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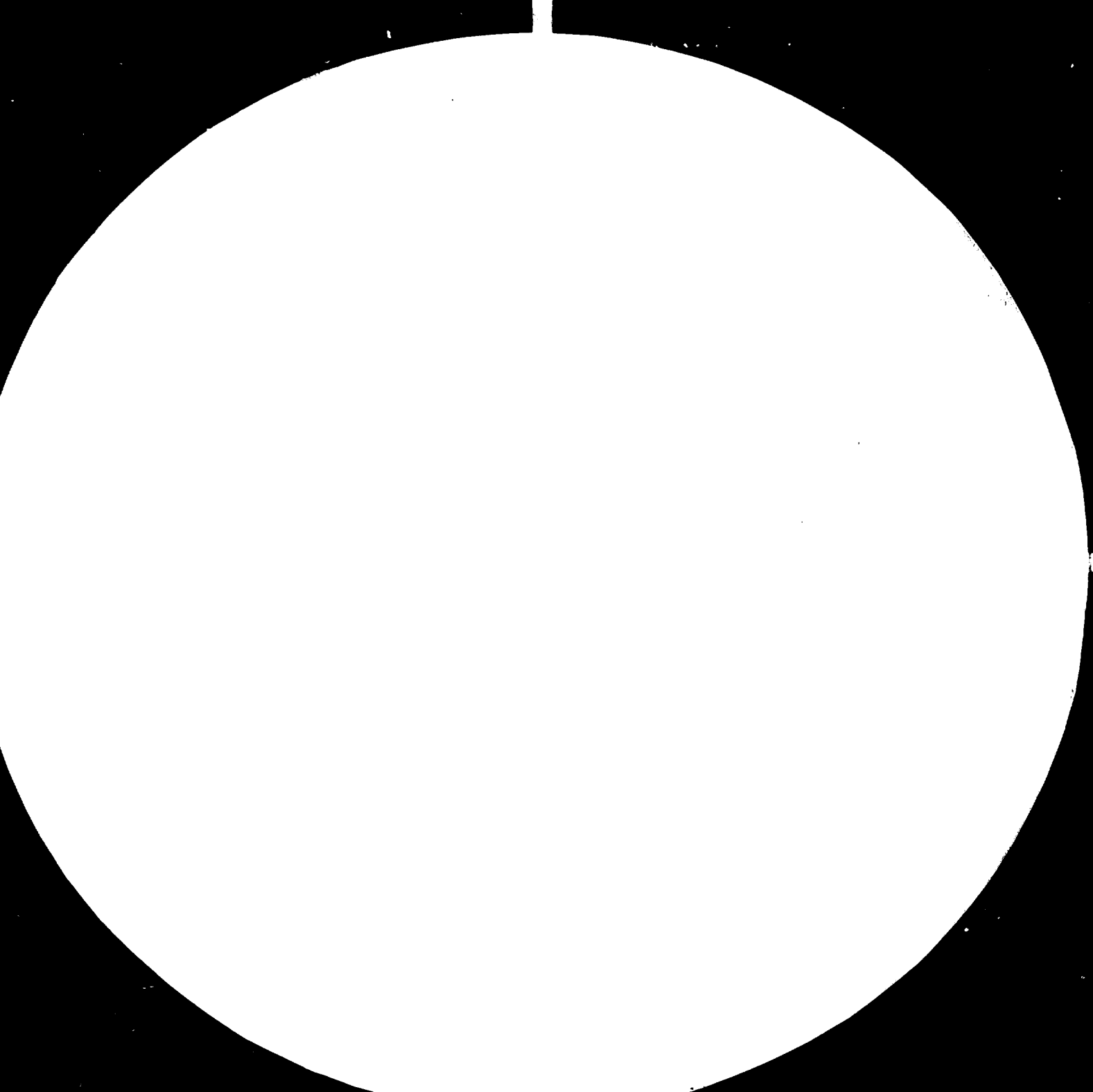

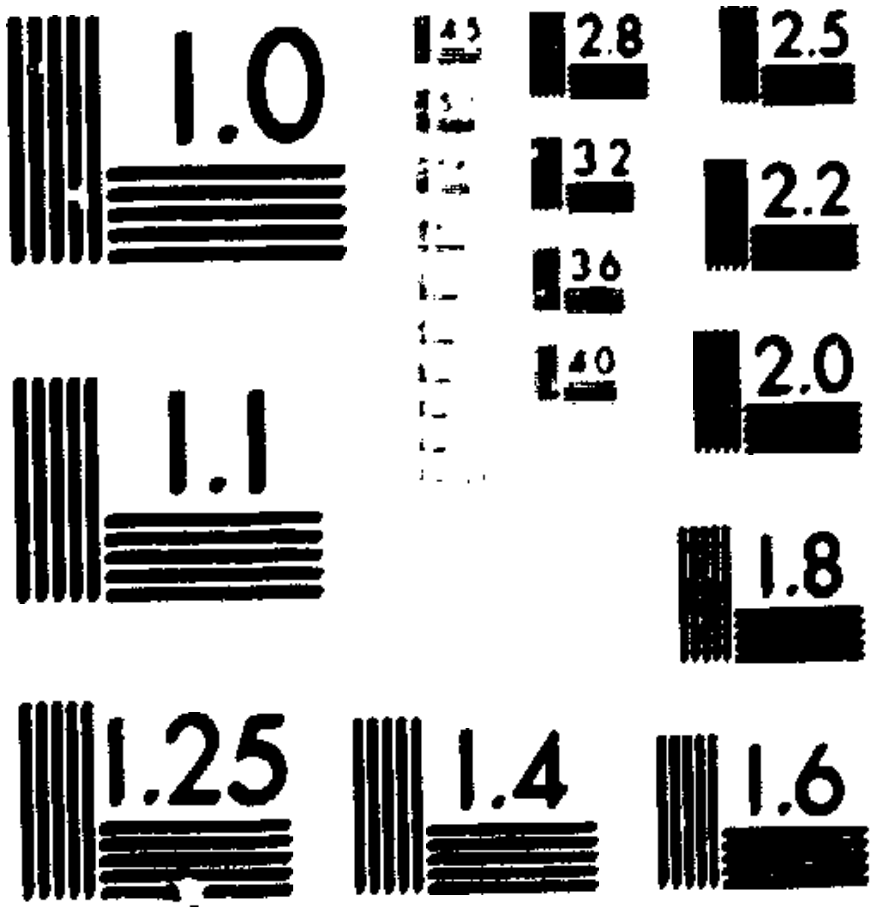

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Meeting on Industry-Research Institute Linkage
with Special Reference to Instrument Design

Sofia, Bulgaria, 20-24 April 1981

RESEARCH INSTITUTE-INDUSTRY LINKAGE WITH SPECIAL REFERENCE TO INSTRUMENT DESIGN*

Prepared by

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Under the conditions of the scientific and technical revolution, the training of specialists with higher education is closely connected with the processes of research investigations and production.

Unifying of the three activities - education, science, production brings to the formation of well trained graduates with possibilities for a quick realization in life.

The architect of the New Educational System in the People's Republic of Bulgaria, Todor Zhivkov, Chairman of the State Council set the task of training of many-sided image of our young graduates.

The achievement of this task requires the Higher Educational Institute to be changed into a compax educational - research center and the training process into a training research one which imposes full utilization of the scientific potential.

The role of the Higher Educational Institute (HEI) for the development of science and technical progress has two aspects. HEIs on the one hand train highly qualified specialists on the other participate actively in the R & D activities and in the implementation into production which appear to integral parts of the training process.

The development of the training process and training of highly qualified specialists as well as the enhancement of the teaching staff qualification cannot exist without active and purposeful research work.

The Educational Reform in the People's Republic of Bulgaria is a naturaly result from the socialist development of the country and the great cares taken by the Bulgarian Communist Party. The economic, social and organizational factors which played an active part in the occurred changes are as follows:

- the rapid rates of building of the material and technical base of the socialist society in our country
- the new economic conditions in our country
- the accelerated development of the scientific and technical revolution

INSTITUTE STRUCTURE AND ACTIVITY

As it was mentioned the Institute for Instrument Design was founded in 1966 in the frame of the Company State Economic Enterprise (SEE) "Instrumentation and Automation" (I & A), attached to the Ministry of Electronics and Electrotechnics. SEE "I & A" runs more than 20 plants, producing and marketing process control instruments for the local and international markets. Every item produced in these 20 plants is developed and implemented by the Institute for Instrument Design.

With a staff of 700 employees, including 200 Masters and Doctors of Sciences, 20 Assistant Professors, 1 Professor, and 300 Technicians, Physicists and Economists, the Institute covers a broad range of activities as mentioned, being responsible for:

- Marketing and forecasting (both local and international markets)
- Suggesting the instrument specifications to be developed produced and introduced into the market
- Providing research and development of the new products
- Preparation of the prototype, quality testing and reliability evaluation
- Preparation of technical documantation, including complete drawings, process flow-chart diagrams, assembling and testing instructions etc.
- Designing and producing of special tools and special testing equipment for the pilot series and mass production of the product in certain plants of the company
- Training the plant (factory) personnel
- Consulting the plant(factory) management on the organization of the production process of the new product
- Consulting and training of the customer personnel on the correct and efficient use and implementation of the new product
- Training and consulting the service personnel on effective service of the new product.

The Institute is headed by a Director, assisted by a Scientific Council, Deputy-Directors and General Affairs Department. The Institute has several departments:

- Electronic Measuring Instruments
- Electromechanical and Pneumatic Instruments
- Numerical Control of Machines
- Process Control Instruments
- Production Technology, Special Tools and Special Testing Equipment
- Prototype Working Shop
- Special Tools Production Shop
- Marketing and Forecasting
- Quality and Reliability Control and Evaluation.

The Institute cooperates intensively with other branch-institutes, the Bulgarian Academy of Sciences, Universities, and especially closely with plants' technical departments. It is important to be mentioned also that the Institute cooperates with many institutes and companies abroad. Good contacts are established with several institues in the developing countries. The last item will be discussed later on.

FINANCING

The Institute's activity and financing is based on Project contracts only (slide No.2). The basic part of the contracts is submitted by the company State Economic Enterprise "Instrumentation and Automation", which runs the company's plants. The company draws the project taking into consideration the market demands, both local and international, as well as the company strategy.

A smaller part of the projects comes from the Ministry of Electronics and Electrotechnics covering the Ministry involvement in instrumentation and automation.

Another part of the contracts comes from the State Committee for Science and Technical Progress, usually connected with long-term strategy and basic (fundamental) research. A very

small part of the contracts comes from the Company's plants, usually connected with production technology modernization as far as the basic plants R & D demands are directed to and through our company.

Occasional contracts come from other sources, usually connected with the solution of specific R & D or quality and reliability evaluation problems.

NEW PRODUCT DESIGN TEAM

After the project contract is signed, a project team is formed to provide the complete R & D and implementation work. In this team as a rule the plant peesonnel is included, i.e. specialists from the plant, designated to introduce into series production the product to be designed. This project team is headed by a project manager - usually a person with more than ten years of experience in R & D. The appointment of the project manager is extremely important task, because his duties include qualification, both in management and technics (R & D) and introduction into series production. He has to be also very skilled in software and hardware technics. The structure of the team (slide No.3) based on a digital voltmeter example, includes:

- input circuitry project engineer
- analog-to-digital circuitry project engineer
- display circuitry project engineer
- power - supply project engineer
- mechanical construction project engineer
- technicians and other personnel.

It is very important to mention once more that from the very beginning of the project, plant personnel works in the project team. This is significant for speeding-up the introduction of the new product into series production, which could be a crucial time-consuming business.

NEW PRODUCT DESIGN SCHEME

It is rather difficult to define completely the new product design scheme because of its complexity, including a great variety of activities, involving a large number of people and laboratories, within the institute as well as out of the institute. Anyway, I have tried to derive a rather rough scheme, basically applied at the institute during the last several years (slide No.4)

The new product design procedure includes the following steps:

- technical and economical evaluation
- laboratory model design
- internal laboratory testing and evaluation
- prototype design, including technical documentation
- official quality and reliability testing and certification
- prototype documentation, special equipment and tools production
- in-plant pilot-series preparation, including personnel training
- in-plant pilot-series production
- official quality and reliability testing and certification.
- mass production.

After the new product enters mass production, the institute team returns back to the institute for carrying out a new project.

It is essentially important to mention, that the special testing equipment and tools, necessary for the new product are designed and manufactured at the institute.

The Institute provides also the start-up customer personnel training in application of the new product. After finishing

the technical evaluation stage, the prototype stage and pilot production stage, the project team reports to the Scientific Council Board. The Scientific Council Board decisions for improvements and/or alternations are ultimately obligatory.

The proposed scheme is an example of the close cooperation between the Institute and industry, the involvement and Institute's responsibility throughout the whole course of project realization - from technical evaluation to mass production.

On slide No.5 a technical and economical evaluation of the product to be designed is shown. It includes:

- state-of-the-art study
- component and material considerations
- production and R & D equipment necessary
- man-power and personnel qualification considerations.

This activity finishes with:

- detailed technical spec's draft
- detailed time-schedule draft
- special problems considerations.

The Scientific Council Board makes the final decision for the project. Sometimes the Board can cancel the Project, if the technical and economical justification proves that the Project is not a prospective one. Such a cancel-decision can be done on every stage of the R & D process taking into account the market demands and other technical and economical considerations.

QUALITY AND RELIABILITY TESTING & EVALUATION

The instrumentation products on the market have to meet extremely high and heavy quality and reliability standard requirements. This is especially valid for the professional instru-

ments working in heavy environment conditions, controlling 24 hours day and night production processes. Sometimes a single failure can cause tremendous production losses.

This is the reason we are involved in a large scale quality and reliability testing & evaluation, both during R & D stage and production stage. A special laboratory is established, equipped with a large scale testing equipment. The test results appear as quality and/or reliability certificate. Without such a certificate no new product can be introduced on the market. The quality and reliability test provided in this laboratory are represented on slide No.6:

- Performance-test at normal ambient conditions
- Environmental tests
- Mechanical tests
- Transport and storage tests
- Reliability tests
- Data analyses
- Evaluation
- Final report

The basic quality & reliability testing reference equipment and facilities are represented on slide No.7 and includes:

- Reference standard-resistors, inductance and capacitors
- Reference voltage sources
- Reference frequency oscillators
- Laser interferometer
- DC potentiometers
- R, L, C bridges
- AC-DC digital voltmeters and multimeters
- Frequency meters
- Oscilloscopes
- Generators
- Electricity meters
- Recording instruments
- Power sources including programmable power supplies

- Equipment for mechanical vibration measurement
- Temperature meters
- Microscopes
- Temperature test chambers
- Salt spray chamber
- Bump test machine.

The reliability testing & evaluation scheme is represented on slide No.8 and includes:

- List of reliability requirements
- Type of test: compliance or determination, laboratory or field
- Test plan: number of test item, test time, replacement policy
- Test item sampling
- Specification of test cycle
- Operating conditions
- Environmental conditions
- Preventive maintenance
- Test item parameters to be monitored, parameters to be measured, monitoring intervals
- Limits of acceptable performance
- Definition of failure demanding immediate reject decision
- Data to be recorded, extent of recording
- List of necessary test equipment
- Test time schedule
- Data analysis
- Evaluation
- Final report.

TRAINING AND EXPERT ASSISTANCE OPPORTUNITIES

Highly appreciating the UNDP-UNIDO assistance the Institute is open for assisting the developing countries.

A twinning agreement is signed between the Institute for Instrument Design and the Electronic Industries R & D Center, Cairo, Egypt. New twinning agreements are under preparation with

Marmara Institute, Istambul, Turkey and Testash, Ankara, Turkey. Many fellows were trained and assistance was given to UNIDO projects in Egypt, Peoples' Democratic Republic of Korea, Mongolia etc. The Institute is ready to accept fellows from the developing countries for training at Institute facilities. We offer also short and long term expert assistance for organization and evaluation of the research, development, production and marketing of laboratory and process control instruments. Quality and reliability testing and evaluation is also available. We offer also expert assistance in organizing the instrument service.

The Institute provides nation-wide service of PYE UNICAM INSTRUMENTS. A new service contract with HEWLETT PACKARD is under preparation for taking the service of HP instruments and computers in our country.

Language training laboratory operates at the Institute. Skilled engineers with good knowledge of English and/or French, German are available to supervise the fellows training at the Institute. With UNDP-UNIDO assistance, a microprocessor training laboratory is established both for MOTOROLA and INTEL microprocessors. Eight bit training facilities are installed and permanent training activity is underway. It proved extremely helpful; excellent results were achieved.

In this connection, I should like to draw your attention to the following subject to be discussed at this meeting:

The rapid LSI technology development causes broad extension of microprocessor application:

- Instrumentation — Every digital measuring instrument is becoming a micro-processor data processing system.
- Automation — Total distributed control systems are applied in all fields such as petro-chemical plants, fertilizer plants, power stations, food industry, pollution control, machine tools, information processing.

- TV sets — Micro-processor programmable controllers are rapidly developed and applied. Based on the powerful and cheap micro-processor technology, the TV sets are becoming a sort of home information and even home training system.
- Washing machines
- Home cooking facilities, etc.

This rapid micro-processor development requires also rapid personnel training in general, micro-processor hardware and software, structure and organization, installation, use, service and application, not only in the developed countries, but also in the developing countries. The world experience, as well as ours shows that a strong psychological barrier has to be overcome in order to become familiar with the micro-processors in general.

That's why I should like to propose a INTERREGIONAL TRAINING CENTER ON MICRO-PROCESSOR DEVICES to be organized at the Institute, based on the existing experience and facilities with additional UNIDO assistance. This center will provide excellent opportunities for long and short term training for the fellows from developing countries both in microprocessor and traditional devices. The training can start immediately, based on the existing facilities, but additional facilities have to be supplied with UNDP-UNIDO contribution.

CONCLUSION

1. The Institute for Instrument Design works in very close cooperation with Company-industry plants.
2. The Institute for Instrument Design staff is involved in the full R & D and production process.
3. The Institute's activity is based on contracts only.
4. Training opportunities and facilities for fellows from developing countries as well as expert assistance are available.
5. An interregional training center is proposed.

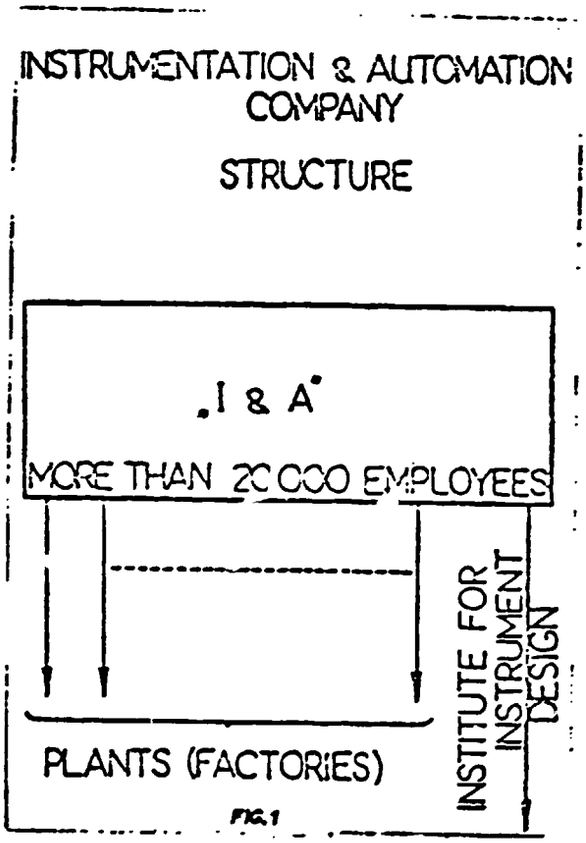
INSTRUMENTATION & AUTOMATION COMPANY
STRUCTURE
„I & A"
MORE THAN 20 000 EMPLOYEES
PLANTS (FACTORIES)
INSTITUTE FOR INSTRUMENT DESIGN

FIG.1

CONTRACT SOURCES

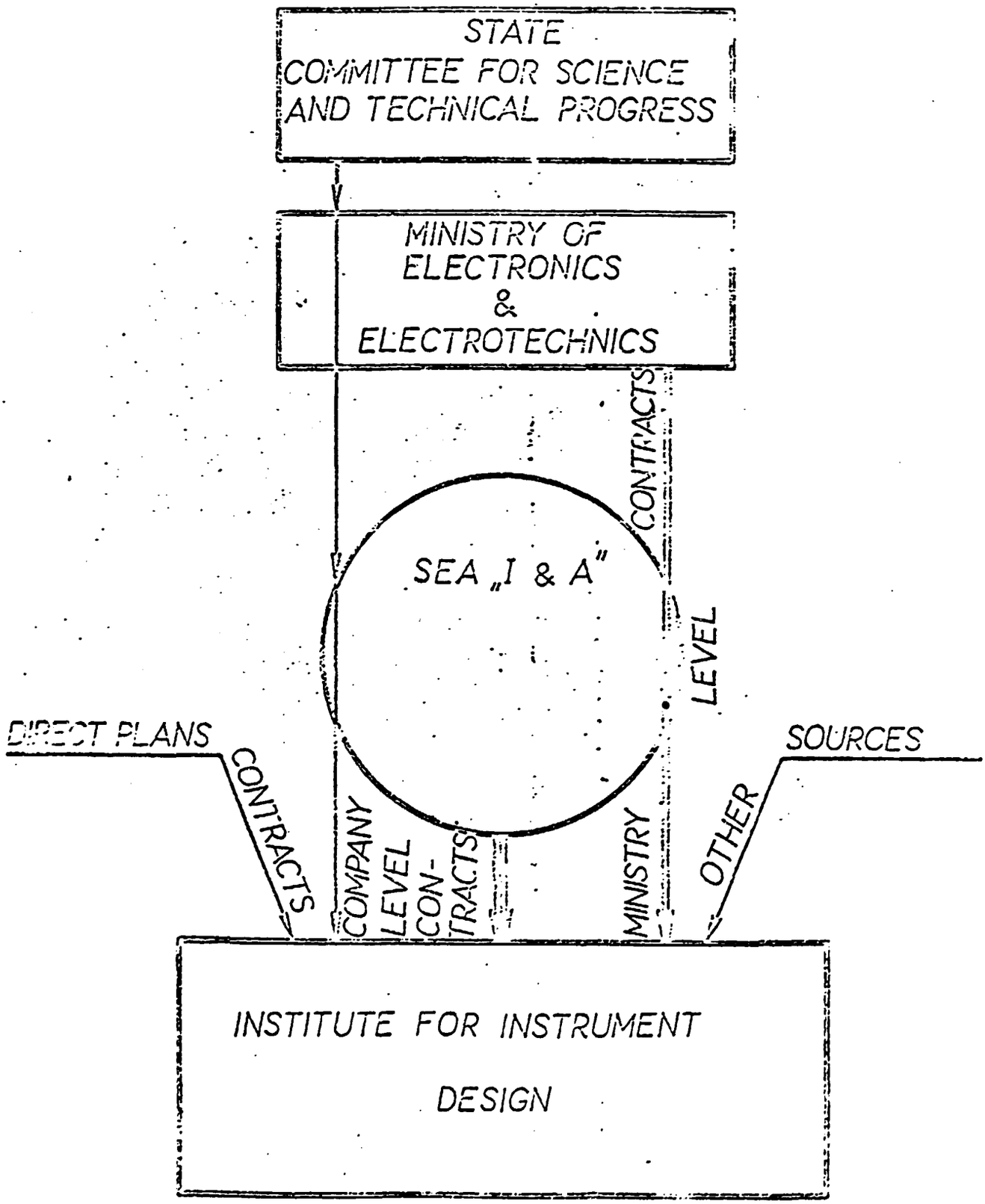

FIG. 2

NEW PRODUCT DESIGN TEAM
BASED ON DIGITAL VOLTMETER EXAMPLE
(INCLUDING INDUSTRY PERSONNEL)

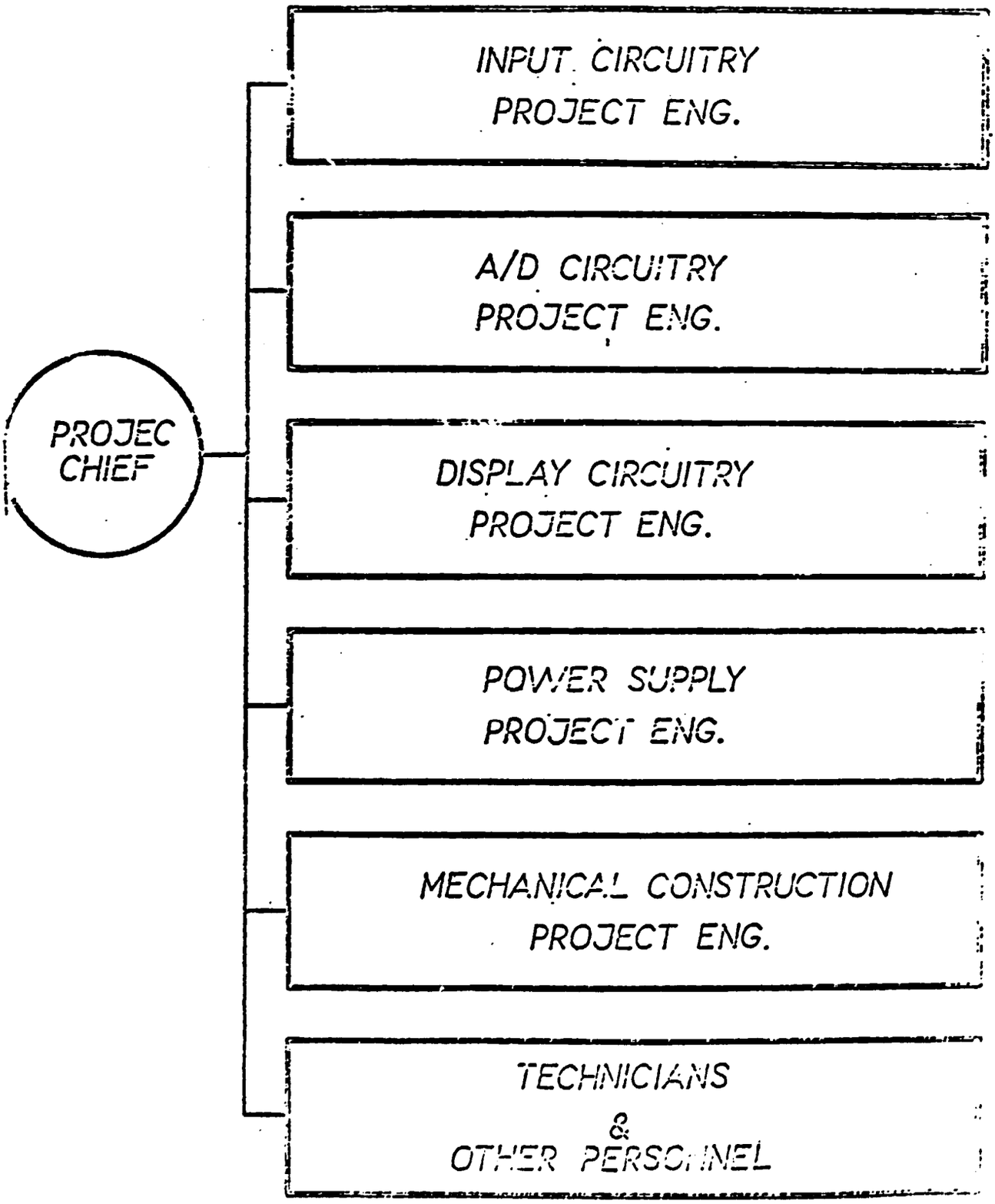

FIG. 3

NEW PRODUCT DESIGN SCHEME

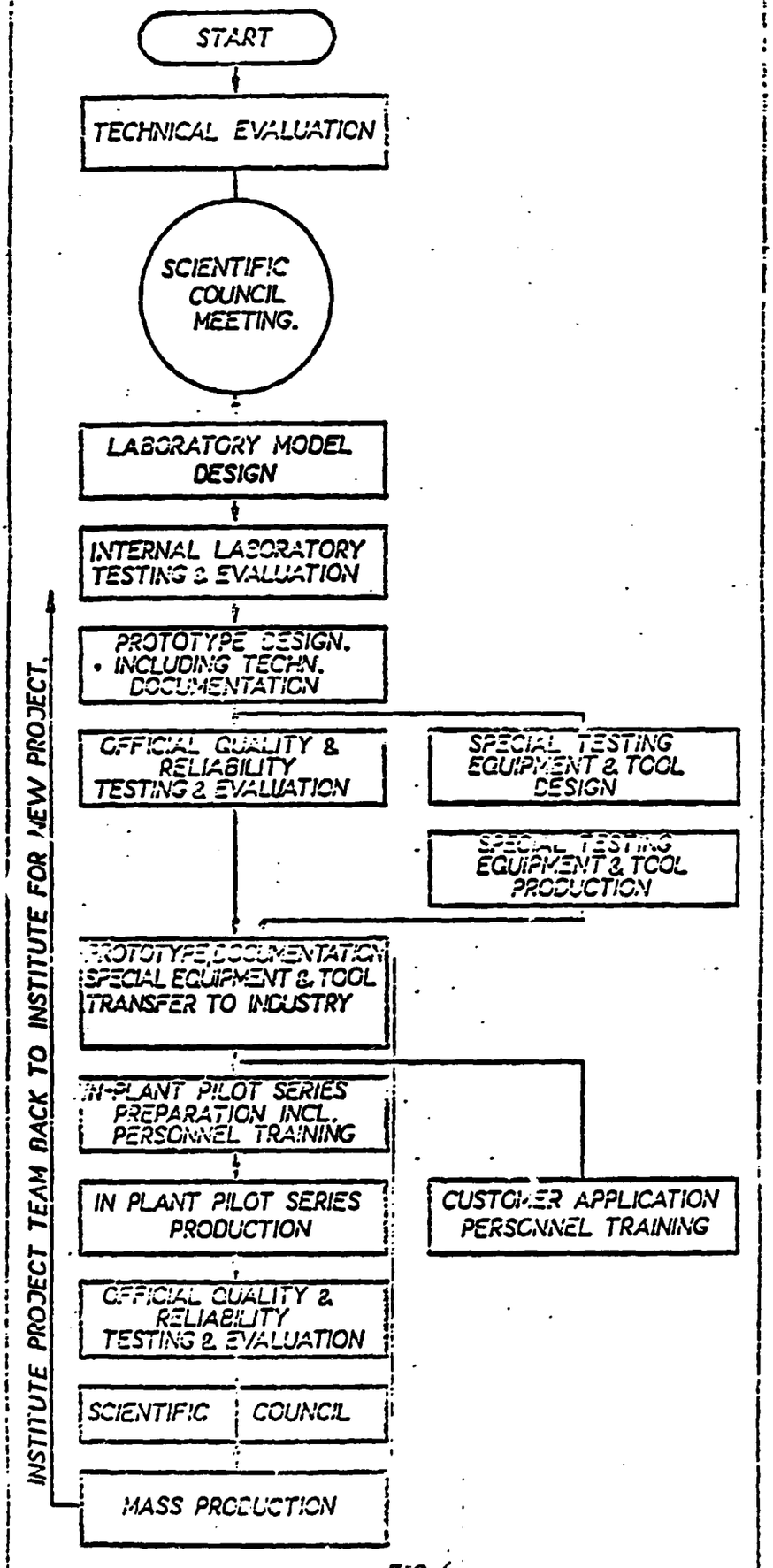

FIG. 4

TECHNICAL EVALUATION OF THE PRODUCT TO BE DESIGNED

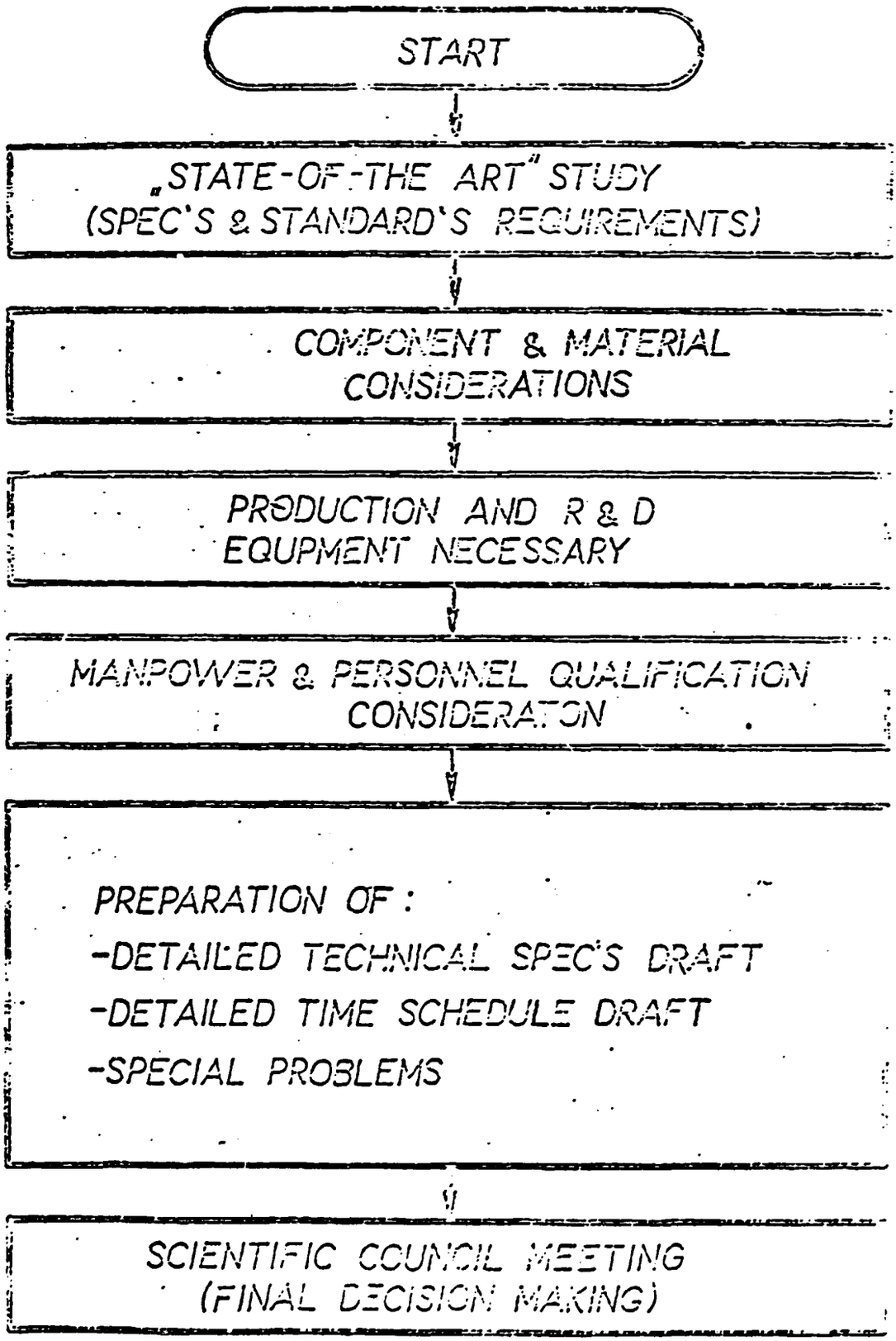

FIG. 5

QUALITY & RELIABILITY TEST

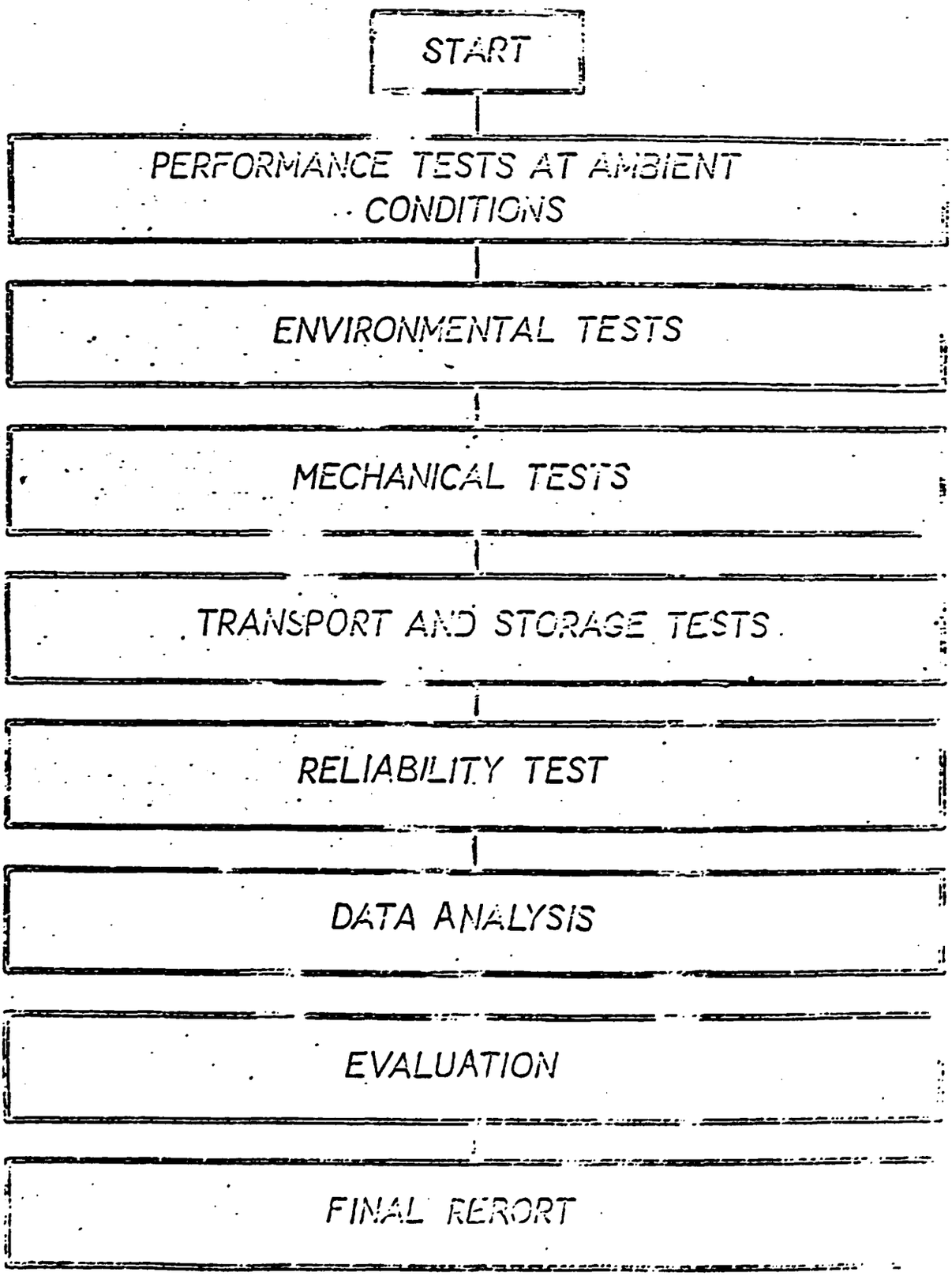

FIG. 6

QUALITY & RELIABILITY TESTING, REFERENCE EQUIPMENT AND FACILITIES.

- STANDARD RESISTORS, INDUCTANCE AND CAPACITORS;
- VOLTAGE STANDARDS
- FREQUENCY STANDARDS
- LASER INTERFEROMETER
- DC POTENTIOMETERS
- R, L, C BRIDGES
- AC-DC DIGITAL VOLTMETERS AND MULTIMETERS
- FREQUENCY METERS
- OCCILLOSCOPES
- GENERATORS
- ELECTRICITY METERS

FIG. 7 (P.1)

— RECORDING INSTRUMENTS

— POWER SOURCES INCLUDING PROGRAMMABLE

— EQUIPMENT FOR MECHANICAL VIBRATION PARAMETERS MEASUREMENT

— TEMPERATURE METERS

— MICROSCOPES

— TEMPERATURE TEST CHAMBERS

— SALT SPRAY CHAMBER

— VIBRATION TEST MACHINE

— BUMP TEST MACHINE

FIG. 7 (P2)

RELIABILITY TESTING & EVALUATION SCHEME

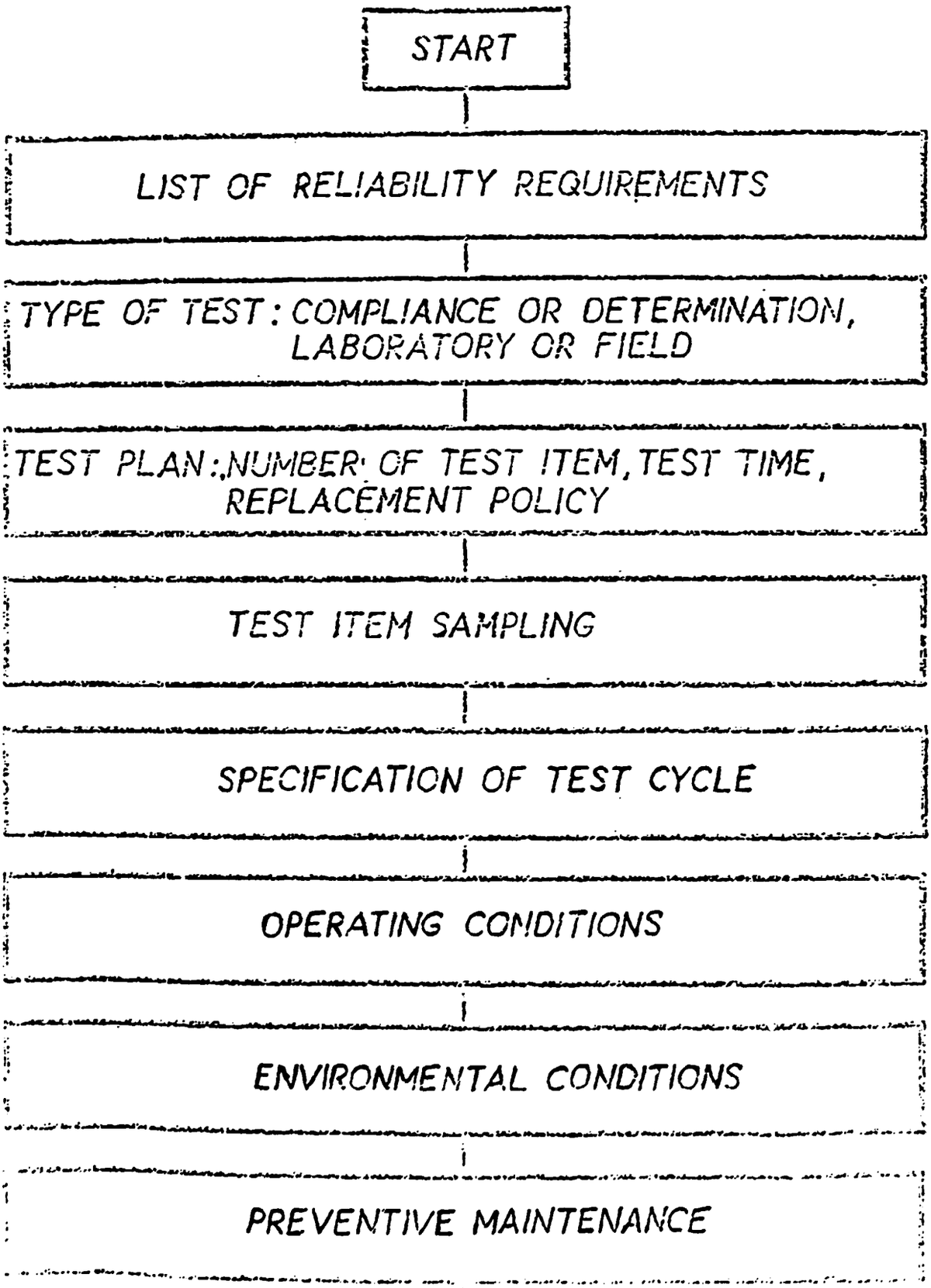

FIG 8 (P1)

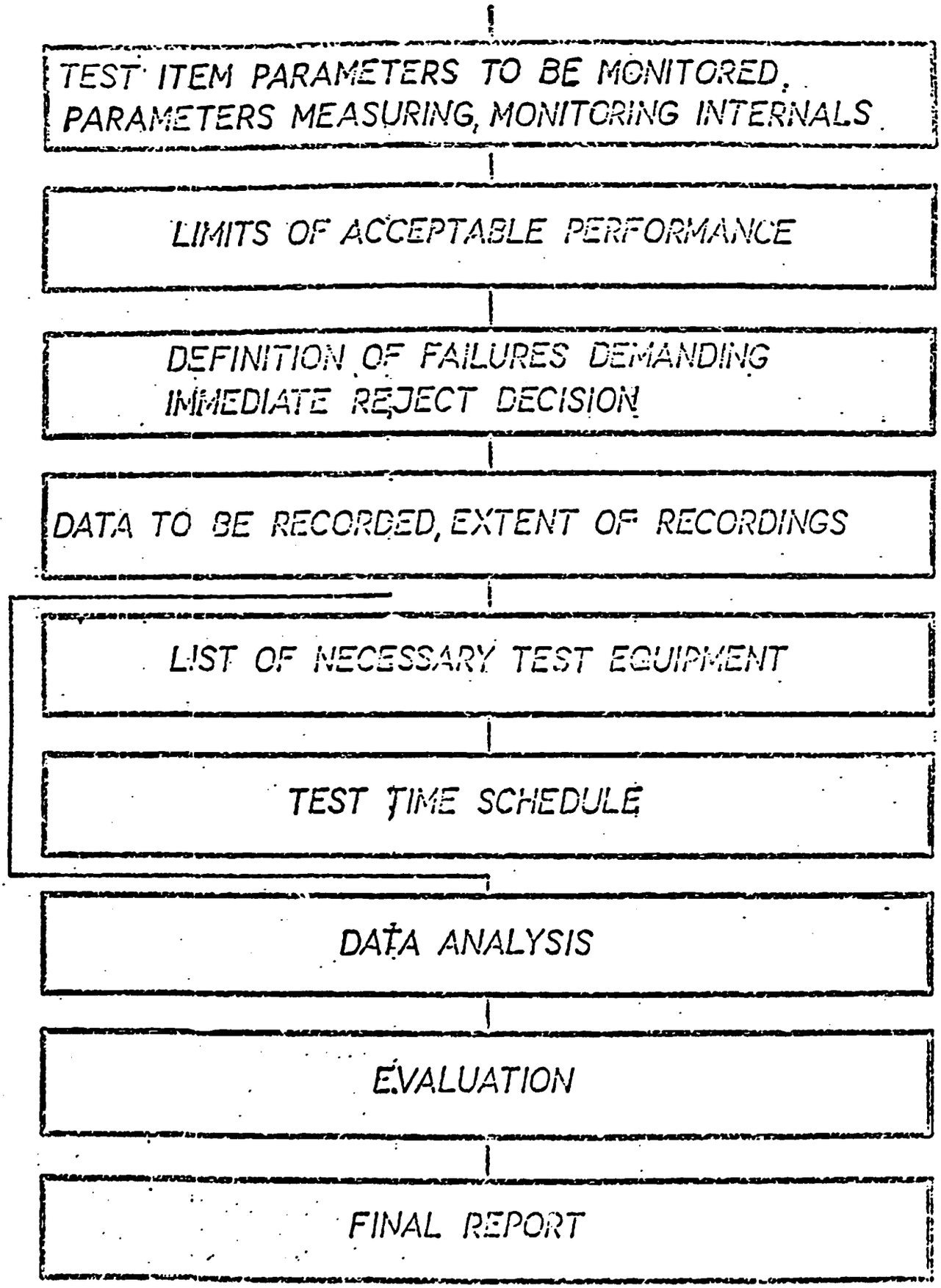
TEST ITEM PARAMETERS TO BE MONITORED, PARAMETERS MEASURING, MONITORING INTERNALS
LIMITS OF ACCEPTABLE PERFORMANCE
DEFINITION OF FAILURES DEMANDING IMMEDIATE REJECT DECISION
DATA TO BE RECORDED, EXTENT OF RECORDINGS
LIST OF NECESSARY TEST EQUIPMENT
TEST TIME SCHEDULE
DATA ANALYSIS
EVALUATION
FINAL REPORT

FIG. 8 (P2)

PERFORMANCE TESTS

- VOLTAGE AND CURRENT MEASUREMENTS
- FREQUENCY AND TIME MEASUREMENTS
- ACCURACY MEASUREMENTS
- STABILITY MEASUREMENTS
- MEASUREMENTS OF RESOLUTION
- MEASUREMENTS OF SENSIBILITY
- IMPEDANCE, INDUCTANCE AND CAPACITANCE MEASUREMENTS
- MEASUREMENT OF ELECTRICAL ENERGY
- MEASUREMENT OF PHASE DISPLACEMENT
- MEASUREMENTS OF NON-ELECTRICAL QUANTITIES - PRESSURE, TEMPERATURE, HUMIDITY, MASS, LENGTHS AND OTHERS

FIG. 9