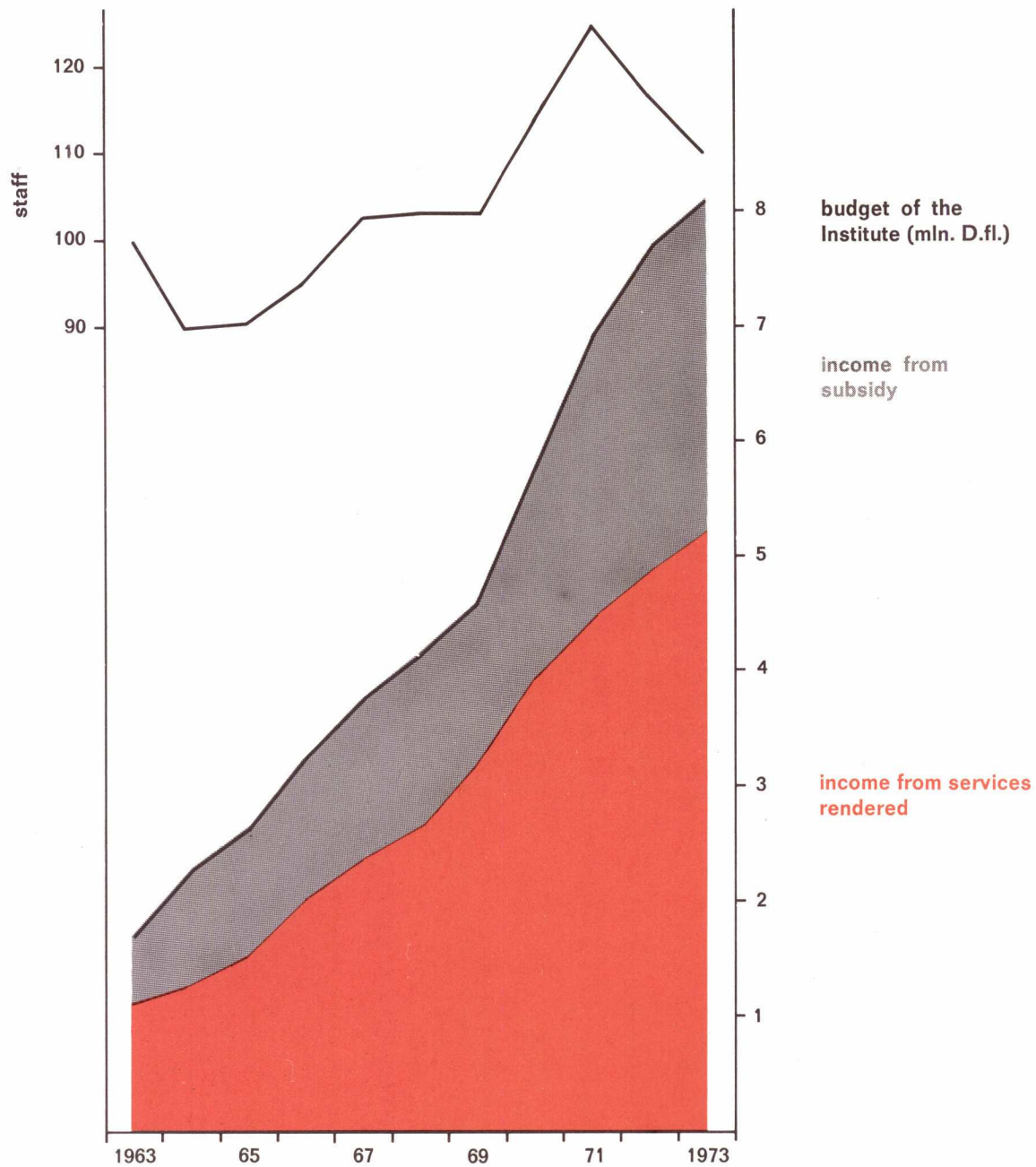


**institute for
mechanical
constructions**

TNO



TNO

TNO, in Dutch, is the abbreviation of Nederlandsche Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek. This translated means: The Netherlands Organization for Applied Scientific Research. At the moment TNO employs some 4700 people of which about 900 are university trained scientists and engineers.

Under the wing of a Central Organization, TNO has four special organizations, namely for:

- Industrial Research
- Food and Nutrition Research
- National Defence Research
- Health Research

The organization for industrial research employs nearly 40 % of TNO's staff. It comprises of five foundations and fifteen institutes, one of which is the institute for mechanical constructions, hereafter referred to as the Institute.

aim

The object of the Institute is to assist in the activities of industry and government by means of theoretical and experimental research and by various forms of service in the field of mechanical constructions and activities related thereto. By co-operating with other institutes TNO's allround versatility is put to use.

Several sections came into existence to meet with the varying problems which have arisen since the Institute was established some 25 years ago.

sections

This brochure is brought to you in order to give a summary of the aims of each section, together with a few examples of the various activities. These activities have been executed either as commissioned or as free research. More than 60 % of the Institute's income is attained through orders from various industries and governmental establishments.

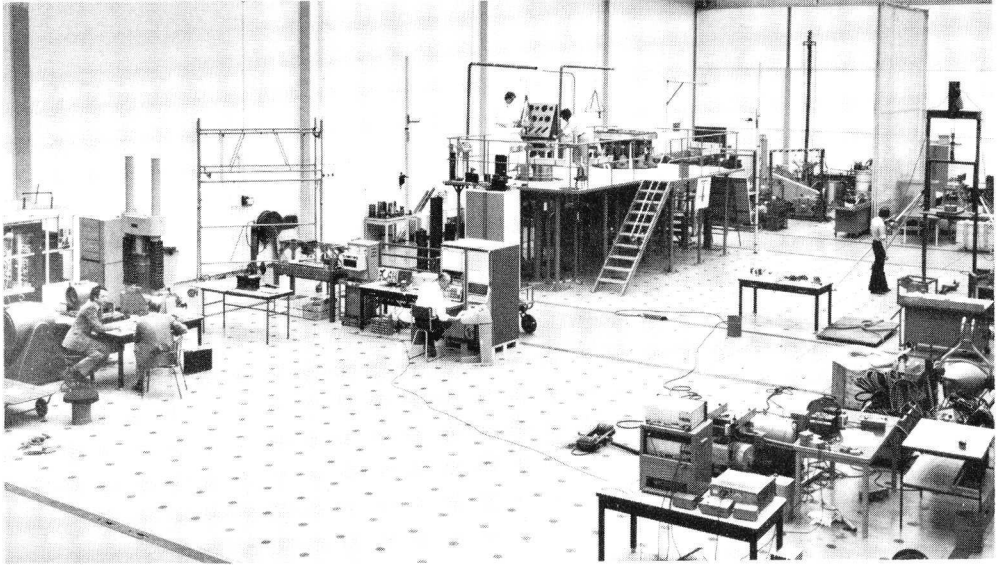
how to contact the Institute

Contact may be sought with one of the staff members mentioned in this brochure at the address below:

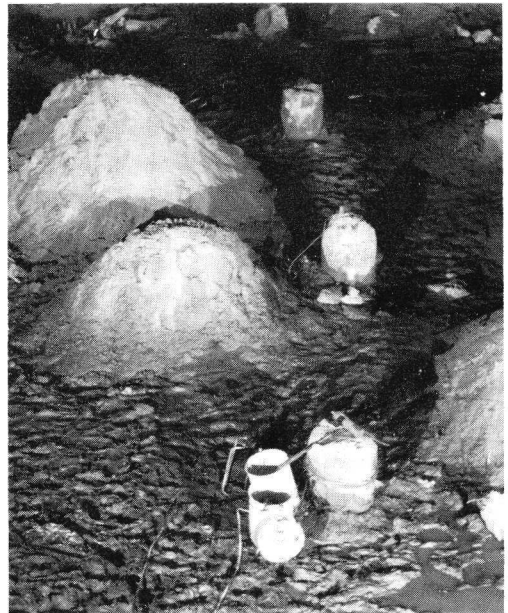
Leeghwaterstraat 5, P.O. Box 29, Delft, The Netherlands.
Telex 32786, telephone 015 - 56 92 18.

General information regarding TNO may be obtained from the Industrial Liaison Department, telephone 015 - 56 93 30, P.O. Box 215, Delft, The Netherlands.

Ir. H. H. 't Hart
managing director



Hall with special floor for shock and vibration apparatus



Measurements of dynamic behaviour of piles

APPLIED MECHANICS



Ir. H. H. 't Hart

In this section the aim is to study the properties of mechanical, naval and similar constructions, by means of theoretical and experimental stress and vibration research. In order to achieve this aim, we must differentiate the theoretical from the experimental technical mechanics.

theoretical mechanics The theoretical technical side can be described as follows:

- stress calculations on linear elastic constructions under static force
- calculations of stress and deformation of non-linear elastic constructions; study of creep, plasticity and fracture
- calculations of vibration in constructions with linear and non-linear dynamic behaviour.

Experience has been gained in the use of computer programmes, based on finite elements methods such as ASKA, NASTRAN, MARC, together with a rotor-dynamics programme.

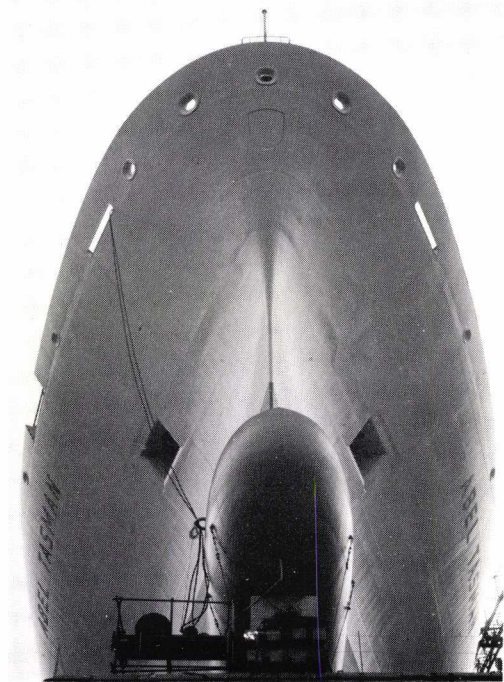
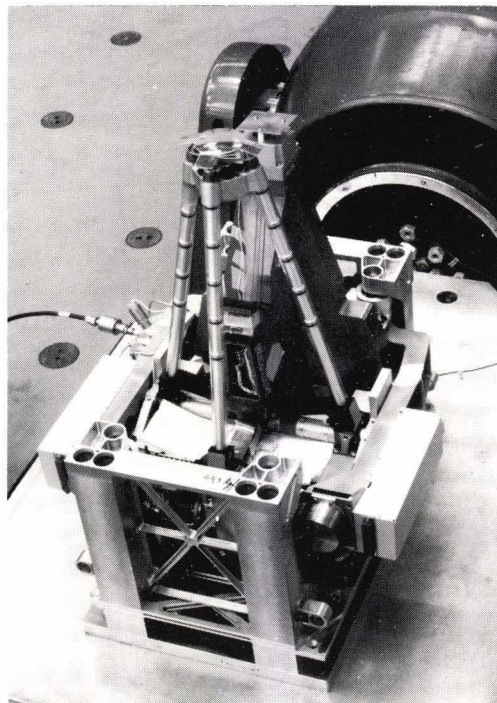
experimental mechanics

The experimental mechanics are, on the other hand, engaged in stress and vibration measurements on constructions and the development of new measuring technics. Study is also made of dynamic properties of constructions, using the mechanical impedance method, and of the coupling of dynamic systems.

facilities

- devices for measuring the static behaviour of constructions by analysing their stresses under static load

Tests on a star spectrometer

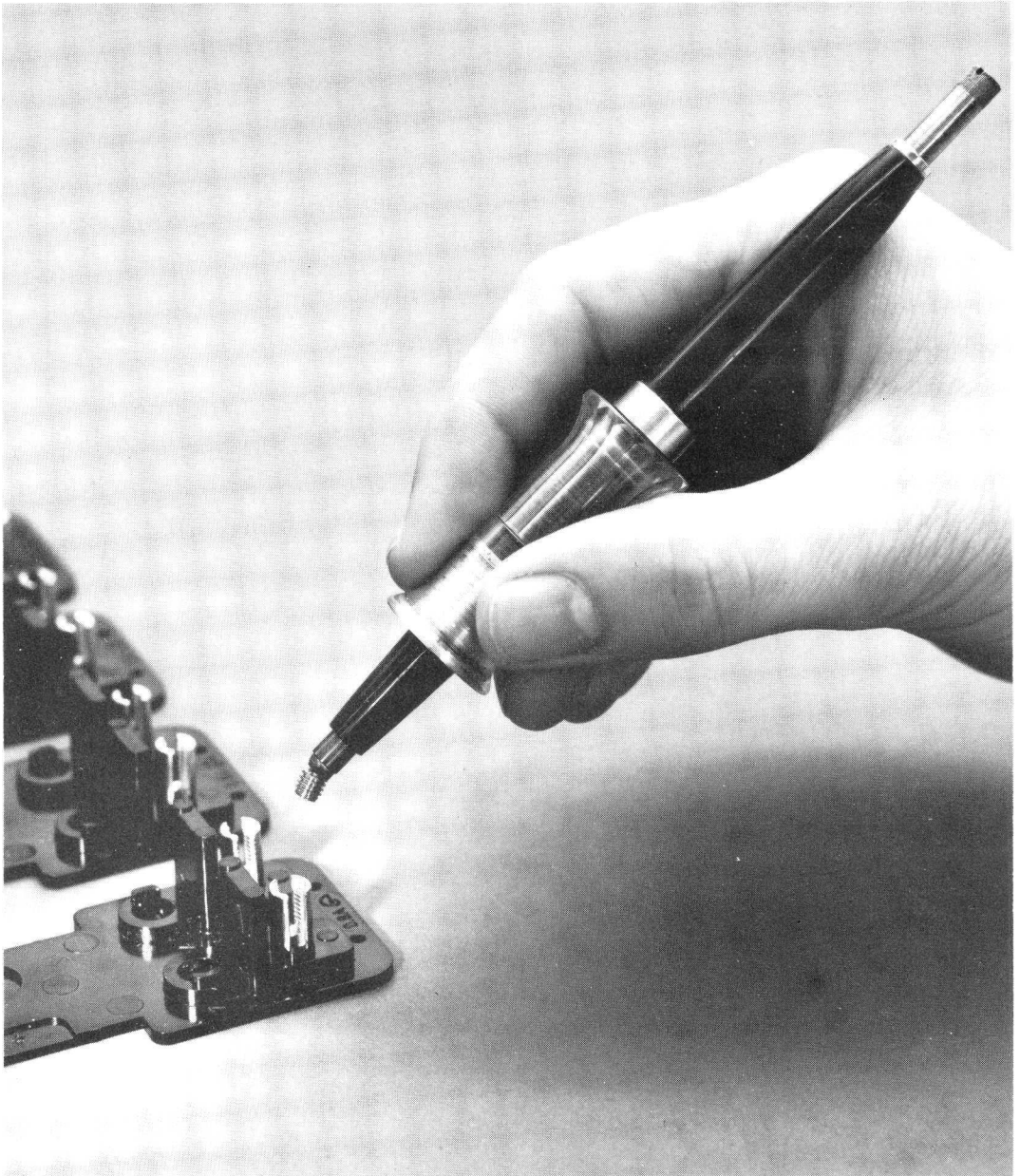


Measurement of slipway stresses during the launching of a container-vessel

- devices for measuring the dynamic behaviour of constructions, e.g. the response under a time dependent load
- recorders, e.g. professional tape-recorders, for recording test results.
- apparatus to convert measurement results, e.g. a Fourier analyser
- installations to expose constructions etc. to shock and vibration. For this purpose shock testing machines and several types of vibrators are available.

The above mentioned facilities and the knowledge and experience gained are mainly used for the strength calculation of (reactor) pressure vessels, the development of ship constructions and the calculation of the possible results of calamities by means of risk-analysis. Where applicable, the non-linear behaviour of the constructions is taken into consideration also.

Under the heading shock and vibration testing, there is a growing interest in the fragility research of instruments and apparatus.



Adhesive-pen used as an auxiliary for fine mechanical assembly (interordering)

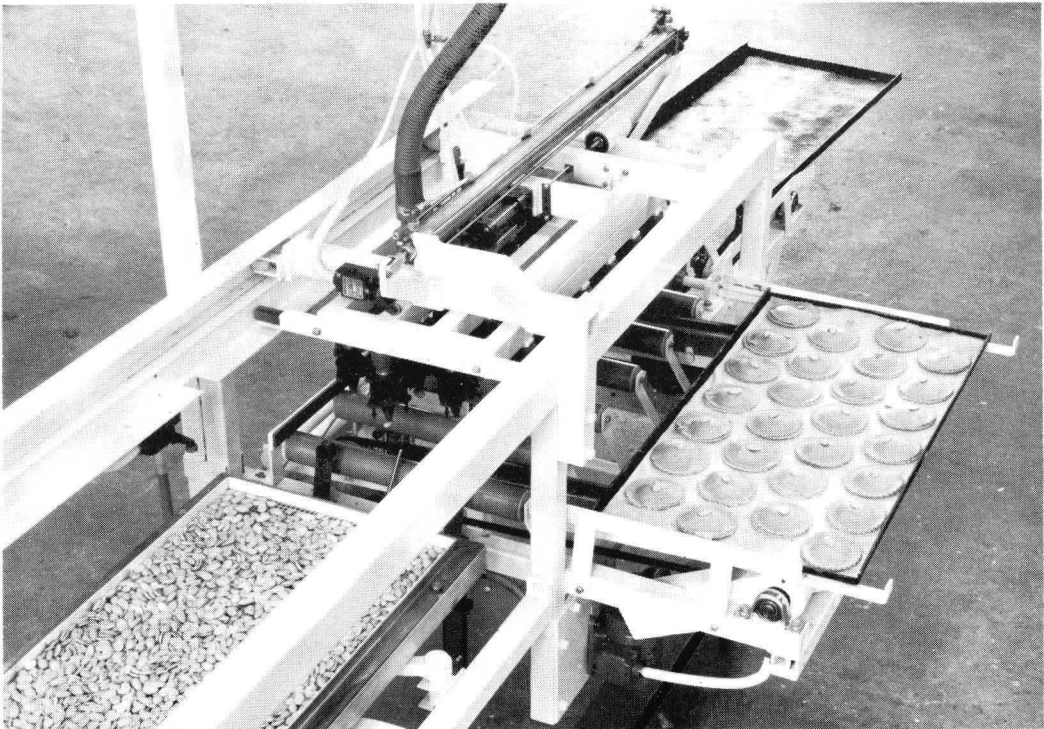
special subjects

The special subjects are related to mechanical design of prototypes or of series production of special machines, apparatus and auxiliaries.

For production lines with limited series, assistance can be rendered by automation of the supply of assembly parts. Simple and low cost automation aids may thus play an important role in reducing the cost of assembly work.

facilities

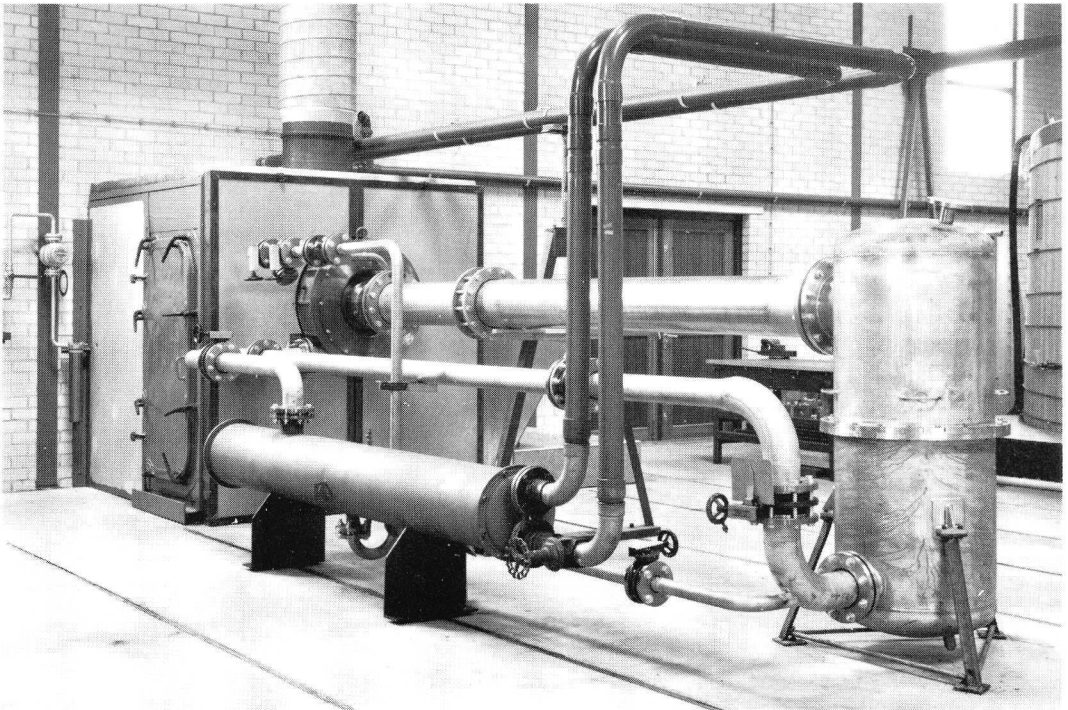
Construction bureau and mechanical workshop.



Almond depositing machine



Laboratory for turbomachinery at Waddinxveen



625 kW compressor during trials



FLUID MECHANICS

Ir. J. B. van den Brug

The objective in this field is to apply the knowledge of fluid mechanics to bearings and seals and to turbo-machines. Advanced methods of design and testing are used in the development of sliding bearings and rotating shaft-seals. In the turbo-machinery field, design and application studies are carried out by theoretical and experimental research.

bearings and seals

The activities in the field of bearings and seals originated 15 years ago from the demand for bearings lubricated with poor lubricating fluids, such as liquid metals and water. The programme comprises of the design and development of hydro-dynamic bearings and hydrostatic bearings fed by an exterior pressure source with media such as oils, gases and low viscous liquids. The static, as well as the dynamic behaviour of bearings is studied. Similar activities take place on high quality shaft-seals in connection with environmental aspects. The programme comprises of both axial and radial seals with optimized leak-rates and life cycle.

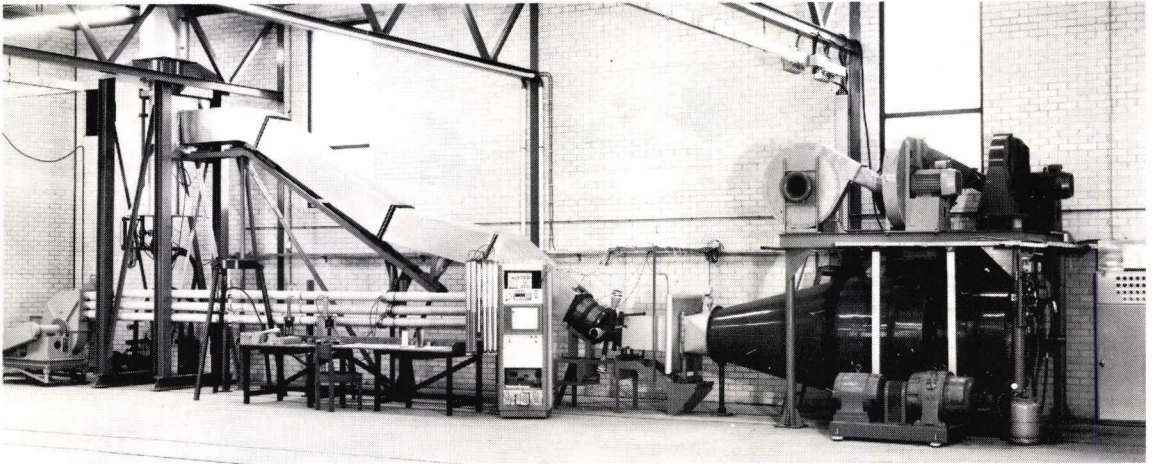
product development

Product development is determined by the development of new — and improvement of present — products, in which bearings and shaft-seals play an essential part.

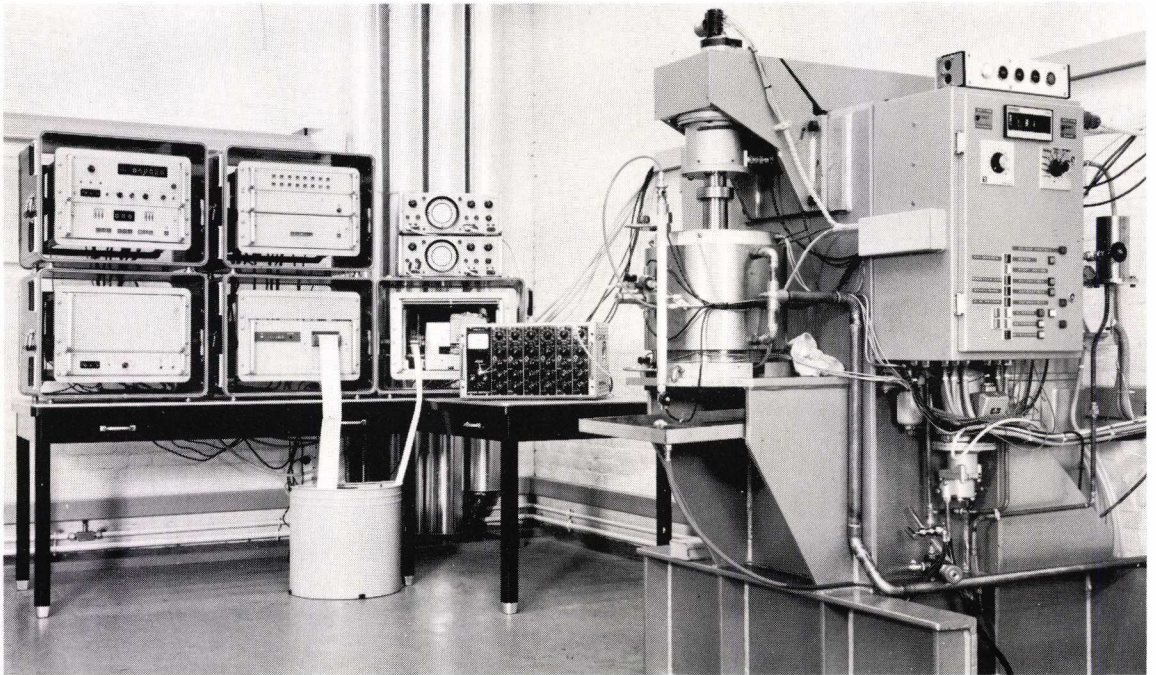
Besides technical advise is given on:

- expertising of ball-bearings and slide-bearings
- bearing stability problems
- dynamics of shaft-bearing systems
- calculation of expected operating temperatures and life cycle of mechanical devices.

In co-operation with the institute TNO for metal research and the central laboratory TNO, the entire area of friction, wear and lubrication is covered.



High speed and high temperature tunnel



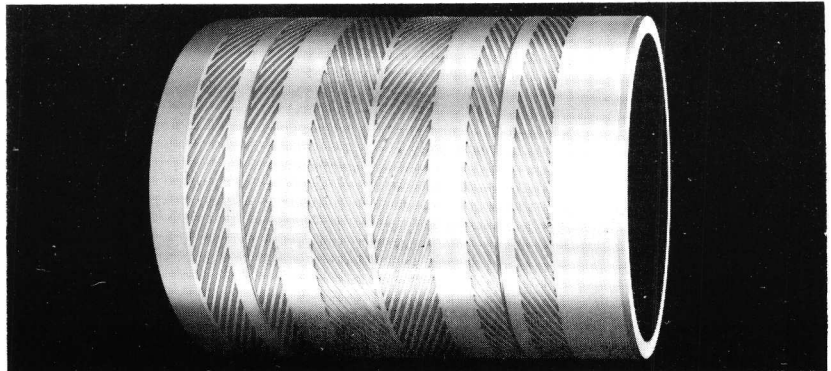
Test-rig for rotating shaft-seals

turbo-machines

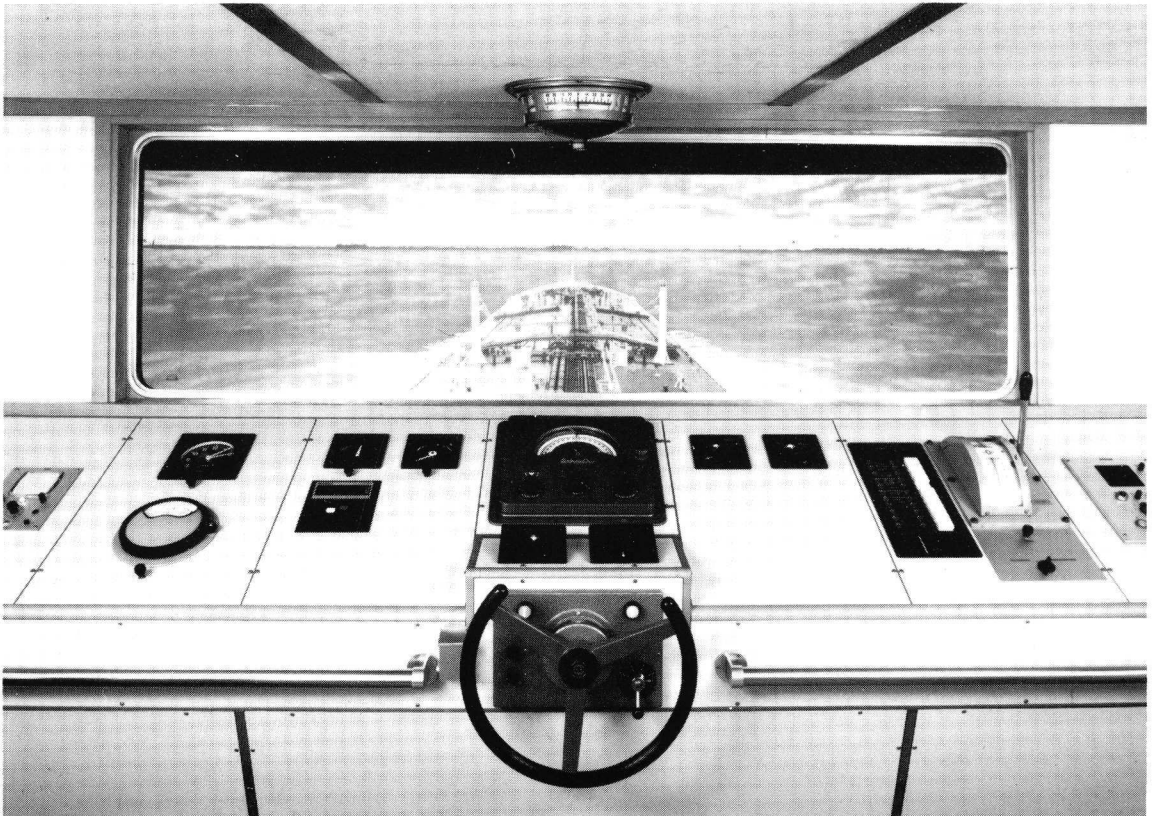
The activities in the field of turbo-machines are generally directed to the development of centrifugal compressors, gasturbines, aerators and pumps. Fundamental research is carried out on the flow-development in vaneless diffusers and on the cavitation phenomenon in pumps. Special types of compressors are developed for application in air-conditioning and desalination installations. Application studies are carried out with regard to total-energy and heat-pump systems.

The design and testing of in-line valves and safety-relief valves forms a side-line which is concerned with the direct necessities of industry. Also included in this category is the advisory work with regard to a variety of problems concerning the practical application of turbo-machines. A typical example is an investigation into the vibration problems of an air-conditioning fan system, the cause of which was traced to flow instabilities in the fan.

Projects carried out in co-operation with other TNO institutes are usually co-ordinated by the projectgroup turbo-machinery TNO.



Grooved journal



Ship manoeuvring simulator



SIMULATION TECHNIQUES

Ir. B. W. Jaspers

The aim in the field of simulation techniques is to simulate processes by forming mathematical models to be solved on a computer. In processes in which man takes part, also his environment is simulated to study these processes as realistically as possible.

It is for these reasons that during the last years the following activities have been carried out:

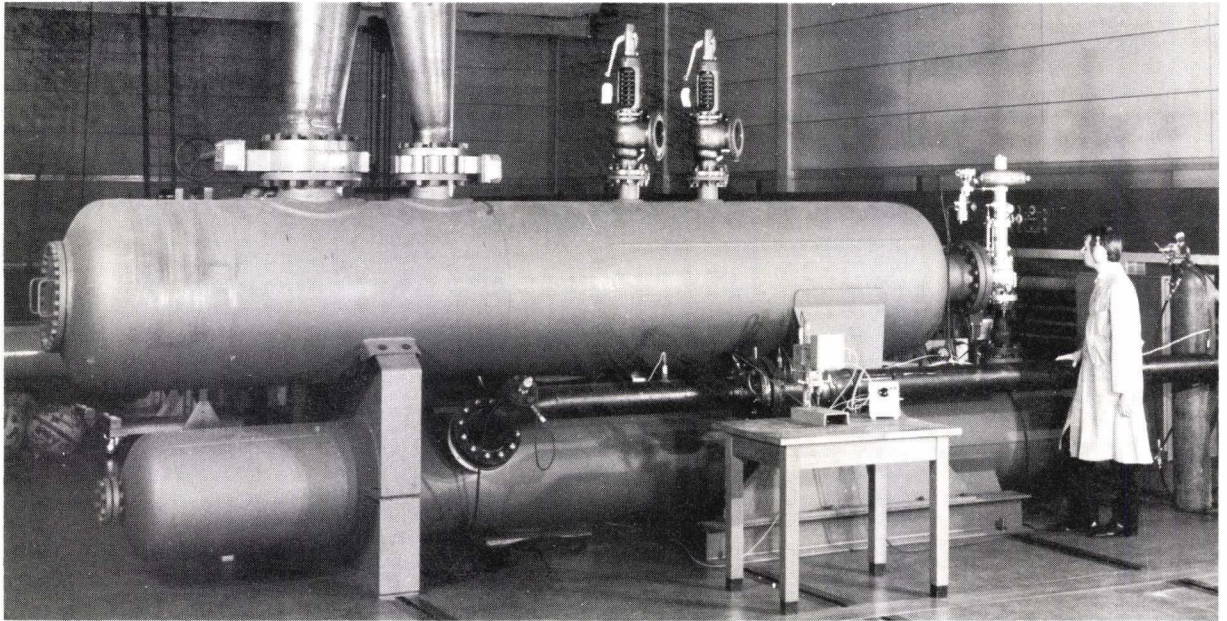
activities

- development of mathematical models for several types of ships in order to study and to improve their manoeuvrability
- development and construction of simulated bridge handling and indicating instruments
- development and construction of visual systems to imitate the ships environment (sea, coast with towers etc.). These visual systems may also be applied to present other information than originally intended
- development of simulation systems for mechanical processes like engine rooms
- simulation of the dynamic positioning of drilling vessels.

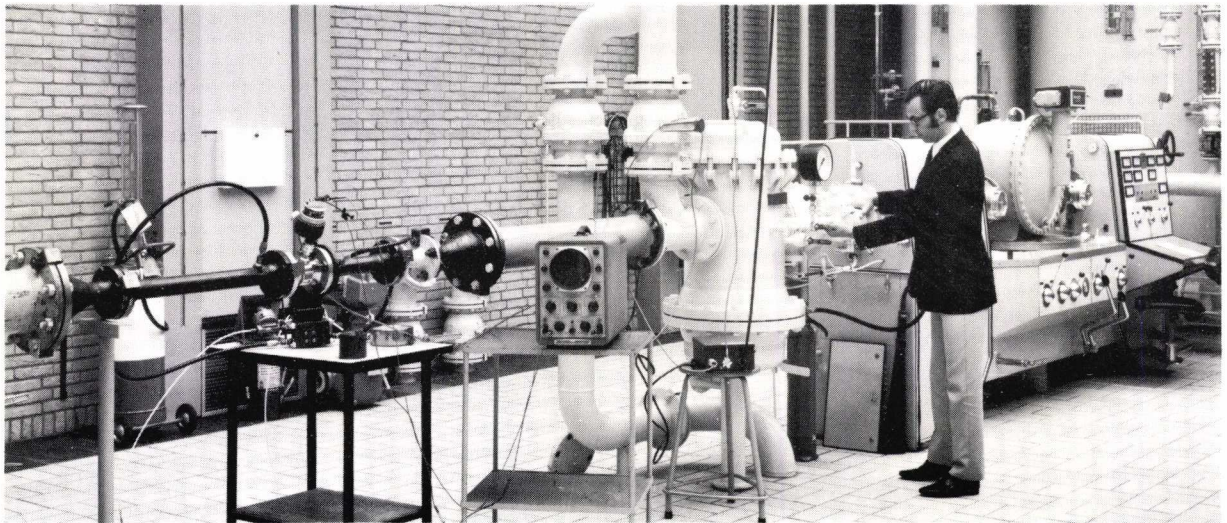
facilities

The first three activities have resulted in a ship manoeuvring simulator. This simulator enables to exercise, on real-time basis, the handling of e.g. supertankers and even of ships that are still in the design phase. Apart from design data of ships with regard to manoeuvring, propulsion, etc., also harbours to be newly designed and/or situated are simulated and studied using a digital computer.

Study of man as part of the complete ship's process is also possible. This activity is carried out in co-operation with the Netherlands Ship Model Basin at Wageningen and the institute for perception research TNO at Soesterberg.



Evaluation of safety valves



Evaluation of a flow-meter in the laboratory of the Dutch Authority for Weights and Measures at Dordrecht



INFORMATION AND MARKET RESEARCH

Ir. F. A. G. Timmermans

The aim in this field is to promote the application of knowledge of instrumentation and automation on behalf of the mechanical and related sectors of industry and government.

The increasing gap between the knowledge available in this field and the application thereof, was the main reason of starting this information activity. Furthermore, the application of knowledge is an obvious task for the organization for applied scientific research TNO.

This kind of information is provided effectively by means of market research, courses and advise. The market research is carried out mainly through product evaluation of industrial instruments and devices which are new or as renewed models on the market. The programme of such evaluations comprises of elaborate environmental testing owing to the practical conditions of use of the products tested.

During the course of the years, several hundreds of devices were tested, with which over 30 man-years of experience was gained.

Courses are given by a group known as the information centre for industrial automation.

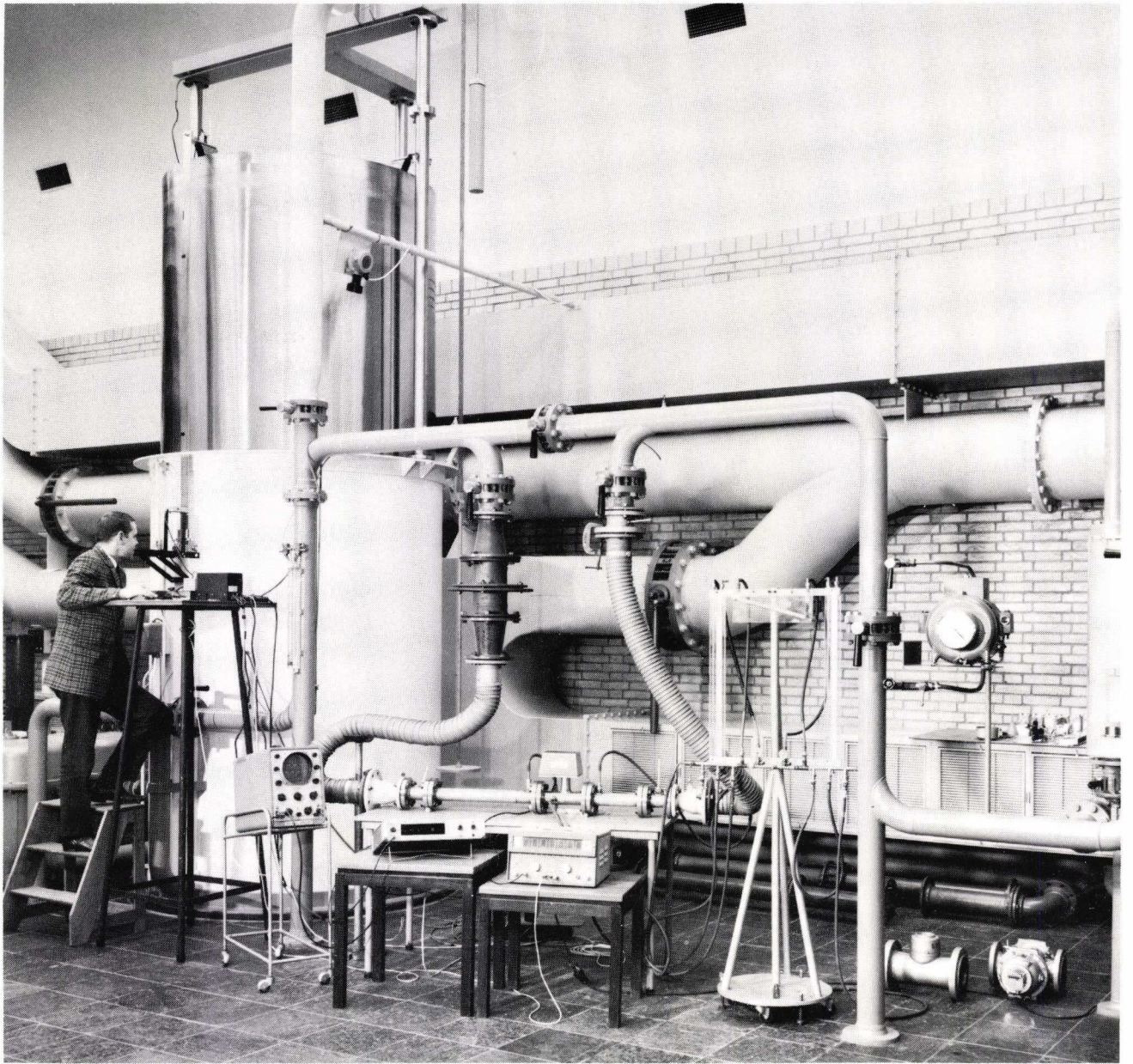
The courses are in the following fields:

- production automation
- process automation
- logic control
- mini computers
- measurement in environment
- logic pneumatics

During more than 20 years at least 400 participants from approximately 2000 industries and governmental establishments took part in these courses. Advisory work also belongs to the activities of this group.

product evaluation

courses



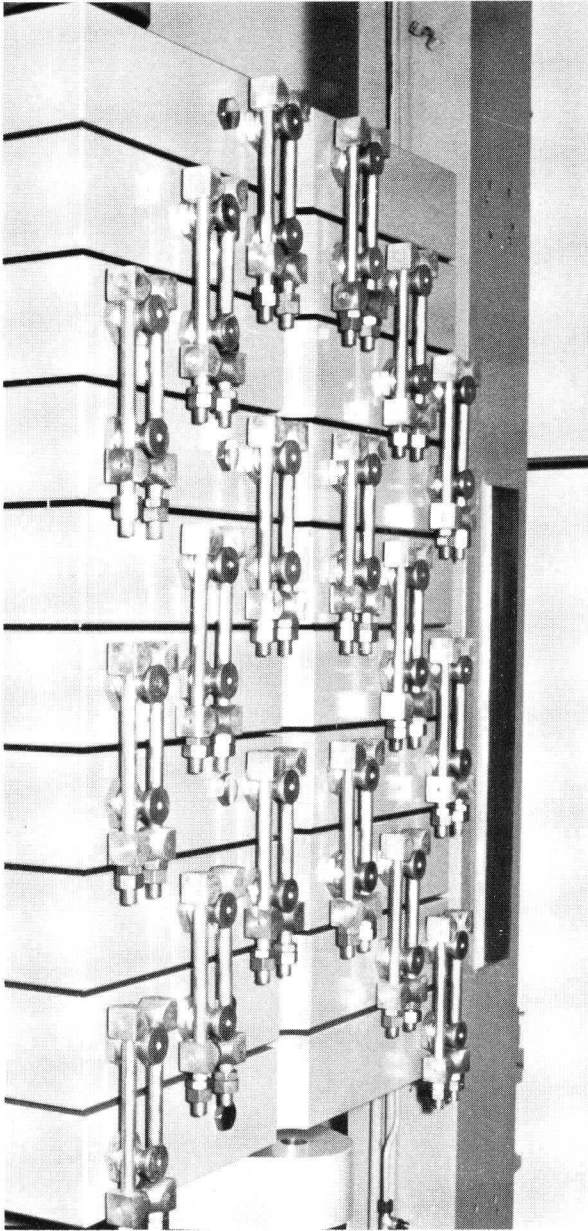
Evaluation of a flow-meter in the laboratory of the Dutch Authority for Weights and Measures at Dordrecht

Like the information activity on measurement in environment other actions are organized, as a useful means of presenting and promoting research work in other fields.

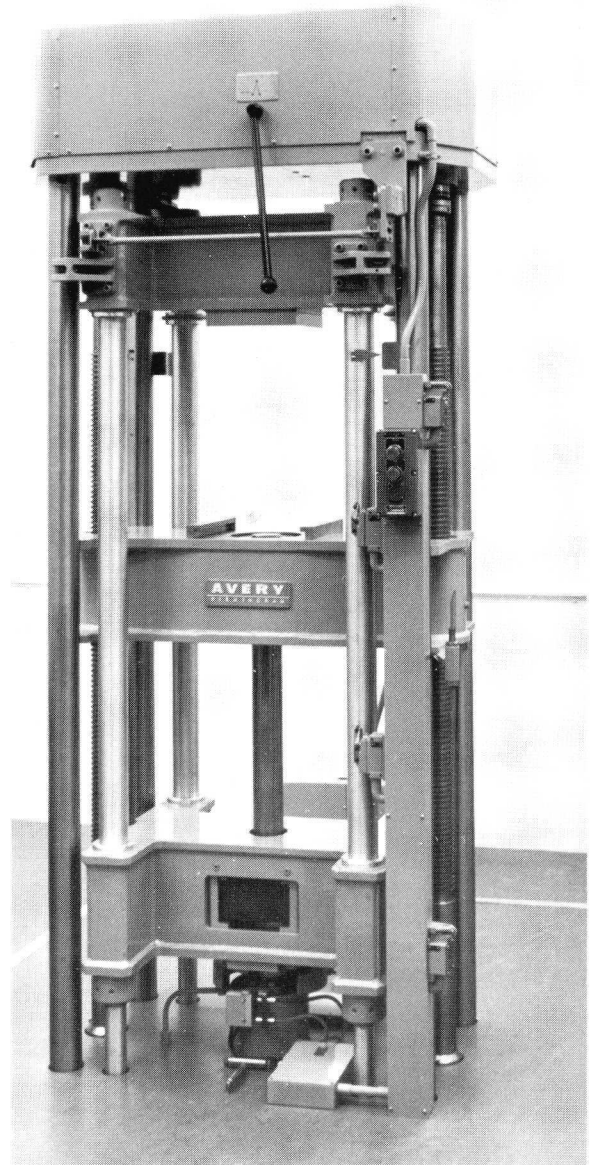
Parts of such actions are: periodical information leaflets on facilities, on services and on case-studies; information days on the possibilities of the Institute and other TNO institutes co-operating with us. Establishment of more contacts is one of the principle aims of these actions and their follow-up.



The VIA demonstration centre



Dead-weight apparatus, weights



Dead-weight apparatus, force section



METROLOGY

Ir. H. Wieringa

The MEASURING CENTRE TNO, which is part of this institute, aims to improve the quality of measurement. Therefore, the centre should be well-informed about measuring and calibration facilities, both within and outside TNO, in order to inform interested parties.

The centre itself is involved in specialised techniques on length-, angle-, force- and pressure measurement.

facilities and activities

The industry is financially supporting the information activities of the centre, which makes advisory work possible and also participation in national and international standardization.

The activities, are among others, the calibration of measuring instruments like pressure-transducers, dead-weight testers and force-transducers. Further, determination of the accuracy of tools for dimensional measurements (calibration- or inspection- or workshop grade) and determination of the dimensions of pieces of work of complex nature. The existing measuring techniques are improved continuously since higher accuracies are requested constantly.

The centre has several measuring devices of high quality available and these are the basis of this research work. Specialization exists in measuring length, out of roundness and involute profiles. Also the calibration is possible of pressure-transducers (up to 300 000 kPa) and force-transducers (up to 555 kN).

contacts

Intensive contacts are maintained with groups and institutions which also offer calibration facilities. In this context may be mentioned several other TNO-institutes, the v. d. Waals Laboratory of the University of Amsterdam, the van Swinden Laboratory of the Dutch Authority for Weights and Measures and the Universities of Technology in Delft, Eindhoven and Twente.

International contacts exist with the NPL in the UK and the PTB in Germany.

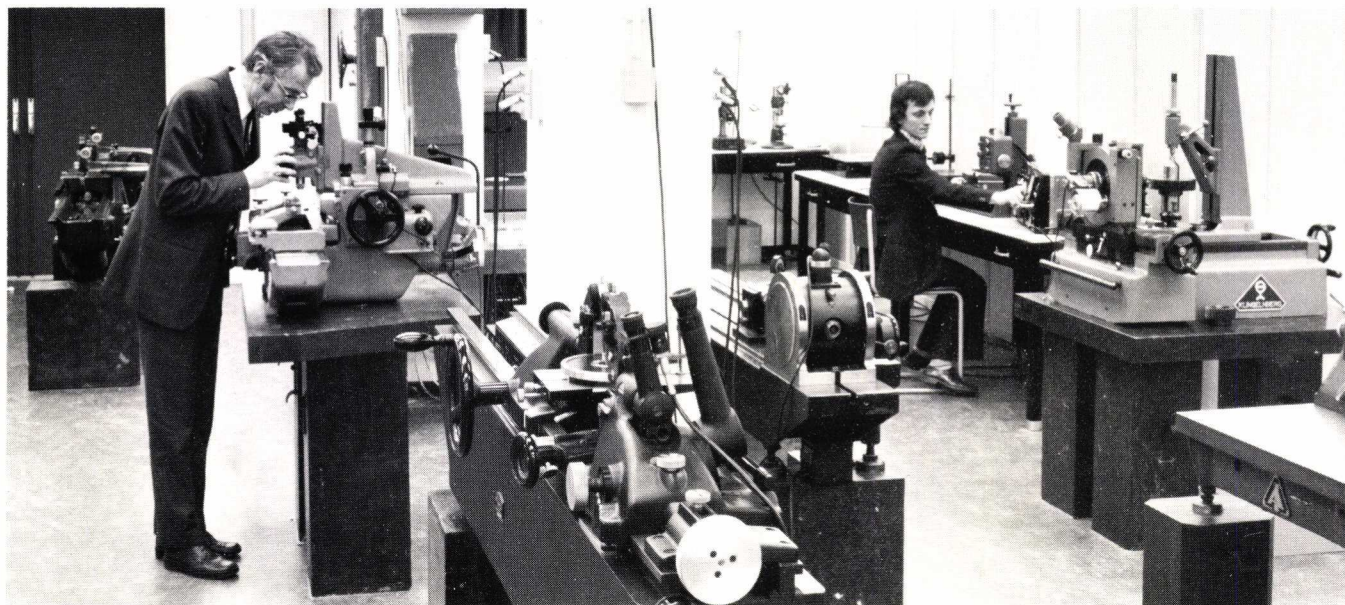
special subjects

A subject closely related to metrology is the high pressure technology, which in recent years has been increasingly applied in the process industries.

The synthesis and polymerisation processes as well as the powder metallurgy, the hydro-static extrusion and the jet cutting technology may be mentioned in

this context. Available for this purpose is test equipment up to 0.2 GPa, to be extended to approx. 1 GPa.

In this field contacts exist with the ASEA high pressure laboratory in Sweden, the Institut Fizyki Politechnik in Poland and the Institute for testing materials in Belgium.



Measuring chamber