The Ministry of Instrumentation has adopted a comprehensive quality-control system. The metrological support subsystem plays an important part in this, since it provides support to a wide range of means of measurement and to automatic control systems that meet the latest requirements. This system also provides the scientific basis for metrological support to the appropriate technical documentation. The following articles deal with experience in the organization of metrological support to quality control in instrumentation.

MICROPROCESSORS IN INSTRUMENTATION AND INDUSTRIAL METROLOGY

M. S. Shkabardnya

The Ministry of Instrumentation plays a leading part in supplying industry with means of measurement that have major functions in controlling the quality of many products, which itself has required advances in instrumentation. A major trend in the instrumentation industry, which provides the engineering basis for metrological support, is the general use of high-throughput automatic facilities, which include means of processing and transmitting data.

The design of the latest instruments involves the definition of methods of construction, which may use new physical principles, including microelectronics, while the industrial production of such instruments requires new technologies, new equipment, and specialists with appropriate training. Particular importance here attaches to strengthening metrological support subsections, including improved qualification in workers' who should be oriented to implementing the latest methods and means of metrological support, particularly ones accompanying the automation of the latest technologies in instrument production.

Automation of instrument production and of quality-control methods is an important task for instrument designers; the general use of automatic instruments and automatic production processes in microelectronics has required a considerable increase in the level of metrological support to many industries that employ instruments, as well as improved metrological support to the instrument-making industry itself.

Microelectronics forms a major means of scientific progress and is developing as an independent area, in which various physical, chemical, technological, and cybernetic researches are involved, all of which lead to the design of small and highly reliable instruments.

A major achievement of modern microelectronics is the production of microprocessors, which provide for programmed data processing by means of LSI chips or modules containing basic LSI together with local storage and interfacing components.

Microprocessors appeared quite recently, but they have already had a vast influence on computing and the implementation of computing techniques in many branches of industry, research, and everyday life. Microprocessors are used in measuring instruments, digital data processing devices, and the like in industry, transportation, medicine, etc.

There are several reasons for the introduction of microprocessors, the main one of which is the level of microelectronic technology that has now been attained, which enables one to produce large integrated circuits that can accommodate complex functions involved in computing devices on single chips. Major features of microprocessors responsible for their general use are: low cost, small size, low power drain, and flexibility in use (programmability).

The design and production of units employing microprocessors and microcomputers has become a major line of advance; the industries of this country in recent years have developed and produced various promising standard microprocessor devices based on LSI.

The volume of instruments and other devices employing microelectronic units is continuously increasing; microelectronic components are used particularly in computing, electrical...
measuring instruments, analytical apparatus, monitoring and control instruments, data-acquisition devices, interfacing, preprocessing units, and data sensors.

In metrology, microprocessors are built into complex measuring and analytical instruments, including the control units, in order to provide improved performance and accuracy. Specialized microcomputers are used in programmable controllers for local monitoring and control in distributed automatic systems for many processes and industries. Such facilities also provide for efficient automation of scientific experiments. This provides an essentially new scientific basis for automatic devices generally in industry and science.

The instrumentation industry is researching the design of a basic range of components and units employing LSI microprocessors and microcomputers, which will include in particular the following: devices for automatic group processing of chromatographic data, a suite of instruments for monitoring and regulating thermal-power parameters, programmable combined digital measuring instruments, and various facilities for data processing.

Microprocessors should play a considerable part in improving measuring processes and instruments; they provide a basis for test-signal methods of error correction as well as techniques based on standard signals, which can greatly reduce the systematic errors in many instruments while extending the permissible limits of variation in the environmental parameters and simplifying the analog sections of instruments by relaxing the specifications for stability and accuracy.

When microprocessors are incorporated into monitoring and recording instruments, the accuracy is improved considerably, as are the response rate and the reliability, while the cost is reduced, particularly on account of self-diagnosis and automatic data preprocessing. Further, the functions of the instruments are extended, and the performance in the following areas is greatly enhanced: averaging, calibration, correction, linearization, temperature compensation, reading comparison, multiplication of readings by a constant, monitoring and management of complex instruments, fault diagnosis, data preprocessing, display, recording and data presentation, and instrument testing and checking.

Microprocessors are widely used in digital instruments, recording, signal generation, geophysical equipment, chromatographs, automatic testers, biomedical instruments, etc. They substantially simplify multifunctional automatic instruments by eliminating the need for precision analog sensors and by improving the general performance of multifunctional instruments, which means that many functions can now be accommodated with fewer instruments.

For example, the main effect from using microprocessors in mass measurement is expected in the field of multiple-weighing devices, where there are several measurement channels, the processes tend to be highly dynamic, and the processing algorithms tend to be complex. So far, hardware available for this purpose has been of limited accuracy. A very promising line is also the use of microprocessors in belt-conveyor weighing, as well as in continuous-acting dispensing systems, where the dispensing of several substances requires tracking of the operation of several transducers and appropriate management of material flows.

Microprocessors are also important in test engineering, where one tends to encounter large volumes of data generated during the tests themselves.

Research is also in hand on the use of microprocessors in analytical instruments and in automatic controls for industrial processes; good results have been obtained. Microcomputers are used in x-ray equipment to improve the accuracy and speed of analyses, and also to make available far more automatic instruments. Gas analyzers can provide improved accuracy and response rate as well as comprehensive automation with data output in real time.

Automatic processing of chromatographic data by microcomputer means that chromatographic laboratories can be equipped with compact devices that provide high accuracy in the selection of peaks, integration, correction, and concentration determination.

The Ministry of Instrumentation has built a system for micro-computer processing of chromatograms, which is to be used in systems for monitoring the environment and for managing petroleum refining. Equipment has been developed for automatic processing of x-ray data, along with other instruments and systems employing microprocessors. The forward plans for development in the instrument industry include researches on new means of processing data by means of the latest LSI microprocessors.