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# Modern Problems of Metrological Supply in the Automobile Industry

**Sulaymanov Sharifjon Abdumanabovich**

Andijan State Technical Institute, Dotsent

Sulaymon.72@mail.ru

**Tursunov Botirjon Tolibjon o‘g‘li**

Andijan State Technical Institute, basic doctoral student

Tursunovbotirjon51@gmail.com

**Annotation**

The variety and complexity of manufacturing, product preparation and control processes in the automotive industry necessitates the correct and accurate measurements in quality assurance processes, as well as ensuring that the measurement error does not exceed the norm. This article is devoted to the study of modern problems of metrological support in the era of information technology in the 21st century.

**Keywords:** metrological support, metrological service, automotive industry, product quality, conformity assessment.



It is known that the automotive industry plays a special role in the world economy, both for social development - solving transport problems, the movement of people and goods, and in terms of the volume of resources consumed and the scale of production. Most of the steel, non-ferrous metals, plastics, glass and other materials are consumed in automobile production - global automobile production exceeds 90 million per year.

Considering that a modern mid-range passenger car consists of more than 20 thousand parts and that more than 70% of the cost of the car is created by suppliers of components, ensuring product quality is a complex engineering task, and metrological support of automobile production is of particular importance, since in this technological sphere about 2 thousand physical quantities operate, which occupy the priority and largest volume, and various requirements are set for their accuracy determination in technology [1].

In general, metrological support in industry is the metrological support of measurements carried out in industrial enterprises. The importance of metrology is that until the 1990s, that is, before the transition to market relations, 3.5 million people were engaged in metrological service of measuring instruments in the country[2].

Industrial metrology is rapidly developing and is essential for ensuring the accuracy of parts production and quality control processes in the automotive industry. These metrological tools include:

1. Coordinate Measuring Machine (CMM)

2. optical digital converters and scanners ODS (Optic Digatal Scan)

3. visual measuring machines VMM (Visual Measure Machine) and measuring instruments.

Metrological support of measurements ( OMT ) is a set of correctly applied, systematized, strictly defined tools and methods aimed at obtaining measurement data necessary for the management and control of technological processes.

Measuring instruments, units of quantity, measurement scales, calibration and other devices, as well as various methods (measurements, calibration, calibration, certification, etc.), specialists (calibrators, testers, comparators, surveyors) and, of course, measurement conditions (tests, calibration, verification, etc.) constitute my OMT elements.

The object of metrological support is the entire system of automotive production (technological processes, a set of design and technological solutions for automotive products, material means of production and production management, etc.).

Automobile manufacturing is a multi-step process, with a complex and lengthy manufacturing process. Metrology is used to measure parts with extreme precision, and it is necessary to determine the uniqueness of a part when assembling a vehicle [3].

**1. Compliance check.** The first step in automotive manufacturing is to ensure the dimensions of the parts, which is done using precise measuring instruments. A CMM - coordinate measuring machine - helps to compare the product with the CAD drawing and make sure it matches exactly.

**2. Monitoring during production.** After the car is assembled, it is necessary to check the accuracy in several key areas to ensure that the components are connected correctly. One of the checks that checks that the parts are manufactured correctly is to test certain areas when checking the accuracy of the guide pins.

**3. Quality control.** SMM can ensure that all components meet the required dimensions and are ideal for each situation. Metrology is a critical step in any manufacturing process, as it ensures that all components are exactly as they should be and guarantees high quality of the final product.

**4. Post-assembly inspection.** These include a final inspection to ensure all parts are in good working order and subsequent quality control tests.

**5. Analysis of indicators.** SMM allows you to take precise measurements and compare them to a CAD drawing of the part, which is used as a standard to correct any problems before adding other parts.

(MT) of technological processes of automobile production is a very important and urgent problem in connection with the development trends of automobile production.

**Key trends in the modern automotive industry[4].**

Naturally, the metrological support system should fully comply with the development trends of automotive production and be implemented as one of its subsystems. This means that the metrological support system is built on a computer base using network communications, which allows for the integration of isolated measurement processes in various areas of production, the accumulation of the results of these processes, and therefore a more complete and reliable receipt and use of measurement data in time and space. A computerized integrated quality assurance

system built into the KIS or its individual components will have new positive features that differ from traditional production management schemes.

arise due to the fact that many enterprises with a developed production technological base and modern technological equipment, capable of producing high-quality products, do not realize their potential due to the low level of organization of metrological support .

At the same time, an analysis of the state of metrological provision shows that negative factors, as a rule, are the lack of qualified personnel, the lack of modern measuring equipment, the use of outdated methods of organizing metrological provision, the high cost of technical maintenance of measuring instruments, etc.

At the same time, the following problems exist in the automotive and component manufacturing enterprises regarding metrological support:

1. Incompleteness of the normative and methodological base;

2. lack of qualified personnel;

3. lack of modern equipment;

4. use of imperfect measurement methods;

5. Inconsistent condition of the measuring instrument base.

That is, the improvement of metrological support should be aimed at improving the management and provision of technological processes, and the development of all systems for ensuring the quality of manufactured products.

The elements and processes of metrological support, as well as the costs of creating and maintaining an organizational system, should be commensurate with the complexity of production, the technological cycles of the enterprise, and the scale of production as a whole.

Automobile production has some characteristics, such as:

1. mass production with high requirements for processes, product quality and cost reduction,
2. the use of a large number of very diverse raw materials and materials,
3. high complexity of the equipment, requirements for its accuracy, reliability and non-redundancy of the equipment,
4. The mass of employees and everyone's involvement in the creation of the product and its quality.

These features, in turn, give rise to a number of technical solutions related to ensuring product quality through the development of a systematic approach to metrological (measurement and information) support of production.

Computerized systems that provide quality control, CAQ (Computer Aided Quality) systems, must have structural, software, metrological and constructive compatibility with all other KIS subsystems: computer-aided design CAD (Computer Aided Design), manufacturing CAM (Computer Aided Manufacturing), planning CAP (Computer Aided Planning), etc.

The quality assessment of KIS subsystems should also be carried out in the CAQ system. The construction of CAQ systems is currently a very urgent and actively being solved task. When constructing and optimally synthesizing CAQ, the measurement and information subsystem of the equipment should be considered as a solution to an independent problem of measurement and information support.

Metrological tools and production automation. One of the most important technologies used in industry to improve product quality is to ensure increased productivity at low cost.

3D technology has enabled the transition from previously used autonomous quality control measurements to manufacturing. Instead of increasing the frequency of measurements, automakers are implementing automated controls and integrating the generated control data into all their product management systems, providing real-time, fast information that helps make decisions about current production.

Emerging metrology technologies allow for accurate metrological data to be obtained for any complex part and for comparison of part dimensions and completeness. The system adopts industrial robots installed in the production line at the measuring station and CMMs.

The 360 SIMS robotic zo-metrology system is a body-in-white terminal station that allows for the measurement of internal and external body parts, i.e., accelerating the automation and speed of automotive manufacturing processes.

Using powerful ICT analytics tools to analyze measurement data makes it easier for manufacturers to identify problems so they can be quickly resolved. The system uses innovative software that enables the development of new and more efficient measurement processes.

Examples of such a measurement and information system include X-GAGE3D sensors that accurately analyze point clouds and Isra ROBOTIC Zee-geometry sensors that measure a large range of vehicle models in real time as relative or absolute measurements. This allows for early detection of defects and quality control of production processes. 100% monitoring allows for immediate response to even the smallest deviations and ensures that no defective component is transferred to the next stage of production. The time and effort required to transport components to the SMM room for analysis is also reduced.

Extensive statistical analysis capabilities provide information on production status and quality achieved during operation. Based on the analysis of process statistics, a warning system can be set up with special settings.

of measurement .pinii is a robotic sensor system controlled for high-precision zo-inspection of the geometry of all relevant measurement elements, such as edges, all types of holes and surfaces. Based on the X-GAGE3D sensor range, the system offers relative measurements with automatic temperature compensation.

Autonomous measurement. A robotic sensor system for high-precision ZP inspection of the geometry of all measurement elements, such as edges, all types of holes and surfaces near the assembly line. The system is particularly suitable for complex inspection of individual parts and components in production environments or in SMM rooms. The system, based on X-GAGE3D sensors, offers relative measurements with automatic temperature compensation. Absolute measurements are also available.

Measurements in vehicle performance. As vehicle lifespans and mileages increase, reaching and exceeding hundreds of thousands and millions of kilometers, measuring characteristics and quantities related to vehicle performance has become increasingly important.

More efficient measurement methods. RDB installation by Advics Manufacturing Ohio Inc. reduced the time to measure the contours of automotive brake components from 45 minutes for a specialist to 3 minutes for a generalist.

That is, today metrology: both as a science and as a practical activity, scientific and practical functions are closely interconnected (65% of precision mechanics instruments at a modern enterprise require training in the specialty "smart measuring instruments"), and in connection with the training of bachelors in the specialty "Metrology", it is necessary to remember the following

most general principles, which are related to the metrological support of products and production and are necessary:

1. take measurements,
2. parameter management.
3. servicing measuring equipment,
4. Implement high-level proposals improvement of metrological processes,
5. preparation of relevant documents,
6. Engage in quality control of measurement performance use measurements,
7. Certification of testing equipment. Metrological examination of documents, etc.

That is, a metrologist today must not only know how to use this or that device, but also understand where these measurements will be used. The main task of a metrologist today is to justify the requirements for the composition of measurements from the point of view of the purpose of technical facilities. And the second task of the metrological service is to assess the compliance of the selected park with the production tasks of the enterprise.

Certain changes are taking place in the world of metrology, with a joint decision of the world metrological organizations introducing a new concept of traceability of measurements based on measurement uncertainty, which applies to everyone - standardizers, testers, technologists, metrologists.

Devices that are currently actively used in high-tech enterprises, the FIE reference book and educational literature are provided, or rather, they exist, but they are mostly in English.

The automotive industry depends on the precision of manufacturing uniform and accurate parts. As the demand for high-quality automobiles increases, metrology equipment is expected to become more sophisticated and automated in the future, which requires the improvement of the training of metrology specialists.

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