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QUALITY AND STANDARDIZATION 1/

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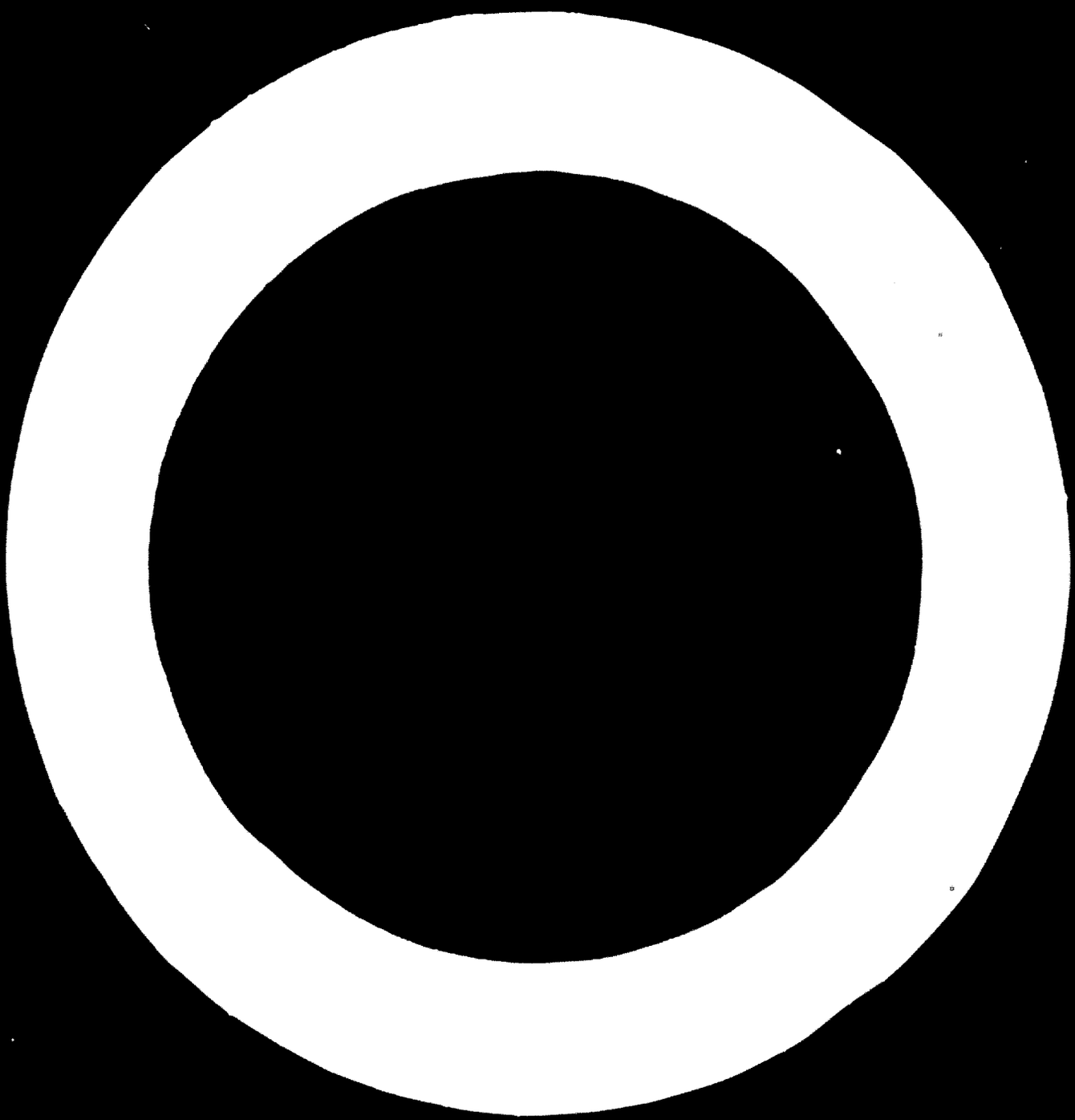
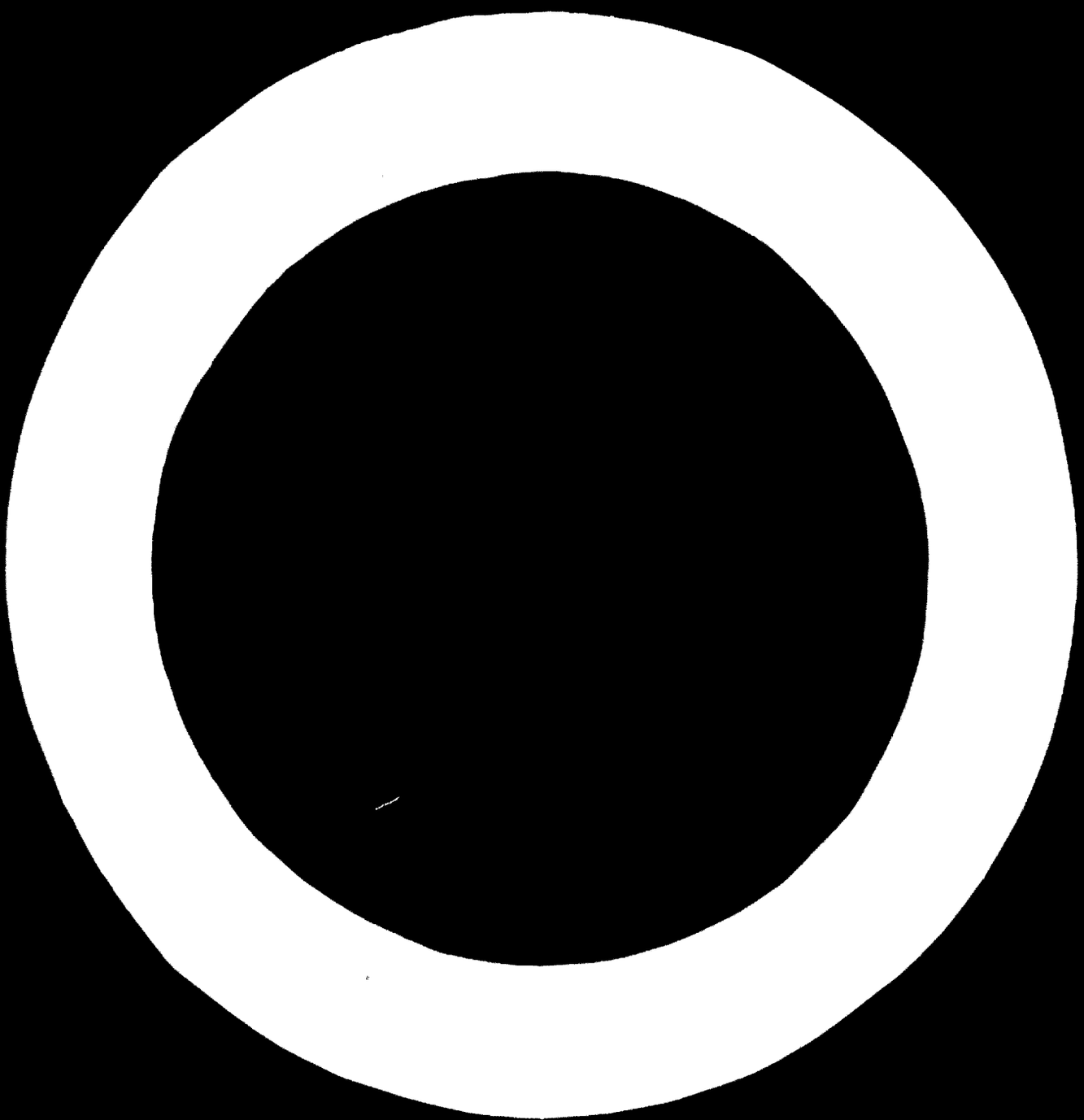




INTRODUCTION

In recent years, countries throughout the world have been giving increasing attention to the question of the quality of production. It is well known that this is an extremely acute and important problem which is crucial to the successful development of technological progress, of production and of the economy.

The level of development of the national economy, increased competitiveness of products and the promotion of exports are largely dependent on the solution of this problem. It is no accident that industrial and administrative leaders throughout the world are concentrating their attention on problems of quality, since quality has a considerable influence on the efficient growth of industrial enterprises as well as on the economy of a given country as a whole and its position in the world market.

One of the peculiarities of the problem of quality is that, far from becoming simpler as the economy develops, it becomes more and more complicated and difficult to solve.

This problem has been compounded by the objective development of the forces of production - a development marked primarily by:

- Extremely rapid scientific and technological progress which in turn means that products become more complex and higher demands are placed on them in terms of technology and performance;
- Increased complexity of the process of production, as a result of the use of modern equipment and mechanized and automated procedures;
- Expanded co-operation between countries and increased specialization within branches, between branches and at the international level.

The problem of the quality of articles and merchandise becomes particularly acute as the needs and requirements of consumers increase and as it becomes increasingly important to satisfy them fully.

Because of its importance and complexity from the scientific, technological, economic and branch points of view, the problem of quality must be tackled on the basis of new principles. The most important of these is the adoption of separate measures designed to establish an accurate and scientically based system of interacting and permanent measures for the control of quality at all levels, which can be applied equally well within an enterprise and at the national or international level.

The objective factors mentioned above have resulted in considerable importance now being attached to the problem of quality, and all countries are seeking economic and administrative measures which will ensure that their products are of a high quality.

It is widely recognized that this problem could be solved through the united efforts of all experts working in various spheres of science and technology. Extremely close contacts should be established between these experts, in order to facilitate the exchange of know-how on quality and the conduct of joint research.

Although this is common knowledge, we reiterate that the quality of a product or a machine is the sum total of the quality of the raw materials, components, semi-manufactures and constituent elements used in its production. Thus, a high-quality product can be obtained if all the constituent materials used are of a corresponding quality. It is here that standardization plays an essential role in guaranteeing the quality of production. Experience of industrial development shows that standardization which imposes qualitative requirements at all stages of production and during all the manufacturing processes is one of the most effective means for accelerating industrial progress and is the basis for industrial specialization, material savings, increased output and improved quality.

The complexity of modern industrial management, the development of machine, equipment and applicance technology, the discovery and utilization of previously unknown materials, inter-branch co-operation, the need for the reorganization and rapid modernization of production, the introduction of avant-garde technology in the shortest possible space of time - all these factors require the broadest possible application of the principles and methods of standardization. Standards enable the interests of consumers and manufacturers to be reconciled and thus guarantee the optimum quality of products by making it possible to unify the technical requirements of various industries.

Modern standardization is a complex system with many internal and external ramifications. It works very efficiently, provided that the best solutions are found.

Standards provide a starting point on the basis of which it is possible to co-ordinate the requirements imposed on designs, raw materials, components, constituent elements and finished manufactured articles by enterprises in the various branches of industry. Standards establish the most up-to-date production indices and bring them into line with the most recent advances in science and technology as well as with accumulated experience.

The importance of standardization is now universally acknowledged and everyone is interested in its development. Governments in many countries have established or are in the process of establishing bodies and specialized services to draw up and apply standards, and are financing these institutions generously. This is enabling them to make marked headway in specialization and co-operation and in unifying and standardizing industrial elements and components. The high quality of many of the articles manufactured by these countries shows that it is perfectly rational to apply the methods and principles of standardization.

The concept of the role of standardization in quality control has led several countries to establish national organizations which deal both with standardization and quality, and standardization programmes are now included in firms' quality control systems.

The part played by standardization in guaranteeing quality, promoting international trade and accelerating technological progress is highly regarded at the international level, as evidenced by the activities of the international organizations most competent in this field, such as ISO and IEC.

It is also well known that the European Organization for Quality Control is likewise dealing with matters relating to the standardization of quality control methods. The theme of this Organization's recent conference was "Quality - standard - qualimetry" and the slogan under which it met at Moscow was: "Towards high quality through standards".

Relationship between standardization and quality

After these general statements, let us attempt to define the connexion between quality and standardization. In most cases, there is a tendency to link standardization with quality control alone, in other words with the last stage of product manufacture. Let us see whether this approach is sound, however. There is a fairly well-established view which answers many questions. It holds that quality is introduced when a product is designed, is created during its manufacture, is verified by testing and control operations and becomes apparent during the product's use, consumption or performance.

Forward and progressive standardization

It is well known that rapid scientific and technological progress speeds up the relative obsolescence of various products for which standards have been prepared.

A standard may very often hamper industrial progress by establishing a level of quality which has already been achieved. Conservative standards can be eliminated by standardization based on forecast data, and by the preparation of anticipatory standards.

Forward standardization is currently defined as follows:

"Forward standardization is standardization which takes into consideration the quality indices of a standardized article, which change with time".

Anticipatory standards establish projected quality indices which can be achieved within a specific period of time and assume the gradual application of these indices by industry.

This means that while in many cases it is difficult to secure the endowment of a product with the necessary characteristics at a given time, this can be done as the national economy develops.

Here we see progressive standards as varieties of anticipatory standards. The final objective of such a standard may be either to secure technical characteristics not yet achieved in the world or (as may be the case in one of the developing countries) to secure properties already achieved in some developed countries but as yet beyond the reach of the developing country in question.

When preparing progressive standards, it is important to establish technical requirements and quality indices which will be optimal at the end of the planning period. These standards are prepared on the basis of dynamic optimization methods, forecasts of standardization subjects, and knowledge of trends in their past and present development.

Thus, according to the most modern thinking, forward standardization determines the role of a standard in technological progress, transforming it into a catalyst of technological development and an important means of forecasting and planning quality.

We have already spoken at length about standardization, quality and the relations between these two concepts. The interdependence between standardization and quality is not contested by any one at all familiar with the subject. It is also recognized that there are mutual links between standardization and technological progress which are developed and strengthened as such progress gains momentum. This is explained by the fact that on the one hand the standard, by absorbing new scientific and technological discoveries, becomes a motive force for the industrial application of the most advanced technology and, on the other hand, the application of the principles of standardization promotes the introduction of new technology in the economy, speeds up preparation for manufacture, and thus contributes to technological progress in all spheres of human activity.

Quality control

In that respect, all is clear. But what, in that case, is quality control? What does the science of standardization and quality have to tell us about this? We may quote the definition given by Professor B. Doubovikov:

> "Quality control is basically the process of seeking the best possible combination of the interdependent categories of quality and quantity, in order to make production as efficient as possible and to obtain the highest yield of productive labour. It is the planning of quantitative indices of a high level of product quality, reliability and durability which meet society's needs and equal the best standards set by other countries. It is also the process of controlling the design, manufacture and consumption of these products, in order to achieve the planned quantitative indices of their quality. In other words, quality control consists of special measures designed to obtain articles (products) which have the necessary quality characteristics".

The quality of an industrial product means the whole range of properties which determine its capacity to be used for the purpose for which it is designed.

The quality of a product is a relative concept which can only be defined in terms of a quality model selected as our objective. Quality varies according to an ascending curve and, at any given time, is determined by existing standards and specifications.

If the quality model no longer meets society's needs and falls short of the latest scientific and technological innovations - in other words, if some of its most important properties no longer correspond to those of the best of similar models known in the world, this quality model can no longer be considered as a suitable measure of quality.

It can thus be seen that forward standards which are systematically revised and improved play an essential role in quality control.

Forward standards are important regulators of product quality.

Naturally, so far as the organization of a national body responsible for standardization, quality, and planning and control in these spheres is concerned, it is extremely difficult to draw up universally applicable recommendations and formulae.

All these activities must be studied and applied in the light of the economic, political, cultural and other conditions prevailing in each particular country.

Nevertheless, although each country has its own way of tackling the problems of economic and industrial development and organizing standardization and quality control, we are going to attempt to make some general suggestions which may be of use to a number of countries.

When drawing up standards, the following assumptions should be taken into consideration:

- The quality of a product varies with time;
- The rapidity of scientific and technological progress and of variations in quality are inseparably linked;
- The untimely application of a standard reduces its usefulness to industry and trade;
- The planning and control of standardizations based on annual and long-term programmes and also on programmes for the application of standards;
- For proper planning, preparation and implementation of standards, the practical results of their application must be analysed and general conclusions drawn therefrom.

Since, in the final analysis, product quality is created during manufacture, we shall examine the main stages in the process of achieving the economically optimal quality level of a product at the enterprise level:

First stage: Preparation of the enterprise for carrying out the main tasks required to guarantee quality.

Second stage: Drawing up of practical and economically sound measures designed to ensure that the planned quality is achieved;

Third stage: Examination of other aspects of the enterprise's activities which could help to solve problems of quality.

Fourth stage: Application of the measures defined.

Fifth and final stage: Comparison of the quality level planned with that actually obtained, identification of defects, assessment and elimination of these by the application of additional measures.

If work is carried out according to the stages listed above, the results are as follows:

(a) Definition of the properties required in standards documentation, including company standards, in accordance with the planned quality indices (establishment of technical requirements);

(b) Application of all measures designed to ensure that the prescribed quality indices are achieved (quality preparation);

(c) Execution of the manufacturing processes in strict compliance with prescribed parameters and technological regulations (quality formation);

(d) Control of product quality (measurement of quality);

(e) Stability of product quality (quality stability);

(f) Measurement of the steady quality level achieved (evaluation of quality level).

The next level at which the organization of work on quality and standardization is carried out is the level of the various branches of industry. At this level, quality control must make provision for branch development plans which link the size of output to the quality level. Variations in quality should be reflected in nomenclature and in the size of the output provided for in annual and long-term plans for the branch in question.

This activity within a branch of the economy requires:

1. Organization of a systematic study of consumers' product quality requirements, and demand for such products, as well as a study of technological and scientific achievements in the field concerned and in allied fields;

2. Study of the actual level of quality based on data relating to the consumption and performance of products;

3. The application of measures designed to guarantee product quality by modernizing mass production, developing inter-branch specialization, and improving technological procedures and methods of checking and manufacture, as well as by designing new products intended to replace out-dated models and to meet the new demands of the national economy;

4. Systematic efforts to improve product durability and performance during use, including the delivery of spare parts;

5. The preparation and introduction of a centralized system for the assembly, processing and distribution of technical information (including standards and specifications) and economic information at all levels of branch management, and also a system for assessing the results of the execution of decisions taken.

Material incentives for staff and standardization at the branch and national level designed to regulate product quality requirements will help to improve this system.

The branch (Ministerial) plans, taken together, comprise the national plan for standardization and technical progress. The implementation of such a plan (so far as the most important issues affecting the national economy, and particularly problems affecting more than one branch, are concerned) should be supervised by the national body responsible for questions of quality and standardization.

The role of metrology

I should now like to say a few words about metrology as a basis for measuring the characteristics of products in general and for the quantitative evaluation of quality.

The problem of quality is closely linked to the state of progress in the field of metrology. It should be borne in mind that basic parameters and dimensions, technical requirements, reliability and durability indices, methods and means of testing and control, as well as specifications for raw materials, metals, tools and equipment, are established by standards. Metrology is fundamentally the technical and scientific basis for all these specifications and quality indices, since they are all in the final analysis, determined according to a system of measures. There is no need to explain yet again the importance of scientific and legal metrology in unifying measures and maintaining them nationally at the necessary level.

Thus, the primordial role of metrology in activities which concern testing methods is very widely recognized throughout the world.

I should like to mention two particular aspects of metrology relating to standardization and quality.

The first aspect concerns so-called "reference materials" used in defining the chemical composition of products and raw materials and their physical and chemical characteristics. These "materials" take the form either of materials which perfectly display certain chemical, physical or mechanical properties or of standard samples of a specific chemical composition.

They may be used, on the one hand, for calibrating measuring instruments used in industry, or, on the other hand, for comparing the characteristics of manufactured products with those of the reference materials. In the first category we may mention, for example, hardness reference blocks, benzoic acid as a standard for calorific value, reference materials for optical properties, viscosity, roughness, etc. The second category includes reference test pieces for metals and alloys and chemical products which can be used as checks in qualitative and quantitative analysis and also for spectral and spectro-chemical analyses.

The use of the first category of reference materials makes it possible to check measuring instruments and apparatus without transferring them to metrological laboratories and to calibrate them systematically and accurately in order to ensure that the measures adopted in the national economy are uniform in nature.

By using the second category, we can make a direct comparison between the parameters of manufactured products and those set forth in the relevant standard. It goes without saying that the preparation, checking and distribution of these materials are the responsibility of a country's metrological service and should be carried out in co-operation with the national standards body.

The second aspect of the interdependence between metrology and standardization is the examination of draft standards from the metrological point of view. This involves the definition of the level of precision of standards for substances and materials and methods of testing them and analysing their chemical composition.

The metrological examination of standards makes it possible to ensure:

- The uniformity of regulations governing the accuracy of definition of chemical composition, physical and chemical properties and the accuracy of their determination;
- The correct use of terms relating to the metrological aspect of standardization and testing, chemical composition, and the physical and chemical properties of materials and substances;

- The uniformity of methods used to determine discrepancies, in standards regarding testing methods.

Standards which should be submitted for metrological examination are those relating to raw materials and concentrates, metals and alloys, chemical reagents, products and materials produced by organic and inorganic synthesis, materials of very high purity, chemical products derived from wood, etc.

The last aspect of metrology's role in the field of standardization and quality about which I should like to say a few words is the link between metrology and qualimetry. But firstly, what is qualimetry, and how does it relate to standardization?

Qualimetry is a branch of scientific and practical activity related to the examination of the theoretical bases and methods for the quantitative evaluation of the qualitative indices of production. This term, which was introduced by Soviet experts, is now very widely used.

The need for a quantitative evaluation of production quality becomes apparent when the numerous tasks of standardization and quality control have to be tackled, particularly the planning of product quality level, the selection of the best possible model when designing a new product, the preparation of a new product, and the compilation of standard documentation on new articles and on the control and certification of product quality etc.

The preparation of standards also requires quantitative proof of the level of quality. Standards must include optimum indices of product quality and methods of evaluating these - this is the concern of qualimetry.

Qualimetry, as a branch of science dealing with problems of quality, has been developed on the basis of standardization, from the terminology it uses to the methods and means of evaluating quality levels and measuring the quantitative indices of quality.

The metrological service is the technical and scientific basis used by qualimetry when making these evaluations.

The quality of standards

To conclude these remarks on standardization, quality, etc., I should like to say a few words about the quality of standards themselves.

The level of the properties which make up the quality of production depends to a large extent on the quality of the technical documentation available (including national, branch and company standards).

All this requires the development and expansion of theoretical, economic and even philosophical research on standardization, since every year activities in this field are becoming more essential to the solution of the pressing problems of our times.

A new field in the science of quality - standards qualimetry - is now emerging.

The quality of a standard means a set of properties which determine, with a well-defined degree of probability, the quality of the end-product of the work which is the subject of this standard (standardization subject). Two aspects of the overall concept of the quality of a standard may be noted:

- The quality of manufacture: this is the entire range of properties of a standard (prepared according to a thematic or technical formula) at the time of its acceptance;
- The quality of consumption - the practical results of the application of a standard, which are conditioned by the standard of manufacture of a product.

Standards which fail to meet the demands of technological and scientific progress do considerable harm to the national economy. The determination of objective laws for preparing and measuring the quality of a standard (examination) is therefore a fundamental taks of scientific development.

The following are included in the qualimetric study of a standard:

- All the properties of a standard considered as a technical standards document;
- The depth and breadth of study of documents at all stages in the preparation of the standard - quality of drafting, layout and accuracy of presentation; improvement of methods used to determine and evaluate the quality required from the standardization subject, etc.;
- The scientific value and reliability of information, used during the preparation of a standard, on technological and scientific progress in the branches in which the standardization subject is manufactured;
- Technological and scientific progress in industrial production, its levels, and criteria for these levels;
- Products and their quality as the subject of standardization;

- Optimization of expenditure on the preparation of standards, considered in the light of the benefits obtained from their application (provided that the quality, reliability and durability of the goods produced are not impaired).

The main aim of such qualimetric study is:

- To form a scientific basis for determining laws for standards quality formation;
- To determine and investigate the factors which influence the formation of standards quality;
- To make objective estimates of the indices and criteria of standards quality;
- To establish such conditions for the scientific preparation of a standard, its structure, language, presentation and form, as will permit processing by computers;
- To establish a national system for the control and examination of standards quality by computers.

This science should be based on three main conditions:

- Recognition of the theoretical and practical possibility of measuring and expressing in a quantitative (mathematical) form the properties which, individually and together, comprise the quality of a standard;
- An approach to standards quality as a dynamic set of individual qualities, each of which, by reason of its interaction with the others, influences the formation of a standard's structure and the quality of the standardization subject;
- Recognition of the need for quantitative methods of estimating the quality of a standard, in order to solve problems of planning and control at various levels of the management of the national economy.

International standardization

Nowadays, no country, not even the industrially most advanced, can develop in isolation, without scientific, technical and economic relations with other countries. Industrial progress and development, the expansion of international trade, and technical, scientific and cultural co-operation require uniform principles and criteria for evaluating product quality, uniform checks and tests, uniform operating instructions, etc. - in other words, all the factors which standardization makes available to scientists and experts working in these fields. It is in this area that international standardization has the most important role to play.

The authority of ISO, which has members in 56 countries, is growing every year, and the Recommendations prepared by its Technical Committees are gaining ever-increasing recognition throughout the world. The ISO Recommendations, which are based on the collective experience of many countries and represent a synthesis of modern technology, are the means of guaranteeing the uniformity of product quality requirements, the interchangeability of components, and unified methods for quality testing and control. They create conditions favourable to the development of economic, scientific and technical relations between countries throughout the world.

The scope of problems dealt with by the International Recommendations is extremely broad, ranging from units of measurement and terminology to computers and aircraft. Although the ISO Recommendations are of an optional nature, their application is in fact crucial to the expansion of trade and economic development. It should be emphasized that standardization, and particularly international standardization, has a strong influence on international trade. It helps to bridge national, tariff and technological barriers and to establish genuinely favourable conditions for co-operation between nations. The success of international standardization has a direct effect on the progress of standardization in the various regions of the world; it strengthens economic relations between different countries, and transcends traditional patterns based on these countries' geographical position or on an earlier economic situation.

In conclusion, I should like to emphasize yet again that in view of the existing state of the economy of the developing countries standardization is a major instrument for securing technological progress and improving the quality of national products.

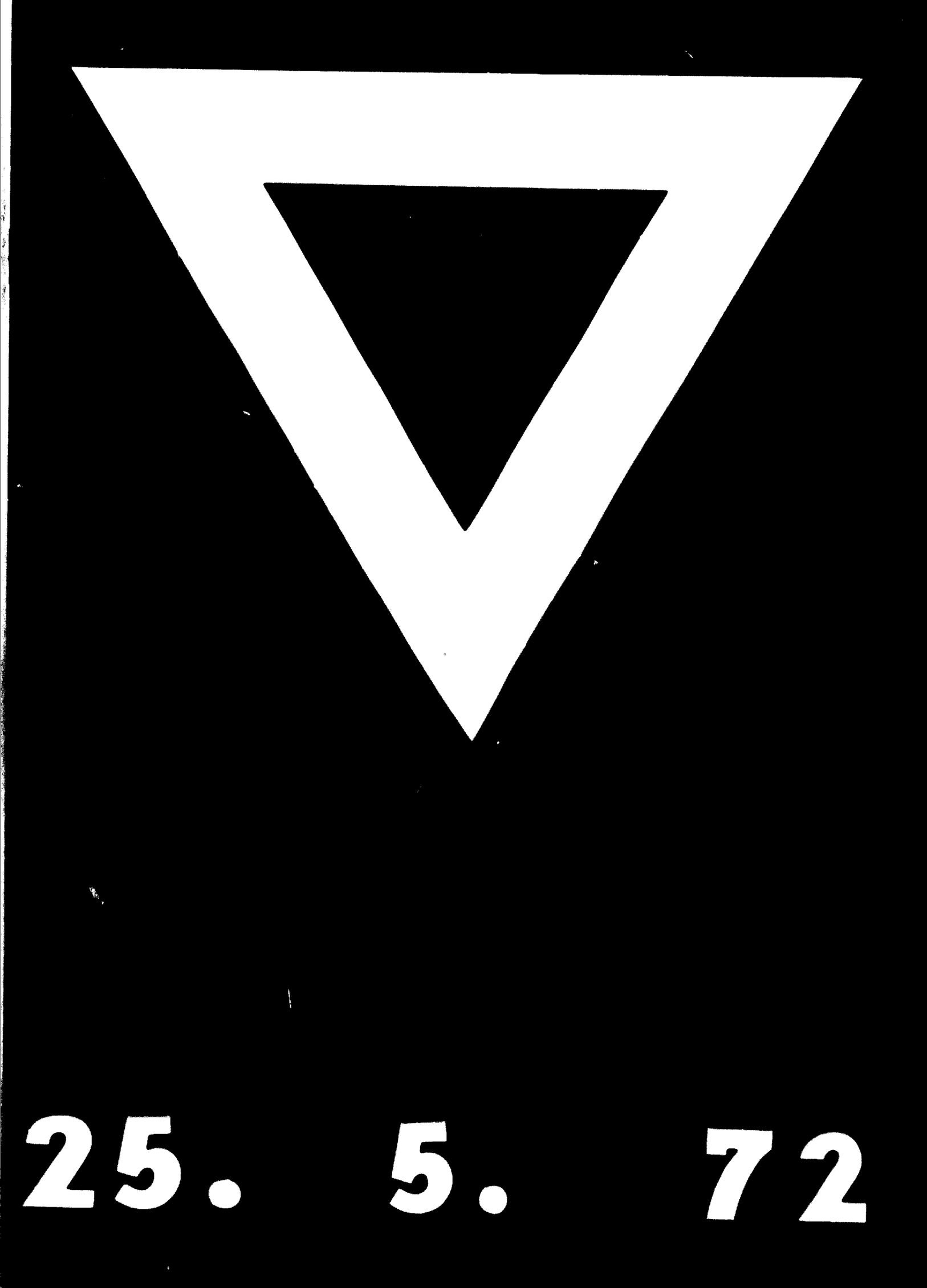
Consequently, the technical and scientific levels of standards must be raised and their role in quality improvement must be promoted. In addition, the standards applied must be revised and renewed from time to time in order to replace out-dated indices and properties.

It is self-evident that in these circumstances national standardization can develop only as the result of planning, since the positive results of standardization and a modern level of product quality cannot be expected immediately.

The experience of certain developed countries shows that the most efficient method is to establish forward standards and put them into effect through gradual and integral standardization.

There can be no doubt that standardization based on scientific projections will heighten the already significant role played by standards in the technological progress of individual countries.

The foregoing illustrates very clearly the interdependence between standardization and quality: by planning and controlling standardization, the quality of industrial production can also be planned and controlled.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