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TPM GENERAL MAINTENANCE REQUIREMENTS OF THE INTERNATIONAL STANDARD ISO 9001:2015 AND IATF 16949:2016.

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Abstract: Since it is based on the ISO 9001 standard, it can be easily integrated with already established management systems, such as ISO 14001. As a result, the implementation of IATF 16949:2016 requires significantly less financial and time investment, while providing good prospects for further business development. The organization's partners and customers are interested in the confirmation of the quality of the manufacturer's products. Thus, the presence of a certificate of compliance with the requirements of the IATF 16949:2016 standard leads to consistently high product quality and demonstrates the stability of the supplier company.

Keywords: ISO, TPM. Certificate, standard, defect, supply, leadership, demand, improvement, version.

The International Organization for Standardization (ISO) is an international organization for standardization founded on February 23, 1947. The headquarters of this organization are located in Geneva, Switzerland. The goal of the ISO international organization is to improve the quality of products and services worldwide by developing and implementing international standards. The ISO organization currently has more than 169 member countries. Uzbekistan is among these countries. In 2000, the ISO organization released the ISO 9001:2000 version. This version introduced a process-based approach. In 2008, ISO 9001:2008 was released. This standard provides for further clarification and improvement of existing systems. By 2015, the world's most famous international version, ISO 9001:2015, was produced. This version focuses more on the needs of organizations and stakeholders based on risks. The ISO 9001:2015 standard consists of 10 sections , the main requirements of which are as follows.[2]

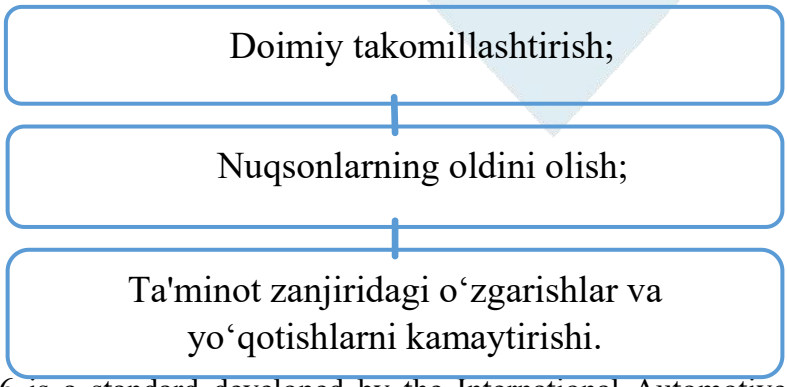
- Leadership is the responsibility of top management, quality policy.
- Planning, risk and opportunity analysis, quality objectives.
- Support resources, skills, products and services.
- Results assessment, monitoring, measurement, internal audits, management review.
- Improvement, bug fixes, continuous development.

ISO 9001 is the most widely used quality management system standard worldwide. As of 2024, it is used in more than 169 countries. More than a few hundred thousand certificates are issued each year. In 2023, more than 1 million companies worldwide were ISO 9001 certified. IATF 16949:2016 is an international automotive industry standard and technical certification. The standard specifies requirements for quality management systems for companies involved in the design and maintenance of products in the automotive industry . IATF 16949:2016 and ISO 9001:2015 provide industry-wide requirements for the management and monitoring of safety-related components for products with integrated software.[2]

The version of IATF 16949:2016 was developed after the revision of ISO 9001:2008 in 2009. ISO 9001:2008 has specific requirements for the application in the automotive industry and related parts manufacturing organizations. The purpose of IATF 16949:2016 is to specify the requirements for an organization's quality management system . (Figure 2.1.1)

Scheme 2.1.1

IATF 16949:2016 quality management system requirements



IATF 16949:2016 is a standard developed by the International Automotive Working Group IATF and Japanese automobile manufacturers. IATF 16949:2016 is a standard developed by Technical Committee 176 and is based on the structure of ISO 9001:2008 . Scope of certification The IATF 16949:2016 standard applies to all organizations in the automotive equipment and component supply chain. The specific feature of the IATF 16949:2061 application specifies requirements for organizations to use a number of tools. Manufacturers of automotive parts or suppliers of services such as storage, transportation, calibration, etc. cannot be certified in accordance with the requirements of IATF 16949:2016 in their quality management system. The requirements of the sections of the standard are the same as those of ISO 9001:2008. (Section 2.14) Defect reduction is based on the implementation of the process for implementing this clause. The enterprise has the opportunity to improve the efficiency of production processes and, as a result, reduce the number of defective products, resources and time costs. Defect reduction is based on the implementation of the process for implementing this clause. Thanks to its use, the enterprise has the opportunity to increase the efficiency of production processes and, as a result, reduce the number of defective products, resource and time costs.

Scheme 2.1.4

Reduce defects is based on the implementation of the process of implementing this item. Thanks to its use, it is possible to increase the efficiency of the enterprise's production processes and, as a result, reduce the number of defective products, resource and time costs. Certification has become a mandatory condition for trade relations for almost all automotive companies. The reason is that it makes it much easier to do business in this system, it is a standard recognized all over the world.

Obtaining a certificate of conformity to IATF 16949:2016 helps to solve problems with FMEA , SPC , MSA and PPAP indicators. (Table 2.2) Auditing is voluntary. All major global automobile manufacturers require their automotive component suppliers to conduct it. This also applies to second-tier and subsequent suppliers. Statistics on certification of quality

management systems according to IATF 16949:2016. By the end of December 2011, 47,512 IATF 16949:2016 certificates had been issued in 86 countries. The countries with the largest number of certificates are: China, the Republic of Korea, the USA, and in Europe, Germany is the leader. The requirements of clause 8.5.1.5 of the international standard IATF 16949: 2016 for reducing downtime and improving efficiency are widely used. (Table 2.1.1)

Table 2.1.1

Key indicators **of IATF 16949:2016 .**

PPAP	Production Part Approval Process - Component Production Approval Process
FMEA	Failure mode and impact analysis is an analysis of the types and consequences of possible failures.
SPC	Statistical process control
MSA	Measurement System Analyses.

The maintenance and repair system plays an important role in ensuring the production efficiency of an enterprise. The condition of equipment, technological lines and production facilities directly affects product quality, production continuity and labor productivity. In this section, we will consider the current state of the maintenance and repair system at the enterprise, existing problems and opportunities for improvement . General description of the existing system In most enterprises, the maintenance and repair process is carried out in planned and emergency ways.

Scheduled preventive maintenance includes scheduled inspections and maintenance work based on equipment life, production load, and production schedules. Emergency maintenance is the rapid repair work performed when unexpected equipment failures occur.

Production line downtime, production schedule disruption, quality degradation, and increased repair costs are possible. Currently, a separate engineering and technical service department has been established for maintenance work, and the following groups operate within this department. (Scheme 2.2.1) Although there is a clear maintenance schedule, it is not always fully followed. In some cases, maintenance is delayed, carried out after a malfunction is detected in the equipment. This helps to strengthen the positive approach instead of prevention. Condition of equipment and level of maintenance Most of the equipment used in the enterprise has a service life of 5–8 years.

Scheme 2.2.1

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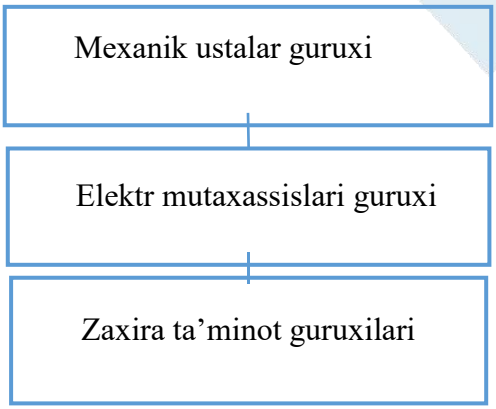
Master groups at the enterprise



Condition of equipment and level of maintenance Most of the equipment used in the enterprise has a service life of 5–8 years. Although some of it is modern, most of it is outdated and often breaks down. The low rate of equipment renewal and failure to replace outdated technologies increase the maintenance load. Factors that lead to a decrease in the quality of maintenance;

- Lack of sufficiently modern diagnostic tools;
- Lack of staff training courses;
- Poor supply of spare parts for repairs;
- Lack of electronic monitoring systems;
- The company's technical maintenance system is not yet fully developed.

Maintenance is carried out as planned. Modern approaches to maintenance TPM, CMMS Computerized Maintenance Management System are not sufficiently implemented. Lack of qualified personnel, training of maintenance personnel is not constantly updated. The number of maintenance (MTO) indicators is calculated by year or month. (Table 2.2.1)

Technical service indicators

Table 2.2.1

No.	**Technical service**
1	Number of failures
2	Equipment life span
3	Reliability level (%)
4	Number of production downtimes
5	Number of employees allocated to maintenance and repair
6	Repair costs

7	Number of repairs

The TXQT system will be gradually improved based on TPM (Total Productive Maintenance);

– Implementation of diagnostic and monitoring systems;

– It is necessary to reduce technical failures by purchasing new equipment and modern equipment. Maintenance and repair work at the enterprise is carried out in an emergency approach. Information on the maintenance of the main equipment and technological systems. (Table 2.2.2)

Table 2.2.2

Toyota maintenance services per year;

No.	Year	Number of TCCs	Number of repairs	Number of failures	Reliability (%)	Costs (million $)
1	2021	120	15	30	85%	30
2	2022	135	40	28	80%	36
3	2023	140	42	21	84%	41
4	2024	155	47	20	86%	49

Maintenance processes are regularly monitored and the quality of each service is assessed. Special systems are used to analyze the efficiency and quality of services. Cost reduction and efficiency improvement include the development of processes for optimizing short-term services and repair processes. A fast and efficient maintenance system creates greater convenience for customers and reduces enterprise costs. By creating special packages for services and offering them to customers, it is possible to increase the profit of the enterprise. The timely delivery of spare parts and materials during maintenance affects the fast and efficient performance of the service. A system for storing spare parts in optimal quantities and their effective use increases the efficiency of the enterprise. This includes factors such as the introduction of modern technologies, improving staff skills, and improving customer relations. With the help of such measures, the maintenance system becomes more efficient and helps to increase the overall efficiency of the company.

To determine the level of uninterrupted operation of equipment, we work with the indicators of mean time between failures (MTBF) and mean time to repair (MTTR). (Table 2.2.3)

MTBF – how many hours of average operation does it take for a device to fail?

MTTR is the mean time to repair after a failure, in hours.

This indicates that the reliability of the enterprise's equipment is relatively stable. For some obsolete equipment, the MTBF indicator is lower, which negatively affects the continuity of production.

Table 2.2.3

No.	MTBF - MTTR indicators goals
1	Optimization of production based on TPM principles
2	Quickly upgrade outdated equipment
3	Modern digitalization of technical service and diagnostics systems
4	Regular training and development of employees in a culture of quality and reliability.

The introduction of TPM is a general production-wide effective maintenance system, the purpose of which is to keep equipment in working order, eliminate malfunctions and unplanned downtime. Equipment maintenance is the responsibility not only of technical personnel, but also of direct operators. Each employee “looks after” his equipment and takes care of it. For example, in some organizations operating in the Tashkent automotive industry, it is recommended to first implement the 5S discipline to organize the workplace, get rid of excess items and materials, maintain cleanliness, and standardize standards. At the next stage, operators are trained in simple maintenance, autonomous service, and minor malfunctions are quickly eliminated by the workers themselves. In international experience, for example, a large company Toyota is trying to achieve a “zero failure” regime by analyzing equipment malfunctions using the TPM system. Enterprises can achieve high results by developing maintenance schedules, implementing autonomous service practices, and implementing the necessary diagnostic tools.

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