions for which they are intended			
Legal requirement, method of compliance and adjustment –			

Use the machine in accordance with the instructions in the instruction manual			
Area of requirements	15) Safety during machine maintenance	**Requirement met**	**No**
Minimum technical requirements: Performing maintenance work should be possible while the machine is switched off. If this is not possible, appropriate protective measures shall be taken to ensure that these work is carried out or the work is carried out outside hazardous areas. Where a machine maintenance log is provided for a given machine, it is kept up to date. Machines that are in motion must not be repaired, cleaned or lubricated, except for the lubrication using special equipment specified in the technical documentation. If the service, repair, repair or maintenance of the machinery poses a threat to the safety or health of workers, the employer should ensure that these operations are carried out by authorized and properly trained personnel.			
Legal requirement, method of compliance and adjustment – Remove unnecessary items from the work zone of the centrifuge. Machine maintenance work should be carried out when it is stationary; If this is not possible, use the appropriate controls			
Area of requirements	16) Disconnecting from the power supply	**Requirement met**	**No**
Minimum technical requirements: Machines are equipped with easily recognizable disconnecting devices from the energy sources and the warning and marking necessary to ensure the safety of workers; Re-connecting the machine to energy sources cannot pose a risk to workers. Machines should be equipped with easily distinguishable and properly marked disconnect devices from all energy sources. Turning on the power supply can not endanger operation			
Legal requirement, method of compliance and adjustment – Use appropriate warning signs and safety plugs near the centrifuge. Proper selection of means for disconnecting the energy sources, devices cutting off the media and proper labeling			
Area of requirements	17) Safe access to various machine parts due to its use	**Requirement met**	**No**
Minimum technical requirements: Solutions should be provided to ensure safe access and occupancy of workers in the production areas and machinery setting and maintenance zones. Workstations should be designed according to the type of work performed and the psychophysical qualities of the workers, while the dimensions of the free (unplanned) work area should provide workers with sufficient freedom of movement to work safely, taking into account the requirements of ergonomics. Every workstation should be provided with a safe and convenient access, with its height at full length should not be less than 2 m. Transitions between machines and other devices or walls intended for operation of the equipment should be at least 0.75 in. m; If there are two-way traffic in these crossings, the width should be at least 1 m			
Legal requirement, method of compliance and adjustment – Remove unnecessary items from the work zone. Workspace, communication - non-slip, stable (anti-slip mats). Use of appropriate equipment for work at different levels			
Area of requirements	18) Fire and explosion protection	**Requirement met**	**Yes**
Minimum technical requirements: Machinery shall be adequately protected in order to protect workers from the risk of fire, overheating or release of gas, dust, liquid and other substances produced, used or stored in machinery, and the risk of explosion of equipment or substances generated, used or stored in machinery. Electrical installations and devices should be so constructed and operated that they do not expose workers to electric shock, atmospheric over-voltages and harmful electromagnetic fields and do not pose a fire or explosion hazard or cause no other harmful effects			
Legal requirement, method of compliance and adjustment – Fire and explosion protection in accordance with applicable regulations. Workplace equipment for fire protection. Periodically check the ground			
Area of requirements	19) Protection against electrical hazards	**Requirement met**	**Yes**
Minimum technical requirements: Machines shall be adequately guarded to protect workers from direct or indirect contact with electricity. Electrical installations and devices should be so constructed and operated that they do not expose workers to electric shock, atmospheric over-voltages and harmful electromagnetic fields and that they do not pose a fire or explosion hazard and cause no other harmful effects			
Legal requirement, method of compliance and adjustment – Protection against electrical hazards in accordance with applicable regulations. Proper selection of electrical installation. Workplace equipment for fire protection. Periodically check the ground			

Summary

The use of the proposed form to assist in documenting the fulfillment of minimum requirements may be beneficial especially for traders using "self-made" machines and those who repair or operate old machines. In majority of such situations, there is no technical documentation required by the Tool Directive. Completing the form allows to systematize machine knowledge, including arranging information in terms of meeting the minimum requirements. It can be assumed that it will be useful for machine users who are required to create documentation related to machine safety. This group includes employees of small family businesses as well as holders of advanced, reconditioned or adaptable machines. The presented form is only an exemplary proposal and cannot be considered a mandatory solution.

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