now possible to develop and edit measurement programs for computer-controlled systems while substantially reducing the area required for equipment repair. One result of this has been an annual saving on labor costs.

METROLOGICAL SUPPORT TO PRODUCTION AT THE RIGA ELECTRICAL MACHINES PLANT

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A major factor in ensuring product quality and production efficiency is the level of metrological support; a unified system for technological preparation for production is in general use, and all aspects related to metrological support are handled by the metrological service, which is headed by the principal metrologist. The principal-metrologist's section is an independent subdivision of the organization and reports directly to the chief engineer.

A major purpose of the metrological support within this unified system is to provide the organizational and technical measures such as will ensure that test and measurement facilities are always available and capable of performing measurements with the required accuracy and reliability. This is essential to ensure high quality, reliability, and long working life in products; it also has an important bearing on metrological evaluation of design and other engineering documents, since these influence the analysis of metrological support to production and the metrological certification of means of measurement and test for any narrowly specialized purpose.

Over 45 thousand different measurements and test units are presently in use at this plant; all the measurement and test techniques are under the supervision of the metrological service, and schedules have been drawn up for state and departmental tests on means of measurement, in which the periods within which checks are to be performed are laid down in strict conformity with the working conditions.

The metrological service at the plant is authorized to perform its own repairs and to undertake departmental responsibilities for checks on instruments for measuring electrical, electronic, thermal, linear, angular, and other quantities within the state system of measurements, in particular in relation to the determination of mechanical parameters of materials. The staff of the metrological service repairs over thirteen thousand means of measurement every year, and also checks over 65 thousand instruments.

The service devotes particular attention to metrological evaluation of design documents

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and other engineering documentation; all current and newly drafted forms of technical documentation throughout the plant are submitted for metrological evaluation.

An important function of the service is regular examination of the state of measurements and the level of metrological support to production. The metrological support to various forms of product is analyzed in order to direct the attention of metrologists to any problems arising in improving product quality. For example, for a long period there were difficulties in running a process for impregnating and drying the armatures of traction motors with monolithic insulation on account of imperfect methods and means of monitoring the working conditions, which involve the use of high vacuum and very close temperature control. The metrological service suggested that new and better means of measurement of a higher class of accuracy should be used in the technique, and also that the temperature, pressure, and other parameters should be recorded on charts as functions of time. This provided a more objective and reliable means of operating the technique, which resulted in an improvement in the quality of the armatures and coils. Again, there had long been a difficulty in the casting shop over temperature measurement for liquid steel. The metrological service defined a solution, which involved direct insertion of a tungsten-molybdenum thermocouple into the molten steel, which worked into a KSP-4 electronic potentiometer. This resulted in a considerable improvement in the quality of many cast products.

Product quality and metrological support within this unified system are very closely linked to the use of test facilities of highly specialized type, which enable one to ensure that the actual parameters of products conform very closely to the specifications laid down in standards and technical specifications.

The staff of the service has also performed a comprehensive metrological evaluation of the test facilities used throughout the plant, particularly in order to ensure that they meet the metrological specifications and are suitable for performing the tests on the products, for which purpose the means of measurement have undergone metrological certification. A major line of activity in the metrological service is also the introduction of new methods and means of measurement and test.

For example, specialists in the electrical measurement laboratory have devised, built, and installed various systems for performing pulse-voltage tests on the insulation between turns and from coils to the frame for the traction motors of electric trains. An instrument has been designed and built for determining the forces on brushes in traction motors, and digital instruments have been introduced for testing the coils in magnetic probes.

The heat-engineering laboratory has designed and built systems for checking heat-measurement facilities; various technical problems have been overcome in the measurement of the temperature of molten steel, in the impregnation and drying of armatures for traction motors, and in the improvement of techniques and methods in repairing and checking imported means of measurement.

Engineers in the laboratory of linear and angular measurements have designed and built various monitoring devices for checking surfaces for parallelism by means of micrometers having limits of measurement above 100 mm, as well as a device for providing a vernier facility for the ShTs-1 angle gauge. The mechanical-measurement laboratory had devised a remote-sensing means of measuring frequency of rotation for traction motors, and also a means of measuring the forces between contacts in starter relays.

At present, many studies are in hand on metrological support within the framework of this unified system, particularly as regards a comprehensive quality-control system. The metrological service works within the framework of the latter and has devised and introduced various in-house standards, which serve to link the operations of the subsections of the plant as regards metrological support within the quality-control system. These in-house standards include "Metrological support to production: Basic concepts," "Organization and sequence of execution of metrological evaluation of design and other engineering documents: Basic concepts," "Means of measurement: Metrological support," "Nonstandard equipment: Planning, definition of design documentation, commissioning, and metrological certification," "Rating data for nonstandard equipment," and "Measuring instruments: Choice of means of measurement and monitoring for linear and angular dimensions."

The principal metrologist's department has provided considerable practical help to the