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PECULIARITIES OF ORDERING AND CONDUCTING ENGINEERING-TECHNICAL AND ELECTROTECHNICAL FORENSIC EXAMINATIONS IN CRIMINAL PROCEEDINGS

Abstract. The article presents a comprehensive analysis of the theoretical, regulatory, and practical aspects of ordering and conducting forensic engineering-technical and electrotechnical examinations in criminal proceedings in Ukraine. The relevance of the study is determined by the growing technological complexity of objects that become the subject of criminal investigation–industrial equipment, electrical installations, metering systems, and construction facilities – and by the increasing share of proceedings in which establishing the circumstances of an offense is impossible without specialized engineering knowledge. The purpose of the article is to identify the specific features of ordering and conducting such examinations and to outline ways of improving practice. The methodological basis comprises general scientific methods (analysis, synthesis, induction, deduction), as well as formal-legal and comparative-legal methods applied to the provisions of the Criminal Procedure Code of Ukraine, the Law of Ukraine «On Forensic Examination», and the Instruction on the Appointment and Conduct of Forensic Examinations and Expert Studies. The article substantiates the praxeological and epistemological approaches to the expert's activity, characterizes the regulatory framework and classification of engineering-technical examinations, and examines engineering-mechanical examination as an independent type. Particular attention is paid to electrotechnical studies of emergency modes, fires of electrical origin, and unauthorized consumption of electricity, as well as to examinations in the field of occupational safety. The organization of complex

examinations, the problem of the expert's competence and the role of the expert's conclusion in the process of proof are analyzed. It is concluded that the quality of examinations directly determines the effectiveness of criminal prosecution and the protection of participants' rights in proceedings, and that updating methodological support, improving expert training, and introducing digital technologies are priority directions for development.

Keywords: forensic examination; engineering-technical examination; electrotechnical examination; criminal proceedings; expert's conclusion; occupational safety; complex examination; evidence.

Problem statement

Modern criminal justice is increasingly shaped by technological development: investigations increasingly concern events whose mechanisms cannot be understood without knowledge of mechanical engineering, electrical power engineering, construction, or industrial safety. A fire on premises, the failure of a lifting mechanism, an electric shock suffered by a worker, or discrepancies in the readings of electricity metering devices–each of these situations involves circumstances that are subject to proof under Article 91 of the Criminal Procedure Code (CPC) of Ukraine [1, Art. 91]. Yet, an investigator, prosecutor or court is, as a rule, unable to establish them independently.

It is precisely this circumstance that necessitates recourse to special knowledge, which is procedurally realized through the engagement of an expert and the conduct of a forensic examination [1, Art. 242–243]. At the same time, the mere fact that an examination has been ordered does not guarantee a high-quality result. The quality of the conclusion largely depends on whether the objects of study have been correctly identified, whether the questions have been properly formulated, whether the expert has been adequately provided with case materials, and whether the chosen expert specialty corresponds to the essence of the task.

In view of this, the practice of ordering and conducting engineering-technical and electrotechnical examinations reveals a range of interrelated problems. These include incorrect or overly general wording of questions, the expert exceeding the limits of his or her competence, inconsistencies between adjacent expert specialties, a lag in methodological support behind the emergence of new technical objects, and difficulties for the court and the defense in assessing the expert's conclusion. These problems result in repeated and supplementary examinations, prolonged investigation periods, loss of evidentiary information owing to changes in the condition of objects and, ultimately, reduced effectiveness of criminal proceedings.

Analysis of recent research and publications

The theoretical basis for resolving the outlined problems is the understanding, well established in forensic expertology, that an examination is a procedural application of specialized knowledge and that the expert's conclusion is an independent source of evidence. These provisions are enshrined in the CPC of Ukraine [1], the Law of Ukraine «On Forensic Examination» [2] and the Instruction on the Appointment and Conduct of Forensic Examinations and Expert Studies [3], which together form the legal foundation of expert activity.

At the same time, scholarly works devoted to engineering-technical examinations are predominantly narrowly specialized: some focus on methods for studying particular groups of objects, others on general issues of assessing the expert's conclusion. Considerably less attention has been paid to issues arising at the intersection of procedural law and engineering practice: aligning the wording of questions with the real capabilities of methods, delimiting adjacent expert specialties, and organizing complex studies. It is this gap that determines the need for a systematic analysis of the specific features of ordering and conducting such examinations.

Purpose of the article

The article aims to identify the specific features of ordering and conducting forensic engineering-technical and electrotechnical examinations in criminal

proceedings in Ukraine and to substantiate directions for optimizing expert practice. Achieving this aim involves the consecutive fulfillment of several tasks: to characterize the theoretical, methodological and regulatory foundations of such examinations; to consider the specifics of individual types of studies–engineering-mechanical, electrotechnical and occupational-safety examinations; to analyze the organization of complex examinations and the role of the expert's conclusion in proof; and, finally, to outline contemporary challenges and prospects for the development of the field.

Presentation of the main material of the study

Theoretical and Methodological Foundations of Forensic Engineering-Technical Examination

Disclosing the specific features of ordering and conducting engineering-technical examinations should begin with clarifying their theoretical nature, since it determines both the procedural regime and the research methods. Forensic engineering-technical examination is regarded as an independent branch of forensic expertology whose subject is factual data on the mechanism of an event, the technical condition of objects and the cause-and-effect relationships between them. The objects of study are machines, mechanisms, structures and equipment, as well as material traces of their operation or damage–deformations, fractures, melting marks and wear products.

The specificity of these objects lies in the fact that they are at once carriers of information and extremely vulnerable to changes in condition. After a fire, accident or dismantling, the original picture may be irretrievably lost. Therefore, the scientific identification of the subject and objects of the examination is not a formal procedure but the initial stage of methodological support, on which the choice of methods and the scope of materials required by the expert depend.

A logical continuation of this proposition is the praxeological approach, which focuses on how expert activity is organized. Its essence lies in developing algorithms for expert actions–the sequence of inspections, measurements, tests, and the generalization of results. Standardizing this sequence reduces the influence of

subjective factors, makes the study reproducible and, as a result, enhances the evidentiary value of the conclusion.

However, the praxeological approach does not exhaust the methodological basis of examination, since the expert's activity is dual in nature. On the one hand, it is procedural, as it is carried out in the forms and within the limits defined by the CPC of Ukraine [1, Art. 69, 101–102]; on the other, it is epistemological, as it is aimed at cognizing objective technical reality by means of special knowledge. A violation of procedural form may render evidence inadmissible, whereas deficiencies in epistemological content may lead to an unsubstantiated conclusion. It is the interconnection of these aspects that determines the quality and legal significance of the expert study.

Regulatory Framework and Classification

Having laid the theoretical foundations, it is appropriate to move on to their regulatory expression. The legal basis for ordering and conducting forensic examinations comprises three groups of acts that complement one another. The CPC of Ukraine defines the grounds and procedure for engaging an expert, his or her procedural status and the significance of the conclusion as a source of evidence [1, Art. 242–243]; the Law of Ukraine «On Forensic Examination» establishes the organizational and legal foundations of forensic expert activity [2]; and the Instruction approved by the Ministry of Justice of Ukraine specifies the list of types of examinations, the procedure for interaction between expert institutions, investigative bodies and the court, and the qualification requirements for experts [3].

It is the Instruction that serves as the basis for classifying examinations, within which engineering-technical studies constitute a separate group of related types. These include, in particular, engineering-mechanical and electrotechnical examinations, construction-technical examinations, and studies in occupational safety. The criteria for distinguishing these types are the object of study and the methods applied, and the

practical significance of this delimitation is that the choice of an expert institution and a particular specialist depends on it.

It should also be borne in mind that the entities ordering an examination–the pre-trial investigation body and the court–act under different procedural conditions. At the same time, the defense exercises its right to engage an expert through other mechanisms. This difference affects the procedure for formulating questions, providing materials and monitoring the course of the study, and therefore requires separate attention when planning an examination. In view of the above, we now turn to the features of individual types of engineering-technical studies, beginning with engineering-mechanical examination.

Forensic Engineering-Mechanical Examination as an Independent Type

Among the types of engineering-technical studies, forensic engineering-mechanical examination occupies a special place; it emerged as an independent field owing to the need for expert support in investigating events related to the operation of machines and mechanisms. Expert specialty 10.25 covers the study of the condition of machines, mechanisms, tools and equipment; it is relatively new but developing rapidly. The reason for this development is obvious: industrial and household equipment is becoming ever more complex, and consequently the number of cases in which the causes of an accident or injury cannot be clarified without a special study is also growing.

The emergence of this type of examination was primarily connected to the need to investigate offenses caused by improper operation or technical malfunction of equipment. The formalization of the specialty within the Ministry of Justice of Ukraine's system was accompanied by the development of the first methods, enabling the transition from occasional engagement of specialists to the systematic conduct of studies. At the same time, the formation of a new type inevitably raised the question of its relationship with existing examinations.

The answer to this question lies in delimiting the engineering-mechanical examination from adjacent types–in particular, construction-technical and trace-evidence (trasological) examinations–by object and method. Whereas construction-technical examination focuses on buildings, structures, and their components, and trace-evidence examination focuses on impression traces as a means of identification, engineering-mechanical examination is aimed at clarifying the technical condition and operation of mechanisms, as well as the causes of their failures. A clear understanding of these boundaries prevents both the erroneous choice of an expert's specialty and the expert from exceeding the limits of their competence.

The practical significance of engineering-mechanical examination is that establishing the causes of breakdowns, accidents, and collapses provides an evidentiary basis in proceedings involving grave consequences. However, no less complex issues arise when the subject of study is not mechanical but electrical processes and devices, which requires separate consideration.

Specifics of Electrotechnical Studies in Criminal Proceedings

Whereas engineering-mechanical examination deals with material structures and moving parts, electrotechnical examination studies phenomena that cannot be observed directly–electric current and its consequences. The range of issues resolved within its framework is extremely broad: from the analysis of abnormal operating modes of electrical installations and the determination of the causes of electrical fires to the study of commercial metering schemes when investigating cases of electricity theft. This feature of the object requires the expert to have thorough knowledge of electric power engineering and related disciplines.

The most illustrative area is the study of abnormal modes and accidents, which involves analyzing short circuits, overloads, and the consequences of emergencies in electrical installations across various voltage classes. The complexity of such studies stems from the fact that much of the evidentiary information is contained in residual traces–melting marks on conductors, changes in metal structure, the condition of

insulation–which may be damaged during firefighting or subsequent examination of the scene. Therefore, it is critically important for the expert to work with objects in the best possible state of preservation.

Another group of issues concerns cases of electricity theft. In such proceedings, the expert analyses connection schemes, measuring transformers, and meter readings to establish the fact of interference with the metering system and to determine the volume of unmetered energy. The results of such studies directly affect the legal qualification of the act and the amount of damage caused, and therefore heightened requirements are imposed on their validity.

A separate but inseparable task is to verify the compliance of electrical equipment with the Electrical Installation Rules, the Rules for the Technical Operation of Consumers' Electrical Installations, and other regulatory documents. Such verification makes it possible to assess compliance with safety requirements and, which is especially important for criminal proceedings, to link their violation to the occurrence of harmful consequences. It is at this intersection of technical and legal issues that electrotechnical examination most often addresses occupational safety.

Examination in the Field of Occupational Safety and Life Safety

The problem of occupational safety, to which the analysis of electrotechnical studies has led, constitutes one of the most socially significant areas of forensic examination. Workplace accidents involve deaths or injuries, so establishing their causes has both legal and public significance. Legal requirements for the safe organization of work are enshrined, in particular, in the Law of Ukraine «On Occupational Safety» [4]. At the same time, criminal liability for their violation is provided for by Article 271 of the Criminal Code of Ukraine [5, Art. 271].

Examination in this field is intended to resolve three interrelated tasks. First, to clarify whether regulatory legal acts were complied with when hazardous work was performed. Second, to determine what role in the occurrence of an accident was played by the actions or omissions of officials and rank-and-file personnel. Third, to establish

the technical and organizational factors that were the direct cause of the event. Only the comprehensive resolution of these tasks makes it possible to reconstruct the full picture of the event.

The results of such an examination directly affect the allocation of criminal liability among different persons. It is the expert's conclusion that enables the distinction between cases where the event resulted from an employee's personal negligence and situations in which managerial or organizational failings, the absence of proper briefing, faulty protective equipment, or deficiencies in the technological process played the decisive role. Therefore, the central issue in such studies remains the causal link between the violation of safety requirements and the occurrence of the consequence.

Establishing such a link is impossible without applying specialized methods for studying objects and documents, which necessitates consideration of the engineering-technical expert's methodological arsenal.

Technical Diagnostics and Methods of Studying Objects

The methodological arsenal of the engineering-technical expert has a multilevel structure. At the first level are general scientific methods–analysis, synthesis, induction and deduction–which provide the logic of any expert study: from decomposing an object into its components to formulating generalized conclusions. At the second level, special engineering techniques are applied, including non-destructive testing, technical diagnostics and metrological verification of measuring instruments.

The study of impression traces–deformations, fractures and scratches–requires separate consideration. To clarify the mechanism of their formation, microscopic and spectral analyses are used, which make it possible to establish the nature of the destruction and the sequence of loads and, accordingly, to distinguish operational wear from the consequences of external influence. The data obtained in this way are subsequently compared with equipment documentation and regulatory requirements for its operation.

Alongside traditional methods, modern engineering technologies are increasingly used, including computer modeling, three-dimensional scanning, and digital photographic recording. They ensure objective documentation of the condition of objects, enable testing of expert hypotheses on models, and significantly reduce the risk of information loss in the event of subsequent changes to or destruction of the object. The technical inspection of buildings, utility networks and communications should also be noted, as in several proceedings it constitutes an independent object of study.

However, even the most advanced methods cannot ensure the completeness of an answer when the question spans multiple expert specialties. In such cases, it is necessary to involve specialists from different fields and, consequently, to organize complex examinations.

Organization of Complex Examinations

The complexity of modern technical systems often exceeds the limits of a single expert specialty: for example, a fire at an industrial facility may require simultaneous study of the electrical network, process equipment, building structures, and compliance with safety requirements. In such situations, a complex examination is conducted, involving specialists from adjacent fields–power engineers, mechanical engineers, metallurgists, and construction specialists–with a clear allocation of questions among them and the coordination of joint conclusions.

A complex examination differs from several separate ones in that its result is not a mechanical sum of conclusions but an integrated assessment of the event, in which each specialist is responsible for their part of the study, and the final provisions are formulated by mutual agreement. This gives rise to specific organizational challenges, above all the problem of coordination: it is necessary to align the methodological approaches, terminology, and time frames of the work of different experts within a single proceeding.

The second, no less important problem is the expert's competence. Exceeding the limits of one's own specialty is a gross violation, since a conclusion made by an incompetent person risks being recognized as unsubstantiated or inadmissible. A preventive measure is a clear division of questions among experts at the stage of ordering the examination and consistent adherence to the principle whereby an expert declines to answer questions that go beyond their knowledge. The quality of the conclusion, whose role in proof is considered next, depends on how well such interaction is organized.

The Role of the Expert's Conclusion in the Process of Proof

The final result of expert activity is the expert's conclusion, which under Part 2 of Article 84 of the CPC of Ukraine belongs to the procedural sources of evidence [1, Art. 84, 101]. This means that its significance is determined not by the expert's authority as such but by the extent to which it meets the requirements imposed on evidence–relevance, admissibility and reliability. Therefore, the conclusion must be considered within the system of proof rather than in isolation from it.

The requirements for the content of the conclusion are set out in the CPC of Ukraine [1, Art. 102]: it must contain information about the examination, the studies conducted and reasoned answers to the questions posed. In practical terms, this means completeness of answers, scientific validity, logical consistency of presentation, and the absence of contradictions between the research part and the final provisions. Failure to meet these requirements has specific procedural consequences: an incomplete or contradictory conclusion may be rejected by the court or become grounds for ordering a supplementary or repeated examination.

The stage of trial is particularly important when the expert is questioned, explains the methods and terms used, and the parties and the court may ask additional questions. Such questioning performs a dual function: on the one hand, it clarifies complex technical provisions for the court; on the other, it allows the validity and independence of the conclusion to be verified. The quality of the expert's preparation

for this stage largely depends on how clearly they substantiate the provisions already at the research stage.

Finally, the relationship of the conclusion to other evidence should be emphasized. It has no predetermined advantage over them and is subject to assessment together with the entire body of evidence in the proceedings [1, Art. 94]. Thus, even a flawlessly performed examination does not relieve the court of the obligation to critically assess its results, which, in turn, raises the requirements for the quality of expert studies themselves and their methodological support.

Contemporary Challenges and Ways of Optimization

The rising requirements for the quality of expert conclusions are developing against a background of rapid technological change, which gives rise to new categories of objects and issues requiring expert resolution. This concerns, in particular, the study of smart power grids, industrial robots and automation systems, and software-controlled equipment. Demand for new types of engineering-technical examinations is growing, while methodological support and the personnel base often lag behind the needs of practice.

The first direction of optimization concerns methodological support. It is necessary to develop and approve modern methods for studying new technical objects and phenomena so that experts can work according to unified, scientifically grounded algorithms, yielding comparable, reproducible results. Without this, any organizational measures will have a limited effect.

The second direction concerns human resources. Systematic advanced training of forensic experts, their instruction in the latest technologies, and the involvement of specialists from adjacent fields help narrow the gap between the pace of technological progress and expert practice. Particularly important is preparing experts for work in complex studies, which require not only deep knowledge of one's own specialty but also the capacity for interdisciplinary cooperation.

The third direction is the introduction of digital tools. The use of artificial intelligence, automated analysis systems, and digital modeling creates opportunities to improve the accuracy and speed of forensic studies. At the same time, such tools should be regarded as auxiliary, since responsibility for the conclusion and its validity always remains with the expert. Summing up the above, the study's general conclusions can be formulated.

Conclusions

The study enables the formulation of several provisions that summarize the specific features of ordering and conducting engineering-technical and electrotechnical examinations in criminal proceedings.

1. Forensic engineering-technical examination is an independent branch of forensic expertology whose methodology is based on a combination of praxeological and epistemological approaches. The algorithmization of expert actions increases the reproducibility and evidentiary value of results. In contrast, the dual–procedural and cognitive–nature of expert activity requires equal attention to observing form and to the substantive validity of the conclusion.

2. The regulation of examination is ensured by the combined provisions of the CPC of Ukraine, the Law of Ukraine «On Forensic Examination» and the departmental Instruction. Despite this framework, the specifics of individual study types–engineering-mechanical, electrotechnical, and occupational-safety–require careful formulation of questions, the correct choice of expert specialty and expert institution, and consideration of differences in the procedural capacities of the entities ordering an examination.

3. Engineering-mechanical and electrotechnical examinations have their own subjects and objects, yet in practice they are closely intertwined with studies in the field of occupational safety, where the results of technical analysis provide the basis for establishing a causal link between the violation of safety requirements and the occurrence of consequences and, accordingly, for allocating criminal liability.

4. The effectiveness of complex examinations depends on the coordination of specialists from adjacent fields and strict observance of the limits of each expert's competence. The most effective preventive measure is a clear division of questions among experts at the stage of ordering the examination.

5. The expert's conclusion acquires evidentiary force provided it is complete, well-founded and objective, yet it has no predetermined advantage over other evidence and is assessed together with it. This gives rise to heightened requirements for the quality of expert studies.

6. Promising directions for the development of the field are updating methodological support, improving expert training and introducing digital technologies–computer modeling, three-dimensional scanning and automated analysis systems–while preserving the expert's personal responsibility for the conclusion. Further research should focus on developing methods for new categories of technical objects and improving procedures for ordering complex examinations.

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