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Netherlands  
organization for  
applied scientific  
research

## A Key to Research Facilities





Netherlands  
organization for  
applied scientific  
research

# A Key to Research Facilities





**I. Keywords** \_\_\_\_\_

**2. TNO in perspective** \_\_\_\_\_

**3. TNO Environmental and Energy Research** \_\_\_\_\_

**4. TNO Building and Construction Research** \_\_\_\_\_

**5. TNO Industrial Research** \_\_\_\_\_

**6. TNO Nutrition and Food Research** \_\_\_\_\_

**7. TNO Health Research** \_\_\_\_\_

**8. TNO Defence Research** \_\_\_\_\_

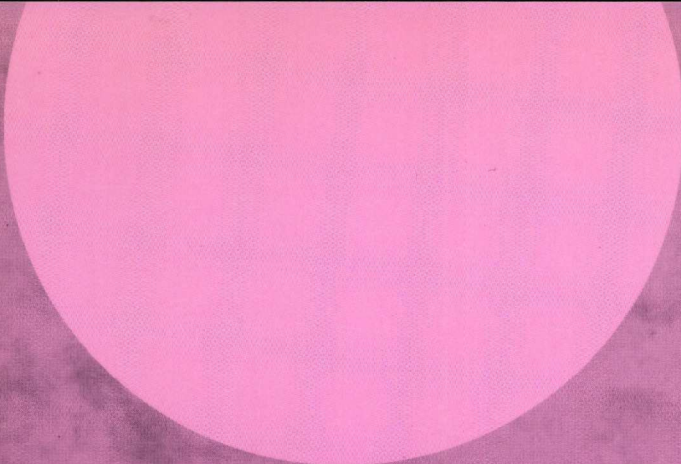
**9. TNO Policy Research** \_\_\_\_\_

**10. Institutions connected with TNO** \_\_\_\_\_

**II. TNO Addresses** \_\_\_\_\_



Keywords





## Keywords

- acid deposition 11
- acoustics 33, 60, 61, 64
- ad(ab)sorption processes 9
- aerosols 63
- ageing research 54
- AIDS 48, 53
- air pollution 8, 9, 11, 12, 15, 63
- alcohol (fuel) 27
- alternative fuels 27
- analytical chemistry 11, 62
- animal:
  - models 48, 54
  - nutrition 42
  - physiology 42
- ANF 46
- antibody 53, 54
- antidotes 52, 63
- antifoulings 39
- antinutritional factors 46
- aromas 43
- artificial intelligence 60
- asbestos analysis 11
- assembly processes 24
- atmospheric pollution 11, 63
- atomic spectroscopy 11
- automation, production 24
- automobiles 27
  
- ballistics 62
- biocatalysis 43
- biochemistry 43, 52
- biocleaning 12
- biofilms (immobilized) 12
- biofiltration 9
- biological monitoring 52
- biological research 12
- biomechanics 37
- biomedical:
  - instruments 33
  - research 48, 54
- biosafety 43
- biotechnology 12, 43
- blanking 24
- board (paper) 36
- boilers, central heating 8, 9
- bone-marrow transplantation 48
- brazing 25, 84
  
- brewing 43
- building research 17ff.
  
- CAD/CAE/CAM 19, 31, 32, 37
- cancer 48, 49, 52
- carbohydrate research 80
- cars 27
- catalysis 29
- CCD 33, 61
- cell biology/physiology 48, 54
- central heating boilers 8, 9
- certification (products, quality systems) 81
- chemical agents 52, 62, 63
- chemical engineering*: 8, 9
  - ad(ab)sorption processes 9
  - extraction processes 9
  - melt crystallization 9
  - membrane technology 9, 29
- ceramics 33
- cereals 42
- chemotherapy 49
- child health 56, 57
- chronic diseases 48
- cleaning techniques 79
- clothing 25, 64, 65
- CNG 27
- coatings research 39
- cognition 64, 85
- combustion 9
- combustion engines, internal 27
- communication 34, 60, 85
- composites 29
- computational mechanics 18
- computer-integrated construction 18
- computer:
  - networks 26, 33, 60
  - science/systems 26
- concrete 18
- construction research 17ff.
- consumer packaging 35
- controlled-release systems 29
- crash research 27
- corrosion 39, 83
- cytostatic agents 48



- data exchange 26  
data fusion 60  
decision-support systems 9, 15, 60,  
defence research 59ff.  
dementia 54  
demographic developments 68  
dental care 56  
detonation 62  
DFA/DFM 31  
diagnostic systems (computer) 26  
digestion 45  
disarmament verification 63  
diseases (chronic, infectious) 48  
discrete product manufacturing 24, 25  
DNA 11, 46, 52, 53  
domestic refuse incineration 9  
dosimetry (radiation) 51, 53  
dust control (indoor) 19  
dynamics (building) 19
- ecology 68  
effluent purification 8, 37  
elderly and health 57  
electromagnetic launch 63  
electronic design/engineering 31, 33  
*energy research*: 7ff.  
- boilers 8  
- conservation 19, 29, 36, 38  
- consumption 19  
- conversion 8  
- electrochemical energy 12  
- geo(thermal) energy 14  
- heat pumps 8  
- heat exchangers 8  
- heat recovery units 8  
- heat storage 19  
- heat transformers 8  
- refrigeration 8  
- solar energy 19  
- storage (subsurface) 14  
- supply (small-scale) 63  
electrets 29  
electrochemicals 29  
electron-beam curing 29  
emergency management 9  
emissions 9, 11  
endothelial cell 54
- engineering:  
- chemical 8, 9  
- civil 18  
- electronic 31  
- industrial 31  
- mechanical 18, 19, 31  
- structural 18  
- system 33  
*environment*:  
- acid deposition 11  
- air pollution 8, 9, 11, 12, 15, 63  
- combustion 9  
- effluent purification 8, 37  
- emissions 9, 11  
- exposure to contaminants 11  
- electrochemical degradation 12  
- electrochemical energy 12  
- electrochemical purification 12  
- gasification 9  
- indoor environment 18, 19  
- laundering 79  
- monitoring systems 12  
- noise (control/annoyance) 33, 64  
- odour (abatement, analysis,  
detection) 9  
- oil pollution 12  
- pollution abatement 8, 11, 12, 36  
- refuse incineration 9  
- sensors 12  
- sludge 12  
- tropospheric chemistry 11  
- waste processing 8  
- waste water treatment 12, 80  
- water pollution 11, 80  
*environmental*:  
- health care 57  
- research 7ff.  
- impact studies 11, 12, 15  
ergonomics 56, 64  
expert systems 26, 57  
explosion prevention/behaviour 62  
extraction processes 9
- fate of pollutants 11  
feeds 42  
FEM 18  
fermentation 43

- fibre(/matrix adhesion) 29
  - fibrinolysis 54
  - filament winding 29
  - finishing 20, 38
  - finite-element method 18
  - fire research 18, 19
  - fishery products 42
  - FIV 48
  - flavours 43
  - flow dynamics 33
  - fluid dynamics 8
  - food:
    - research 41ff.
    - preservatives 46
  - footwear 37
  - fossil fuels combustion 9
  - foundation piles 19
  - fraud resistance 34
  - fuels 9, 27, 62
  - furniture 20
  
- garment 37
- gas (exploration, management, production) 14
- gene therapy 48
- genetic transformation (plants) 46
- geo(thermal) energy 14
- geo-hydrology 14
- geo-information 14
- geoscience 14
- geriatric diseases 54
- gerontology 54
- glass 33
- GLP studies 11
- goods flows 25
- groundwater 8, 14
  
- handicapped 27, 85
- hazardous:
  - goods/substances 9, 62
  - goods packaging 35
  - waste 8, 15
- health care (preventive) 56, 57
- health research 47ff.
- hearing 64
  
- heat:
  - balance 64
  - dynamics 33
  - exchangers 8
  - recovery units 8
  - pumps 8
  - storage 19
  - heating boilers 8
  - heating, spontaneous 12
  - homologation 27
  - horticultural products 35
  - host/vector systems 53
  - humidity 19
  - hydrological research 77
  - hydrology (geo-) 14, 77
  - hyperthermia 48
  
- image processing 33
- immunodeficiency 48
- immunology 48, 52, 53
- impact research, environmental 11, 12
- indoor environment 18, 19
- industrial:
  - design/engineering 31
  - fluid dynamics 8
  - innovation 75
  - research 23ff.
  - risks 9, 69
  - safety 8, 9, 62
  - infectious diseases 48
- information:
  - infrastructure quality 26
  - networks 26, 33, 60, 64
  - processing (cognition) 64
  - quality/retrieval/storage 26
  - technology 18, 26, 60, 68
- injection moulding 29
- injury prevention 27
- innovation:
  - consultancy 72
  - industrial 75
  - management 72
  - policy 75
- instrumentation 33, 34
- integrated optics 33
- interfacial chemistry 29
- interferons 49

*Keywords*

- interleukins 49
- internal combustion engines 27
- ionizing radiation 48, 53
  
- joinery work 20
- joining 24, 84
  
- kilns 20
- knitwear 25
  
- laboratory animals 48, 52
- land use (planning) 68
- laser applications 24, 33
- laundry 79
- leather research 37
- leukemia 48
- linear analysis 18
- logistics 24, 60, 68
- LPG 27
  
- macromolecular chemistry 29
- malaria 49
- malting 43
- man-made fibre analysis 11
- manufacturing:
  - mechanical 31
  - paper 36
- maritime research 82
- masonry 18
- materials research 24, 29, 30, 33
- meat 42
- mechanical engineering 18, 19, 31
- mechanics, computational 18
- mechanization (building) 18
- medical technology 54, 55
- medicines 45
- melt crystallization 9
- membranes 9, 29
- metal:
  - cutting operations 24, 84
  - matrix composites 24
  - research 24
  - speciation 11
- microbiology 43, 52,
- microelectronics 86
- microwaves 53
- mine warfare 60
- models:
  - energy conversion 8
  - heat/flow dynamics 33
- model testing (structures) 18
- modelling (products) 32
- molecular analysis 43
- molecular biology 46, 48, 54
- monitoring systems (pollution) 12
- monoclonal antibody 53, 54
- mould(ing) 29
- movement research 56
- multiple sclerosis 49, 53
- munitions 62, 63
- mutagenesis (chemical) 52
  
- natural resources (subsurface) 14
- networks (computer/communication) 26, 33, 60, 64
- neural computing 60
- neurotoxic chemicals 52
- noise (control/annoyance) 33, 64
- non-destructive testing 18, 30
- non-ionizing radiation 48
- non-linear analysis 18
- numerical models 33
- nutrition research 45, 47ff.
  
- occupational health 56
- ocean engineering 82
- odour (abatement, analysis, detection) 9
- offshore structures 18, 82
- oil:
  - exploration/production 14
  - pollution 12
- oncology 48
- operations research 60
- optics 33, 61
- organ ageing/physiology 54

- organic/organometallic chemistry 29
- orthopedic shoes 37
  
- packaging 35, 43
- paint 39
- paper research 36
- parallel processing 26, 60
- particle characterization 11
- patent (information/search) 31, 73
- pathology 54
- PCB layout 31
- perception research 64
- pesticides 43
- pharmacology 52
- photo-chemical conversion 11
- phytotechnology 43, 46
- physical planning 68
- physics 33, 60
- piles 19
- plant biotechnology 43, 46
- plastic binders 62
- plastics 29, 84
- policy:
  - analysis 68
  - research 67ff.
  - studies 69
- pollutants (fate, behaviour) 11
- pollution:
  - air 8, 9, 11, 12, 15, 63
  - oil 12
  - soil 8
  - water 11, 80
- poisonous substances 52
- polymer(s) 29
- posture research 56
- precision injection moulding 29
- preservation (buildings) 18
- preservatives (food) 46
- preventive health care 56ff.
- primates (non-human) 48, 49
- product:
  - certification 81
  - design/development 31, 38, 39
  - evaluation 32
  - process control 64
  - production chains (food) 43
  - production scheduling 25
  - propellants (rocket) 62
  - public health 56
  - production automation/research 24
  - protective clothing 64
  - proteolysis 54
  - prototyping (fast) 31
  - pyrotechnics 62
- quality assurance 18, 39, 74
- quality management 74
- QA/QC services 11
  
- R&D (policy, programming, organization) 76
- radar 60, 61
- radiation 48, 51, 52
- radiation curing 29
- radiobiology 48
- radiological protection 51
- radiotherapy 48, 49
- radon 51
- recombinant DNA 46, 53
- recycling (paper) 36
- refrigeration 8
- refuse incineration 9
- regional development 68
- remediation (air, soil, water) 8, 12
- reservoir engineering 14
- rheology 29
- rehabilitation 85
- risk:
  - analysis 9, 62, 63
  - assessment 12, 15
  - management 9, 15
  - perception 69
- reliability:
  - equipment 9
  - software 26
  - structures 18
- rheumatism 49, 54
- road vehicles 27
- roads and traffic 64
- rocket technology 62
- rubber research 29

- safety 8, 57, 62
- security 34, 60
- sediment remediation 8
- seismic research 14
- sensors 12, 33, 60, 61
- sheet metal forming 24
- ship powering 82
- shock testing 19
- shoe technology 37
- signal processing 33, 61
- simulation 31, 33, 35, 60, 61, 65
- SIV 48
- sludge 12
- solar energy 19
- sonar systems 61
- smoke hazard 19
- smoke spread 19
- software:
  - development 31, 57
  - engineering 60
  - reliability 26
- soil remediation 8
- solid fuel/propellants 62
- space science 33
- spatial organization 68
- speech (transmission/processing) 64
- spinning 30
- spontaneous heating 12
- stability (structures) 18
- stoves (emission) 9
- strategic planning 68
- stress (mental load) 65
- structural engineering 18
- structures 18
- submarine warfare 60
- system:
  - certification 81
  - development 60
  - control 64
  - engineering 33
  
- tanning processes 37
- task load 64, 65
- technology:
  - assessment 55, 69
  - consultants 76
  
- management 71
- telecommunication 69
- telematics 26, 69
- textile research 38
- thermal insulation 18
- thermophysiology 64
- timber research 18
- tissue typing 49
- toxicology 45, 52, 62, 63
- traffic 68
- traffic behaviour 64
- traffic control 61
- transport 27, 68
- tropospheric chemistry 11
  
- upholstery 37
- urban development 68
- UV (exposure to) 53
- UV-curing 29
  
- vaccines 49, 53
- vascular research 54
- vehicles 27
- ventilation 19
- vestibular sensing 64
- vision 64
- visual ergonomics 65
  
- waste 8, 9, 12, 15, 18, 37, 42
- waste water treatment 12, 80
- water:
  - pollution 11, 80
  - management 77, 78
- welding 25, 84
- weapons (control, effects, systems) 61, 62, 63
- wheelchairs 85
- wood(base materials) 19, 20
- work and handicap 85
- working conditions 56, 64

TNO in perspective



## TNO in perspective

TNO is the Netherlands Organization for Applied Scientific Research. Its primary tasks are to support and assist trade and industry, governments and others in technological innovation and in solving problems. TNO does this by rendering services and transferring knowledge and know-how. Know-how is obtained from TNO's own research, through collaboration with others, or by exchanging or purchasing knowledge.

TNO is a fully independent R&D organization with a staff of about 5200 and a total turnover of nearly 400 million US dollars\*) a year.

### Features and organization

Features of TNO are:

- Multidisciplinary
- Practice- and market-oriented
- Independent
- Possessing unique know-how and facilities
- Internationally oriented

TNO's research takes place at a number of institutes and laboratories, spread throughout the Netherlands, most of which can be reached in less than an hour's drive from Amsterdam International Airport Schiphol.

TNO's present organizational structure is outlined on page 2. The management of the Organization is in the hands of the TNO Board of Management.

To make the best possible use of the internal synergy in the Organization, TNO has combined its major activities into seven divisions:

- TNO Environmental and Energy Research
- TNO Building and Construction Research
- TNO Industrial Research
- TNO Nutrition and Food Research
- TNO Health Research
- TNO Defence Research
- TNO Policy Research.

The names of these divisions clearly reflect TNO's major fields of activity. These fields are subject to a multidisciplinary approach.

\*) 1 US dollar = NLG 1.75



# Organizational structure of TNO

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## TNO Supervisory Board

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## TNO Board of Management

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F.E. Mathijssen Gerst (*president*)  
J.H. Parmentier  
A. Rörsch

---

## Divisions

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TNO Environmental and Energy Research

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TNO Building and Construction Research

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TNO Industrial Research

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TNO Nutrition and Food Research

---

TNO Health Research

---

TNO Defence Research

---

TNO Policy Research

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## Nature of the research

- TNO's most important product is knowledge. Its major activities are research, the transfer of know-how and the application of advanced knowledge in products and processes. In this respect three types of activities are distinguished:
- strategic and policy supporting research;
  - product and process development;
  - services to clients in the form of troubleshooting, testing and analyses.

TNO's research is largely directed at answering questions of practical importance. However, TNO maintains close contacts with basic research institutes, both at home and abroad, in order to translate up-to-date knowledge and insights into practical applications. These relationships range from the execution of joint projects to the establishment of combined institutes.

## Clients

Important clients of TNO are governments and industry, both at home and abroad. In addition to carrying out research for individual companies, TNO also works for industrial collectives. This often involves the transfer of knowledge that is of importance for groups of companies or for a whole branch of industry. An important number of industrial clients belong to the small and medium-sized enterprises (SME's).

### International relations

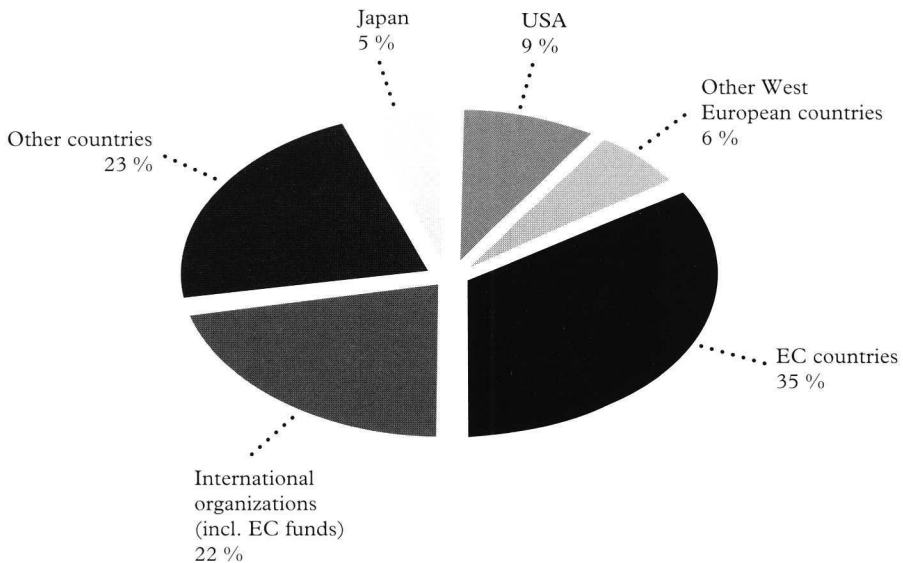
At present TNO derives about 16 per cent of its market turnover from contract R&D for the foreign private sector and international organizations. This amounted to some 33 million US dollars in 1989. The foreign clients' share was 25 million US dollars, that of organizations about 8 million US dollars. A breakdown of TNO's foreign market turnover is shown in the graph below.

TNO's main foreign markets are in Western Europe and in other OECD countries. However, the Organization is broadening its markets in Eastern Europe, the Middle East, the Far East and developing countries.

TNO participates in EC programmes like BRITE, EURAM, ESPRIT, RACE and EUREKA. In addition, TNO has concluded cooperation agreements with several foreign research institutes. These include the Fraunhofer Gesellschaft (Germany), the British Technology Group (UK), ANVAR (France), the Danish Invention Centre (Denmark), NCTD (Hungary), the Center for Hazardous Materials Research (USA) and the Council of Scientific and Industrial Research (India). TNO is a member of the European Association of Contract Research Organizations (EACRO).

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### Foreign market turnover 1989: some US \$ 33 million



Moreover, TNO carries out contract R&D projects in a number of Third World countries. These involve projects in the fields of water supply, food and nutrition, the transfer of industrial technology, energy, environmental technology, environmentally safe pest control, and projects for small and medium-sized industries.

### **Unique expertise and facilities**

TNO possesses unique expertise and R&D facilities in a wide range of areas. For instance, specific know-how in defence research in areas such as radar, sonar, infrared detection, explosion prevention, protection against toxic agents, rocket technology etc. In the field of product technology TNO offers testing facilities and installations on a semi-technical scale to many branches of industry. Advanced computer simulation packages have been developed in recent years. The facilities for geophysical and groundwater research are also unique, as are those for ecotoxicological research, research in the field of waste treatment and medical-biological research. The Organization also has a large arsenal of special instruments and inspection facilities in all possible fields.

A detailed description of the expertise and R&D facilities of TNO, arranged according to TNO's seven divisions, is given on page 7 ff.

### **Finance**

TNO operates in a business-like fashion, which is keeping with the general philosophy of TNO as an independent research organization.

More than half of TNO's revenue comes from contract research for industry, the government and other bodies. For the part of TNO that is engaged on industrial research this share is considerably greater.

Furthermore, TNO receives government funds to carry out special research projects and subsidies for the opening up of new areas of research, for which TNO may determine its own approach.

### **Doing business with TNO**

In principle, research is carried out by TNO under the 'Standard Conditions for Research-and development Instructions given to TNO'. Custom-tailored contracts may also be concluded with TNO, not only regarding the execution of research instructions, but also for the transfer of existing TNO expertise, the granting of patent and know-how licences, consultancy services, and so on. TNO is always prepared to negotiate the terms and conditions under which specific requests of clients can be met.

## TNO Marketing Department

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### Organization

The TNO Marketing Department comprises the following sections: Strategy and Business Development; Marketing Planning and Coordination; Contracts Office; International Coordination and Consultancy; and Marketing Communications.

### Scope of activities

TNO's foreign markets are mainly in Western Europe and in other OECD countries. However, the Organization is broadening its markets in Eastern Europe, the Middle East, the Far East and developing countries. To this end TNO has many representatives and agents in various countries, as part of an active marketing and communication policy. The TNO Marketing Department supports the TNO organization in preparing and implementing this policy.

Major tasks of the TNO Marketing Department include:

- to maximize coordination between TNO programmes and the requirements of the national and international markets, including governments, trade and industry, the service sector, contract research organizations, and international funding organizations;
- to coordinate projects involving various discipline-oriented TNO institutes in order to make the best possible use of high-level TNO expertise and know-how;
- to formulate overall marketing goals and translate these into specific action programmes;
- to promote national and international cooperation.

The Department represents TNO in the European Association of Contract Research Organizations (EACRO).

As part of the Organization's communication policy the TNO Marketing Department publicizes TNO through brochures and audiovisual presentations and through participation in exhibitions all over the world.

The newsletter 'Applied Research' regularly reports on recent findings and developments by TNO. Your application for a free subscription is welcomed.





*TNO Environmental and Energy Research*

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Based on the necessity for a sustainable development of society, TNO Environmental and Energy Research aims at contributing, through research and advice, to adequate environmental management, rational energy consumption, and the proper management and use of subsurface natural resources.



# TNO Environmental and Energy Research

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- TNO Environmental Research comprises four institutes:
- TNO Institute of Environmental and Energy Technology
  - TNO Institute of Environmental Sciences
  - TNO Institute of Applied Geoscience
  - TNO Study Centre for Environmental Research.



# TNO Institute of Environmental and Energy Technology

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**Staff and personnel:**  
260

## Organization

The institute comprises the following departments: Environmental Technology; Fluid Dynamics; Heat and Refrigeration Technology; Air Pollution Control; Industrial Safety; and Chemical Engineering.

## Scope of activities

The Institute conducts R&D on apparatus, systems and working methods that contribute to sustainable developments.

### *Environmental Technology:*

R&D on processes, equipment and methods for the abatement or prevention of environmental pollution. Major topics of research include:

- processing of hazardous waste;
- waste recycling, including dismantling of complex products;
- remediation of polluted soils and sediments;
- purification of industrial effluents and groundwater;
- prevention of pollution by process-integrated measures or product developments.

### *Fluid Dynamics:*

- Air pollution dispersion (obstacles, dense gas releases);
- wind engineering (wind hindrance, loading);
- wind energy (siting, wake effects, wind mapping, wind loading);
- industrial fluid dynamics (model experiments, computational fluid dynamics).

### *Heat and Refrigeration Technology:*

R&D and consultancy on domestic and industrial energy technology, heat pumps and refrigeration systems. Topics include:

- testing of domestic central heating boilers and heat recovery units;
- fouling of heat exchangers;
- modelling of energy conversion processes;
- heat pump and heat transformer development and application;
- new refrigeration cycles and fluids.

### *Air Pollution Control:*

R&D on combustion and gasification of waste and fossil fuels; development and consultancy on air pollution control. Research topics include:

- the incineration of domestic refuse and other waste;
- odour and air pollution abatement by biofiltration and other techniques;
- detection and analysis of odour;
- emissions from industrial installations, boilers and stoves.

### *Industrial Safety:*

R&D on the reliability and safety of industrial installations, systems and processes, and of transport and storage facilities. Topics of research include:

- production, storage, transport and use of hazardous substances;
- reliability and maintainability studies of all kinds of technical equipment and complex systems; industrial safety studies: analysis of potential hazards and probability of incidents; risk analysis;
- risk and emergency management: studies of local or regional risks; development of tools for formulating industrial and governmental policies and for decision-making in case of calamities; case studies of accidents and environmental risks;
- development of decision support systems and expert systems for the maintenance of technical equipment, process safety and emergency management.

### *Chemical Engineering:*

R&D on new separation processes, with emphasis on the following areas: melt crystallization, membrane technology, new extraction and ad(ab)sorption processes.

### **Equipment and facilities**

- Laboratory and pilot-plant facilities based on physical and chemical technology.
- Atmospheric boundary layer wind tunnels, air pollution dispersion computer models, 2D water flow circuit, double and triple hotwire anemometers, fibre optics Laser Doppler velocity/turbulence measurement equipment, thermistors for wind tunnel measurements of velocities, smoke generators, digital image processing software, computational fluid dynamics software.
- Climate rooms, infra-red camera, test facilities for boilers and small heat recovery units.
- Fluidized-bed furnace (0.4 MWth) for refuse incineration. Facilities for testing incineration equipment, gasifiers and air pollution control equipment. Emission monitoring van with various flue-gas analysers and data acquisition and control system. Special sampling trains for organic microcomponents (e.g. PAH, PCDD/F). Mobile odour detection laboratory for organoleptic detection.
- Software packages for risk analysis: EFFECTS (effects related to outflow, dispersion, explosion, etc.), and RISKCURVES (individual risk contours

and group risk curves). FACTS: industrial accidents databank containing data on a great many accidents involving hazardous substances.

- Various pilot-plants for chemical engineering; explosion-proof test hall.

### **International relations**

The institute takes part in EC and IEA projects.

Scientific contacts through international associations IIR and ASHRAE.

(Multi-)client-sponsored projects are carried out in cooperation with international (petro)chemical industry.

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180

## Organization

The institute consists of the following departments: Analytical Chemistry, Environmental Chemistry, Biology, and Environmental Biotechnology.

## Scope of Activities

### *Analytical Chemistry:*

Analytical research, development and services in the field of environmental and materials analysis. The department is operating under a strict quality control system qualified by the Dutch laboratory certification authority. The certificate is valid for repetitive analyses research and development in specific areas of environmental analysis.

Areas of research and services include:

- characterization and quantification of industrial emissions;
- metal analyses with atomic spectroscopy and neutron activation analysis;
- metal speciation;
- organic (trace) compounds in air, water, soil and biota from natural and anthropogenic sources e.g. dioxins in waste gases, terpenes, PCB, DMS;
- abiotic degradation and other GLP studies;
- DNA adducts from exposure to environmental contaminants;
- QA/QC services;
- development of reference materials and analytical standards
- asbestos and man-made fibre analyses, particle characterization;
- trouble shooting.

### *Environmental Chemistry:*

Research into the behaviour and fate of pollutants, as well as their effects on the abiotic environment; the assessment of measures against pollution.

Areas of research include:

- emission registration and analyses for abatement purposes; environmental audits;
- physics and chemistry of pollutants (photo-chemical conversions and (acid) deposition);
- tropospheric chemistry;
- determination of measuring strategies; validation of dispersion models;
- environmental impact studies of emissions from traffic, industry and other sources;

- effects of air pollution on materials;
- policy studies of the effectiveness and cost of measures; model predictions of future developments;
- risk assessment.

#### *Biology:*

Biological research into the environmental effects and impact of chemicals, products and wastes:

- ecotoxicological and biodegradation testing of chemicals and products according to internationally accepted guidelines and OECD principles of Good Laboratory Practice;
- research into the effects of chemicals, pollutant sediments, sludges, solid wastes, oil and other substances on specific organisms, populations of organisms or on communities in model ecosystems under semi-natural conditions;
- development of methods for testing chemicals in aquatic, sediment or soil systems, including microbiological and cell-biological stress indicators;
- mathematical modelling for ecotoxicological purposes.
- biological monitoring of chemicals in rivers, lakes and offshore and field surveys for recordings of animal communities;
- risk analysis and risk assessment of ecological effects of chemicals in the (aquatic) environment and general environmental impact studies;
- research and (controlled-release) application of pheromones for insect pest control.

#### *Environmental Biotechnology:*

Research into the biotechnological abatement of toxic environmental emissions and the remediation of polluted air, water and soil. Development of sensors and monitoring systems. Electrochemical research.

Research topics:

- biofilter research for cleaning air and off gases;
- biological treatment of domestic and industrial waste water;
- application of specialized micro-organisms and new reactor configurations using immobilized biofilms;
- testing of the behaviour of household chemicals in an experimental large scale domestic waste water purification plant;
- biocleaning of soils and solid wastes;
- sensor research and development for environmental and industrial monitoring systems;
- electrochemical degradation and removal of pollutants from waste streams;
- electrochemical energy storage, conversion and use (batteries and fuel cells);
- spontaneous heating of materials (coal, dried sludge, etc.).

#### **Equipment and facilities**

Gas generation systems for organic compounds at sub ppb to ppm level, advanced gas chromatography and mass spectroscopy, field laboratory with

mobile mass spectrometer, liquid chromatography with multiple detection systems, laser fluorescence instrumentation for sensitive and selective detection, special laboratory for handling extremely toxic samples and materials, atomic plasma emission and absorption spectroscopy, ultra clean laboratory for trace metal analysis, materials analysis by electron microscopy, X-ray micro analysis and FTIR-microscopic analysis.

Instrument calibration facilities. (High-)precision (air) pollution detection equipment with automated data processing facilities. Software for environmental quality modelling, e.g. models for emissions, dispersion, chemical transformation, and exchange among air, water and soil.

Smog chambers for research into atmospheric chemistry. Instruments for measuring emissions and the dry deposition characteristics of pollutants.

Culturing rooms; specialized equipment for ecotoxicological studies. Aquatic (fresh water and marine), benthic and tidal mesocosms of various sizes (up to semi-field scale). Mobile laboratory for research at sea. Equipment for the chemical and biological characterization of semiochemicals.

Experimental facilities for waste water treatment up to 500 p.e. scale, laboratory fermenters, soil columns, landfarm facilities, battery and fuel cell testing facilities, equipment for electrochemical conversion systems, confocal laser scan microscope, ellipsometer, microcalorimeter, optical and electrochemical sensors.

### **International relations**

Umwelt Bundes Amt (Germany), System Application Inc. (USA), Citepa (France), Norwegian Institute for Air Research (Norway), Atomic Energy Research Establishment (UK), Warren Spring Laboratory (UK), Technische Ueberwachungs Verein (Germany), Battelle (USA, Germany), Institute for Hygiene and Epidemiology (Belgium), Fraunhofer Institut (Germany), Institute of Terrestrial Ecology (UK), Riso (Denmark), Danish Maritime Institute (Denmark), University of Hamburg (Germany), University of East Anglia (UK), University of Madrid (Spain), EIVR (Belgium), Bureau Communautaire de Référence (EC Brussels), Centre for Hazardous Materials Research (USA).

# TNO Institute of Applied Geoscience

Schoemakerstraat 97  
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Phone +31 15 69 71 84

**Director:**  
Dr. H. Speelman  
**Staff and personnel:**  
140

## Organization

The institute comprises four departments: Geo-Hydrology; Geo-Information; Geo-Energy; and International Cooperation. The institute has formed cooperative relations with the Delft University of Technology and the Vrije Universiteit van Amsterdam.

## Scope of activities

- Scientific and technological research and development in geosciences, consultancy on the exploration, exploitation and management of subsurface natural resources, and the transfer of expertise in geosciences.
- The institute is the central body in The Netherlands for groundwater data acquisition and monitoring, data analyses and system assessment, modelling and information management. It supplies comprehensive information and state-of-the-art tools for the efficient management, use and protection of groundwater resources.
- The institute is the main independent body in The Netherlands for gas and oil seismic research, reservoir engineering and information management systems and for geothermal energy and energy storage. It conducts state-of-the-art R&D and provides technical consultancy necessary for the efficient exploration, production and management of gas and oil, geothermal energy and the subsurface storage of energy residues.
- The institute is involved in the strengthening of and knowledge transfer to geoscience institutes and government bodies abroad. It is engaged on institutional strengthening, knowledge transfer and technical consultancy, to contribute to the proper management and use of subsurface natural resources abroad.

## Equipment and facilities

Hardware and software: geoscience information management and processing and interpretation systems, both on mainframe computers and workstations. Geoscience equipment: telemetric systems for reflection seismics, geo-electrical and EM instruments, well-logging and well-testing equipment.

## International relations

The institute carries out geoscience research projects with R&D institutes and universities in most Western European countries. In the past decades the institute has carried out numerous projects in Africa, Asia and Latin America.

# TNO Study Centre for Environmental Research

Schoemakerstraat 97  
P.O.Box 6013  
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Telex 38071 zptno nl  
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Phone +31 15 69 69 00

**Director:**  
Prof. dr. F.B. de Walle, M.Sc.  
**Information officer:**  
Ms. P.W.A.M. Venis  
**Staff and personnel:**  
30

## Organization

The Centre comprises the sections: Waste management and soil protection, Risk management, Effect and evaluation, and Air management, as well as a Bureau for Environmental Impact Assessment.

## Scope of activities

- Studies of the environmentally safe management of hazardous waste streams; the logistics of waste disposal and trends with regard to new material substitutions and small quantity generators. Emphasis is placed on waste reduction and minimization and policy studies.
- Studies regarding risk assessment and risk management; management of control options; the role of the human factor in risk reduction; cost-effectiveness of control options; zoning-studies and management of industrial areas.
- Social and judicial studies for policy development; development of regulatory frameworks; evaluation of decision-making processes; studies regarding the corporate management of environmental issues.
- Global integrated air pollution studies emphasizing management and control options; regional air quality studies.
- Completion of integrated environmental impact studies; prediction of environmental impacts of future activities; environmental evaluation of governmental plan making.

## International relations

University of Washington, Department of Environmental Health, Seattle, Washington, USA. US Environmental Protection Agency, Cincinnati, Ohio, USA.  
Several EACRO partners. Consultancy and R&D firms in Italy and Spain.







*TNO Building and Construction Research*

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TNO Building and Construction Research provides comprehensive research and development service specifically geared to the needs of the construction and engineering industry.



## TNO Building and Construction Research

*Main office:*

Lange Kleiweg 5, Rijswijk  
P.O. Box 49  
2600 AA Delft  
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Telex 38270 ibbc nl  
Fax +31 15 84 39 90  
Phone +31 15 84 20 00

**Director:**

Prof. J. Witteveen, M.Sc.

By concentrating all its building oriented R&D and consultancy activities in one division, TNO has created the gateway to a wide variety of disciplines concerned with building and construction research. TNO Building and Construction Research covers a very broad field: from raw material to construction, from policy issue to project realization. Apart from R&D and consultancy work, the division undertakes strategic research to anticipate future developments.

TNO Building and Construction Research has two branches in Delft:

*Centre for Timber Research*

Schoemakerstraat 97  
P.O. Box 151, 2600 AD Delft  
The Netherlands  
Fax +31 15 61 13 21  
Phone +31 15 69 69 00

*Centre for Mechanical Engineering and  
Department of Indoor Environment, Building Physics and Systems*

Leeghwaterstraat 5  
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Telex 38192 iweco nl  
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# TNO Building and Construction Research

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**Director:**  
Prof. J. Witteveen, M.Sc.  
**Deputy director:**  
Th. Monnier, M.Sc.  
**Deputy director:**  
Prof. J.W.B. Stark, M.Sc.  
**Staff and personnel:**  
350

## Organization

TNO Building and Construction Research consists of the following departments and centres: Structural Engineering; Indoor Environment, Building Physics and Systems; Building Technology; Centre for Timber Research; Computer Integrated Construction; Computational Mechanics; Strategic Studies and Quality Assurance; Centre for Mechanical Engineering; Centre for Fire Research.

## Scope of activities

Research, development and consultancy on building materials and structures, building systems, mechanical engineering and fire prevention. The activities include civil engineering as well.

Testing and investigating building materials for mechanical and chemical properties and for durability; on-site inspections and non-destructive testing. New materials and the utilization of waste materials.

## *Building materials and structures*

Structural design and construction technology; finishing the detailing of building components and product innovation. Fundamentals for the evaluation of parts of the built environment. Physical properties of materials, moisture transport, thermal insulation, preservation of historic buildings.

The mechanical behaviour of concrete, timber and masonry structures. Reliability of existing structures and of structures in the design phase. Computing techniques, realistic models, structural details; fire resistance of (prestressed) concrete structures. Offshore structures. Methodology of building process, systems approach to quality control and maintenance. Model testing of structures difficult to analyse. Strength and stability of steel structures. Structural details, joints, computing techniques. Mechanization in building and construction. The application of information technology in building. FEM in applied mechanics: linear and non-linear analysis of structures with DIANA, a general purpose finite-element code; utilization of the research results by releasing product versions of DIANA.

Dynamic problems: vibration phenomena, wind loading and problems in connection with piling. Electronic measuring techniques. Pile diagnostic systems, monitoring of structures and integrity tests.

#### *Fire Research*

The causes, consequences and combating of fire; fire prevention. Behaviour of materials and structures subjected to fire. Smoke hazard and smoke spread. Fire detection.

#### *Indoor Environment, Building Physics and Systems*

Research into factors influencing indoor air quality in occupational and non-occupational environments. Major topics of research are:

- physical and chemical aspects of the working environment in industry and in public utility buildings; technical solutions to control these aspects; policy studies;
- the quality of indoor climate in homes; chemical and biological contamination; indoor climate control systems: humidity and dust control and ventilation problems;
- the relationship between indoor environment quality and energy consumption.
- heat technology: energy saving, solar energy, heat storage, building physics.

#### *Mechanical Engineering*

Research with regard to the lifetime and damage prevention of structures and machines subjected to severe operating conditions. Topics include:

- investigations into fatigue, collapse and unwanted dynamical- structural behaviour with regard to structures and machines;
- computer- aided design systems incorporating structural strength aspects of, and new design techniques for structures and machines;
- the design and construction of test machines for special purposes, e.g. shock testing;
- design against shock; design of proper shock specifications, laboratory testing of shock resistance and field measurements during shock testing of ships at sea.

Worldwide field measurements of mass, strain, stress, pressure, force acceleration, velocity of displacement by means of TNO Building and Construction Research instruments (mostly computer controlled). The development of condition monitoring systems for rotating equipment on the basis of measurement techniques, tribology, structural mechanics and computer technology.

#### *Timber Research*

Research into wood and woodbase materials. Technical testing and consultancy. Structure of wood and identification of kinds of wood. Mechanical and physical properties of wood and woodbase materials. Testing

of wood, timber structures, furniture and joinery work. Drying properties of wood; advice on kilns.

Preservation of wood. Wood chemistry; composition, durability, decolourization, bleaching and finishing; wood stabilization.

Technological timber research: joints (e.g. adhesives) and timber engineering, sheet materials, woodwaste.

Quality and tolerance; finishing of surfaces with paints, varnishes, foils.

### **Equipment and facilities**

- Standard equipment for all current tests of building materials. Equipment for the non-destructive and integrity testing of concrete; corrosion tests; arrangements for the investigation into the weather resistance and the resistance to aggressive substances of building materials and structures.
- Equipment and model techniques for testing rain and wind tightness. A building with adjustable indoor climate to test the thermo-hygric behaviour, durability and heat insulation of wall and roof structures. Climate rooms.
- Equipment for the full-scale testing of structural elements under static or varying loads up to failure. Measuring equipment for observing the behaviour of structures and for registering phenomena elapsing rapidly or slowly with time.
- Apparatus for the integrity testing of foundation piles and for the non-destructive testing of piles and pile foundations. Automatic registration facilities for the on-line computer analysis of experimental data.
- Equipment for making and testing elastic and realistic models of concrete and steel structures on a reduced scale. Computer programs and other computation techniques for the rapid calculation of the distribution of forces in complicated structures. Linear and non-linear (simulation) analyses of structures: DIANA. Several CAD/CAM systems for specific building.
- Furnaces and fire-shed for determining the fire resistance of building components.
- Equipment for determining material properties in case of fire; facilities for testing fire-extinguishing equipment; smoke detection, etc.
- Test chamber for indoor climate; test chamber for emission rates. Wide variety of mobile automated measuring and detecting facilities for on-site analysis.
- Cyclic force testing machine; shock testing facilities; vibration test facility; deep-water tank; three floors with a large mass; main interference generators; radio frequency interference test facility. Various calibration facilities: torque-generating machine; transfer standards up to 5 MN (2.10<sup>4</sup>F); differential pressure standard.
- Mechanical testing equipment and wood-working machinery. Kiln-drying plant; Incubators for fungal research; plant for semi-industrial impregnation and the manufacture of boards. Measuring-van. Wood samples collection.

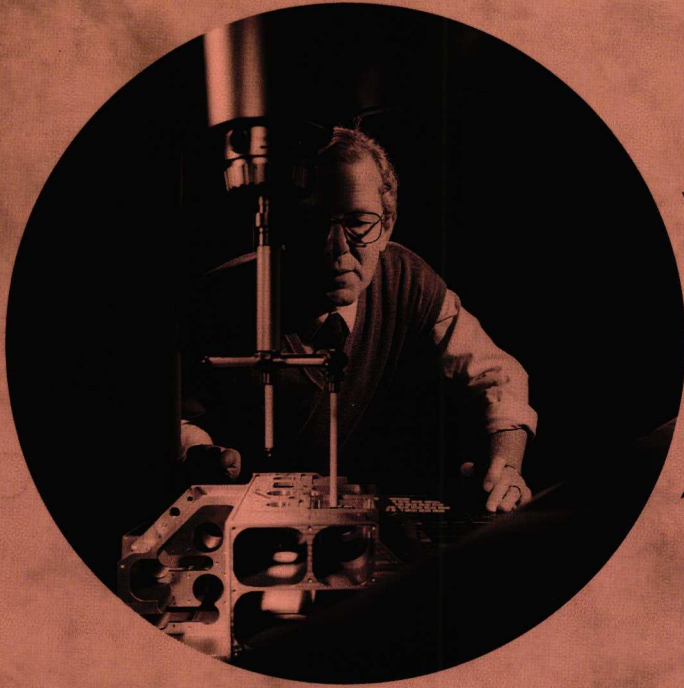
- CAD/CAE systems for: electronic design, printed circuit board lay-out and mechanical design and manufacturing.
- Clean rooms (up to class 100). Optical measurement rooms. Experimental laser-machining equipment. Solar test and passive solar test facilities.
- Measuring rooms for airconditioning equipment.
- Test facilities for resilient mountings and resilient shaft couplings.

### **International relations**

Comité Euro-international du Béton (CEB), Paris.  
 Réunion Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions (RILEM), Paris.  
 Fédération Internationale de la Précontrainte (FIP), Paris.  
 International Institute of Welding, London.  
 Conseil International du Bâtiment pour la Recherche, L'Etude et la Documentation (CIB), Rotterdam.  
 European Coal and Steel Community, Luxembourg.  
 Organization for Economic Cooperation and Development (OECD), Paris.  
 Inter-Governmental Maritime Consultative Organization (IMCO), London.  
 International Organization for Standardization (ISO), Geneva.  
 Convention Européen des Constructions Métalliques.  
 European Community (EC), Brussels.  
 International Shipbuilding Progress (ISP; Delft, Netherlands).  
 International Cooperation on Marine Engineering Systems (ICMES; Stockholm, Sweden).  
 Permanent Committee for Stress Analysis (Lyngby, Denmark).  
 West-European Cooperation in Marine Technology (WEMT; Council Secretariat Delft, Netherlands).  
 COST (Brussels, Belgium).  
 International Instrument Users' Association (Breda, Netherlands).  
 Food and Agricultural Organization (FAO).  
 International Union for Forest Research Organizations (IUFRO).







**TNO Industrial Research**

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TNO Industrial Research conducts research and renders services in the field of industrial technology. Major target groups are industry, the service sector and the authorities. Industrial technology comprises areas such as physics, chemistry, product development, production technology, materials science, industrial engineering, micro-electronics, computer science and telematics.



## TNO Industrial Research

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**Division director:**  
J. Delcour, M.Sc.  
**Deputy director:**  
R. Meijer, M.Sc.

### Organization

TNO Industrial Research comprises the following institutes:

- TNO Institute of Production and Logistics Research
- TNO Institute of Applied Computer Science
- TNO Road-Vehicles Research Institute
- TNO Plastics and Rubber Research Institute
- TNO Product Centre; Institute of Product Design and Development;
- TNO Institute of Applied Physics.

### Branch-specific Research Centres

Schoemakerstraat 97  
P.O. Box 6034  
2600 JA Delft  
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Fax +31 15 56 03 02  
Phone +31 15 69 69 00

**Director:**  
M. Meijer, M.Sc.  
**Deputy director:**  
T. Frieling, M.Sc.  
**Staff and personnel:**  
150

Within TNO Industrial Research, branch-specific research is carried out in five centres:

- TNO Centre for Packaging Research
- TNO Centre for Paper and Board Research
- TNO Centre for Leather and Shoe Research
- TNO Centre for Textile Research
- TNO Centre for Coatings Research.

# TNO Institute of Production and Logistics Research

## *Apeldoorn branch:*

P.O. Box 541  
7300 AM Apeldoorn  
The Netherlands  
Fax +31 55 41 98 37  
Phone +31 55 49 34 93

## **Director:**

H.A.M. Verhelst, M.Sc.

## **Marketing:**

G.H. van Duren, M.Sc.

## **Staff and personnel:**

200

## *Eindhoven branch:*

Horsten 2, building O  
5612 AX Eindhoven  
The Netherlands  
Fax +31 40 43 65 35  
Phone +31 40 47 45 17

## **Organization**

The Institute is a merger of the TNO Metals Research Institute (now Apeldoorn branch) and the TNO Institute of Information Technology for Production Automation (now Eindhoven branch). The Eindhoven branch of the Institute is a joint venture of TNO and the Eindhoven University of Technology.

## **Scope of activities**

Work of the Institute covers a wide range of activities for clients (manufacturers and users of machinery, equipment and installations; suppliers and directly related logistics; and governments and other regulating bodies).

Main fields of activities are:

- materials technology, especially metals and metal matrix composites;
- technology for discrete product manufacturing;
- automation for both discrete product manufacturing and the processing industry;
- logistics management;
- activities concerning the interfaces between these areas.

## *Apeldoorn branch:*

With the emphasis on materials and technology, the Institute is engaged on R&D, consultancy, training and inspections regarding:

- metal cutting operations, sheet metal forming and blanking, laser applications;
- joining technology and assembly processes;
- materials, products, technical systems and tools.

Activities concerning the design, preparation and production of discrete products; quality, throughput time and delivery reliability.

Activities in the field of production technology and logistics for the clothing and knitwear industry.

Training courses on metal cutting and sheet metalworking technology, machine tool inspection, welding and brazing.

#### *Eindhoven branch:*

With the emphasis on automation, technology and logistics management, the Institute concentrates on automation in production and logistics concerning:

- development and improvement of products, production processes and equipment;
- production scheduling, preparation and materials supply;
- management and optimization of production processes;
- maintenance and quality control;
- management of internal and external goods flows;
- supply of management information.

#### **Equipment and facilities**

- Metal cutting and metal forming and blanking: (CNC) machine tools for testing, training, development; flexible manufacturing system (FMS).
- Group-technology based software for production control (MICLASS) and CNC turning (MITURN).
- Equipment for inspection and (acceptance) testing of machine-tools.
- Software for measuring-equipment and machine-tools control.
- Welding and brazing: equipment for submerged arc welding, gas shielded welding, welding robots, high-temperature vacuum furnaces.
- Software for the selection of metal cutting processes.
- Laser facilities: CO<sub>2</sub>-lasers, Nd-YAG lasers, excimer lasers.
- Equipment for microscopy and analysis (e.g. SEM), chemical analysis, mechanical testing, tribological and corrosion research.
- Development facilities for the areas of automated handling and production control in the clothing industry.
- General-purpose and dedicated computer facilities.

The Eindhoven branch has networked access to relevant local and national university computer facilities and can dispose of the laboratories of Eindhoven University of Technology.

#### **International relations**

The Institute maintains international working relations with multinationals, universities and research institutes. The Institute participates in some 20 European research projects under ESPRIT, EUREKA, BRITE-EURAM and SPRINT.

# TNO Institute of Applied Computer Science

Schoemakerstraat 97  
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Phone +31 15 69 70 71

**Director:**  
R.H.J.M. Overmeer, M.Sc.  
**Information officer:**  
Ms. J.M. van Steenberg  
**Staff and personnel:**  
75

## Scope of activities

### *Software quality:*

- Information Quality: information policy and information planning.
- Software (project) Quality Assurance:  
Software quality policy.  
Project and quality planning for software projects on requirements regarding functionality, performance, safety, reliability, and confidentiality.  
Assessment and investigation of plans, documentation or (interim) results of software processes (e.g. package testing, arbitration).
- IT-infrastructure Quality:  
Performance improvement of computer systems and networks (parallelization in particular).  
Reliability and confidentiality of computer systems and networks.  
Information storage and retrieval  
Presentation of information (graphical; man/machine interfaces).

### *Special applications of computer science and telematics:*

- Telematics:  
EDI, PDI, Mail, information services, etc.  
Data exchange protocols: X.400, STEP, MAP, etc.  
Infrastructures: database technology and networking.
- Industrial Diagnosis and Control:  
Diagnostic systems (e.g. alarm processing, maintenance).  
Process control.  
Statistical optimization
- Task support systems:  
Knowledge management.  
Advisory systems (e.g. expert systems).  
Intelligent design systems.  
Experimental design.

# TNO Road-Vehicles Research Institute

Schoemakerstraat 97  
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Phone +31 15 69 69 00

**Director:**  
P.D. van der Koogh, M.Sc.  
**Assistant director:**  
G.K. Tanis, M.Sc.  
**Staff and personnel:**

## Organization

The Institute has four R&D departments: Internal Combustion Engines; Crash and Injury Prevention; Vehicle Dynamics; and Homologation.

## Scope of activities

Research and development on road vehicles and their components. Product evaluation and approval testing regarding properties, design and use of road vehicles and road-vehicle components.

### *Internal Combustion Engines:*

Application of alternative fuels (LPG, CNG, other gases and alcohols).  
Optimization of engines as to efficiency and exhaust emissions for a range of different fuels. Fuel supply and (electronic) control systems.  
Mathematical simulation of combustion, heat release and flow processes in engines.

### *Injury Prevention:*

Passive safety and biomechanics of injury.  
Crash phenomena of vehicles.  
Development and application of restraint and protective systems for adults and children.  
Development and application of dynamic mathematical crash models.  
Development of special crash test dummies.

### *Vehicle Dynamics:*

Vehicle-driver dynamics and criteria for stability and manoeuvrability of single and double-tracked vehicles (active safety).  
Optimization of vehicle design properties.  
Quality aspects of small vehicles.  
Transport of handicapped people.

### *Approval testing:*

Testing for vehicle approval in accordance with national and international (EC, ECE, US) regulations.



### **Equipment and facilities**

Engine dynamometers (2 to 600 kW), roller test benches (moped to commercial vehicle) and a fully equipped emissions laboratory.

Impact rig and complete test machinery for restraint systems and helmets.

Full-scale crash test facility (max. impact speed 100 km/h).

Cross-wind simulator (max. wind speed 30 m/s).

Measuring facilities for stability and car-driver experiments (gyro-stabilized platform, steering input generator, etc.).

Fatigue and functional test laboratory for small vehicles (bicycles and wheelchairs).

Interlinked computer system for on-line and off-line data processing and model calculation.

### **International relations**

Industries; cooperation with universities in Europe and the USA and with government agencies in a number of countries.

The Institute participates in EC research programmes.

# TNO Plastics and Rubber Research Institute

Schoemakerstraat 97  
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**Director:**  
A.P.M. van der Veek  
**Assistant director:**  
Dr. K.E.D. Wapenaar  
**Information officer:**  
W. Adriaansen, B.Sc.  
**Staff and personnel:**  
170

## *Zeist branch*

Utrechtseweg 48  
P.O. Box 108  
3700 AC Zeist  
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Fax +31 3404 5 41 86  
Phone +31 3404 4 41 44

## **Organization**

The Institute consists of the following departments: Chemistry; Physics; Processing and Application.

## **Scope of activities**

The Institute carries out research and development and provides consultancy and training services on plastics and rubber. In addition R&D is performed in the field of organic chemistry, organometallic and interfacial chemistry, catalysis and macromolecular chemistry.

## *New materials and methods:*

Research focuses on the synthesis and development (on a laboratory and semi-technical scale) for the chemical and pharmaceutical industry of:

- specialties-carbohydrates-bioactive compounds;
- special catalysis for polymers (membranes);
- electrochemicals and interfacial chemicals.

Radiation curing polymers (both UV and electron-beam); plasma-polymerization; controlled-release applications, e.g. hollow-fibre membranes; electrets, especially for filters; piezo-active polymer sensors; conductive polymers; polymer blends, e.g. thermoplastic rubbers; liquid-crystal polymers; composites; improved filament winding techniques; fibre/matrix adhesion; new applications; and specialized products.

## *Processing:*

Research on the rheological behaviour of plastics and rubber during processing; precision injection moulding; relations between processing conditions and product quality; optimization of process conditions; mould design.

Energy conservation; spinning techniques.

Long-term behaviour of materials; evaluation of material properties; tests for mechanical, chemical, weathering, and electrical properties; fracture mechanics, prediction of long-term (weathering) behaviour; adhesion science.

Nondestructive testing, e.g. acoustic emission, ultrasonics; and dielectric measurements.

Materials characterization; instrumental analysis.

#### *Consultancy and training:*

Market research; idea generation, production techniques; techno-economic auditing; feasibility studies; quality control; trouble shooting; and good manufacturing practice (GMP)

Postgraduate education (in cooperation with Dutch Universities of Technology); training courses; seminars.

Projects in developing countries.

#### **Equipment and facilities**

Synthetic facilities up to 200 l.

MO-CVD and electrochemical equipment.

Machines for processing plastics and rubber both on semi-industrial and laboratory scale.

Equipment for testing mechanical, dynamical and electrical properties, and weatherability.

Analysis techniques, e.g. DSC, GPC, HPLC, FTIR, TGA.

Specialized equipment: UV-curing; dynamic viscosity; CAD/CAM programs; fully instrumented injection moulding machines and rubber mixers; equipment for fabricating composites (filament) winding; nondestructive testing equipment.

Hollow-fibre membrane spinning equipment.

#### **International relations**

The Institute maintains contacts with many national and international companies and institutions.

# TNO Product Centre

## Institute of Product Design and Development

Oostsingel 209  
P.O. Box 5073  
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The Netherlands  
Fax +31 15 60 87 56  
Phone +31 15 60 89 09

**Director:**  
Dr. A. Scheepmaker, M.Sc.  
**Information officer:**  
J.H. Lucas  
**Staff and personnel:**  
120

### Organization

The Institute comprises several departments: Mechanical and Industrial Design and Engineering; Electronic Design and Engineering; Mechanical Manufacturing; Applied Research; and Product Testing.

The Institute collaborates with the Faculty of Industrial Design of the Delft University of Technology (TNO CAD Centre), as well as with a leading CAD/CAM company in Norway.

### Scope of activities

The Institute carries out product development projects for companies both at home and abroad. The goals are to develop new products, renew existing products and to perform applied scientific research on subjects such as CAD in product development, CAD/CAM (CAD/NC), CAD/CAD (product Data Interchange), DFA/DFM, fast prototyping and Design for the Environment. Assistance is given to industry in every stage of product development.

#### *Product Design:*

- problem analysis;
- patent search;
- brain storming/idea generation;
- consulting specialists;
- concept design/list of requirements and restrictions;
- visualizing (mock ups, renderings and 3D CAD presentations);
- ergonomic studies;
- specification of product functions;
- selection of materials and production methods.

#### *Engineering:*

- mechanical construction;
- electronic design/PCB lay out;
- software development;
- simulation;
- test of critical parts;
- selection of manufacturers.

### *Modelling:*

- making of test models and prototypes;
- functional testing;
- preparation for production;
- making pilot series;
- supporting manufacturers.

### *Product evaluation:*

- functionality;
- safety and durability;
- comparative product assessments;
- quality research;
- expertise research.

### *TNO CAD Centre:*

- Consultancy and support to companies regarding the selection, introduction and implementation of CAD/CAM/CAE. Activities include feasibility studies and information analysis, automation plans, the selection of CAD systems, benchmarking, and choice and implementation.
- Product and production development with respect to CAD/CAM/CAE. Projects are carried out for various (groups of) clients and range from short-term, practical orders to longer-term research projects.
- The organization of workshops, seminars, and training courses often in cooperation with industry and suppliers of hardware and software.

### **Equipment and facilities**

CAD system for product design: CAD/CAE system for the design and simulation of electronic hardware. Equipment for the automatic testing of electronic devices, printed boards and components.

Workshop equipped with CNC machines suited for machinery within very narrow tolerances. Fully equipped photo studio and photochemical laboratory. Zeiss machine for high-accuracy, three-dimensional product measurements. Product test facilities.

The TNO CAD Centre has the disposal of a broad collection of hardware platforms and software programs.

### **International relations**

The TNO Product Centre executes contract work for companies abroad, including product development projects for clients in several European countries and the USA.

The TNO CAD Centre is involved in the ESPRIT project CIM-Data, as well as in SPRINT and BRITE proposals.

Collaboration with partners in several European countries in the field of PDI (Product Data Interchange).

# TNO Institute of Applied Physics

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Phone +31 15 69 20 00

**Director:**  
J.D. van Zijverden, M.Sc.  
**Finance director:**  
W. Kooijmans, M.Sc.  
**Information officer:**  
A. Verbraeck  
**Staff and personnel:**  
300

## Organization

The institute comprises five departments: Acoustics; Heat and Materials; Optics; Instrumentation; and Evaluation Centre for Instrumentation and Security Techniques.

The Institute has legally founded cooperative relations with the Delft and Eindhoven Universities of Technology.

## Scope of activities

The Institute's mission is to utilize results of the physical sciences, mathematics, electronics, informatics, mechanics and materials science in the development of new and advanced systems for clients.

### *Acoustics:*

Noise control in and around buildings, industries and machines, in traffic and on board ships.

### *Heat and flow dynamics:*

Development and application of numerical models for flow, heat and mass transport, pulsating flow in pipe systems and flow machinery, development of measuring instruments for thermal parameters.

### *Materials:*

Properties and technology of glass, ceramics (whiteware, technical ceramics, structural ceramics and refractories), X-ray diffraction analysis of crystalline materials.

### *Optics:*

Optical systems, spectrometers (from infrared to X-ray), optical detection systems, sensors and instruments for space science, laser applications, optical sensors and integrated optics.

### *Instrumentation:*

Development of sensors, electronic design and system engineering, data collection and information networks, image processing and image interpretation, computer applications in signal processing and simulation, biomedical instruments.

*Evaluation of instrumentation and security techniques:*

Evaluation of measuring and control systems, the security of data-communication systems, and the fraud resistance of documents and securities.

**Equipment and facilities**

CAD/CAE systems for electronic design, printed circuit board lay-out and for mechanical design and manufacturing.

Clean rooms (up to class 100). Optical measurement rooms.

Equipment for testing glass products and for research into the preparation of ceramic coatings by Chemical Vapour Deposition (CVD). X-ray diffraction.

Transmission, reverberation and anechoic rooms; reverberating water tank.

Measuring rooms for airconditioning equipment.

Test facilities for resilient mountings and resilient shaft couplings.

**International relations**

Projects are carried out for companies abroad, multinationals and international institutions.

The institute regularly acts as a prime or a subcontractor in (very) large projects financed by the European Commission and the European Space Agency, ESA.

The Institute participates in a number of European programmes, such as JESSI, ESPRIT, BRITE and DRIVE.

# TNO Centre for Packaging Research

Schoemakerstraat 97  
P.O. Box 6034  
2600 JA Delft  
The Netherlands  
Telex 38071 zptno nl  
Fax +31 15 69 62 80  
Phone +31 15 69 69 00

**Director:**  
C. Sonneveld, M.Sc.  
**Staff and personnel:**  
25

## Organization

The Centre has four working groups: Packaging of Agricultural Products; Packaging of Hazardous Goods; Packaging of Industrial Products; and Consumer Packaging and Environment.

## Scope of activities

Research, development and consultancy on packaging and packaging materials; trouble shooting, information services, courses, seminars, workshops.

Major topics of research include:

- Packaging for transport, retail and industrial purposes; packaging of agricultural and horticultural products and of hazardous goods.
- Studies of environmental aspects of packaging materials and systems.
- The development of computer models for optimizing packaging systems and for the prediction of quality. Simulation techniques.
- Testing in accordance with international standards.

## Equipment and facilities

Climate rooms, drop tables, vibration tables, compression testers.  
Instruments for measuring permeability to water vapour and gases.  
Equipment for measuring material properties and the shock absorption of packages. Equipment for testing intermediate bulk containers.

## International relations

International Association of Packaging Research Institutes (IAPRI).  
United Nations Industrial Development Organization (UNIDO).  
International Trade Centre (UNCTAD/GATT).  
International Standardization Organization (ISO).  
International Packaging Consultants (IPC).



# TNO Centre for Paper and Board Research

Schoemakerstraat 97  
P.O. Box 6034  
2600 JA Delft  
The Netherlands  
Telex 38071 zptno nl  
Fax +31 15 69 65 11  
Phone +31 15 69 66 74

**Director:**  
R.P. Versluijs, M.Sc.  
**Staff and personnel:**  
15

## **Organization**

The centre consists of two working groups: Process Technology and Product Technology.

## **Scope of activities**

Paper manufacturing process technology.  
Environmental problems.  
Energy conservation.  
Paper recycling.  
Product testing, specification, normalization.  
Consultancy, information and documentation.

## **Equipment and facilities**

Pilot plant for paper manufacturing.  
Product testing equipment.

## **International relations**

PIRA (UK);  
Centre Technique de l'Industry des Papiers, Cartons et Celluloses;  
Institut für Papierfabrikation;  
European Community (EC);  
Spanish Institute for Paper (IPE).

# TNO Centre for Leather and Shoe Research

Mr. van Coothstraat 55  
P.O. Box 135  
5140 AC Waalwijk  
The Netherlands  
Telex 35083 Istno nl  
Fax +31 4160 4 17 35  
Phone +31 4160 3 32 55

**Director:**  
W.R. van Wijk, M.Sc.  
**Information officer:**  
Ms. G.A. Verhoeven  
**Staff and personnel:**  
30

## **Organization**

The Centre has three sections: Shoe Technology; Leather Technology; and Biomechanics.

## **Scope of activities**

Research, development and consultancy on leather and footwear production and leather products.

Raw materials; production process design, product development; quality improvement and quality control.

Optimization of tanning processes; treatment of waste water and solid wastes.

Improvement of production efficiency; product testing; specification of materials and products.

Biomechanical studies; computer-aided design (CAD) projects; footwear design.

Orthopedic shoes, leather goods, garment and upholstery, sportshoes and safety shoes.

Training courses on 'Leather Technology' and 'Shoe Modelling and Design'.

## **Equipment and facilities**

Processing equipment and machines for the production of all kinds of leather on a pilot-plant scale.

Chemical laboratory, physical laboratory.

CAD (computer-aided design) facilities for shoes.

Mobile measuring unit for industrial waste water.

## **International relations**

Shoe and Allied Trades Research Association (SATRA).

European Union of Research Institutes for Shoes (EURIS).

Groupe Européenne de Recherches des Industries du Cuir (GERIC).

United National Industrial Development Organization (UNIDO).

# TNO Centre for Textile Research

Schoemakerstraat 97  
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Phone +31 15 69 66 58

**Director:**  
Dr. J.A. van Aken, M.Sc.  
**Information officer:**  
R.B.M. Holweg, M.Sc.  
**Staff and personnel:**  
40

## Organization

The Centre has five working groups: Chemistry; Process Technology; Physics; Mechanical Technology; and Product Research.

## Scope of activities

- Textile finishing processes.
- Environmental problems.
- Energy conservation.
- Product development.
- Quality control.
- Consultancy work.
- National and international standardization.
- Testing, specification and calibration.
- Information and documentation.

## Equipment and facilities

- Pilot plants for finishing processes.
- Product testing equipment.

## International relations

International Institute for Cotton; International Wool Secretariat (IWS).  
Forschungsinstitut Hohenstein.  
Centexbel.  
Svenska Textilforsningsinstitutet.  
International Standardization Organization (ISO).  
European Community (EC).  
Wool Industries Research Association.  
BTG (UK); DWI (Germany); ITF (France); DTNW (Germany).

## TNO Centre for Coatings Research

Schoemakerstraat 97  
P.O. Box 6034  
2600 JA Delft  
The Netherlands  
Telex 38071 zptno nl  
Fax +31 15 61 28 34  
Phone +31 15 69 64 61

**Director:**  
Dr. F.R.J. Willemse  
**Staff and personnel:**  
35

### Organization

The Centre comprises the following working groups: Product Development; Corrosion Prevention; Testing; Expertise and Consultancy.

### Scope of activities

Research, development and consultancy on paints and painted objects.

Topics include:

- product development: specialty coatings; water-borne and solventless coatings; antifoulings;
- corrosion prevention: substrate pretreatment; paint application and electrochemical corrosion measurement techniques; lifetime prediction of paint films on different substrates; marine corrosion;
- testing paints and painted objects for mechanical properties, corrosion protection, and weatherability; inspections/trouble shooting, quality control; testing for environmental aspects;
- expertise and consultancy: advising on and handling of complaints along with introduction of quality assurance systems.

### Equipment and facilities

Equipment for the manufacture of paints, and for substrate preparation and paint application. Equipment for testing paints for weatherability, corrosion protection, mechanical properties, rheological behaviour. Electro-chemical corrosion impedance measurement. Spectrophotometer for 8/d colour measurements.

### International relations

Permanent International Committee for Research on the Preservation of Materials in the Maritime Environment (COIPM). International Standardization Organization, Technical Committee 35 (ISO-TC 35). Fédération d'Associations de Techniciens des Industriels des Peintures, Vernis, Emaux en Encres d'Imprimeries de l'Europe Continentale (FATIPEC). European Coil Coaters Association (ECCA).

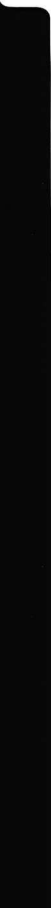




*TNO Nutrition and Food Research*

TNO Nutrition and Food Research conducts technological, biotechnological, analytical, nutritional and toxicological research on foods and allied products, including feedstuffs.

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## TNO Nutrition and Food Research

Utrechtseweg 48  
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Phone +31 3404 4 41 44

**Acting division director:**  
R.A.P.J. Schulze, M.Sc.  
**Information officer:**  
K. Waterreus

TNO Nutrition and Food Research consists of:

- TNO Food Technology Institute
- TNO Biotechnology and Chemistry Institute
- TNO Toxicology and Nutrition Institute
- RUL-TNO Centre for Phytotechnology.



# TNO Food Technology Institute

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**Acting director:**  
R.A.P.J. Schulze, M.Sc.  
**Information officer:**  
K. Waterreus  
**Staff and personnel:**  
90

## Organization

R&D departments are: Cereals, Feed and Bakery Technology; Fish Technology; General Production Technology; Netherlands Centre for Meat Technology.

## Scope of activities

- Quality control during all process phases, i.e. from the supply of raw materials up to the finished product and its distribution.
- Production optimization with respect to raw materials, auxiliary compounds, use of energy, waste streams and the re-use of waste.
- Development of new production processes and techniques.
- Consultancy particularly to small and medium-sized enterprises on equipment, materials, process operation.

## Equipment and facilities

Experimental processing lines for research into meat, fishery products, bakery products, feeds and oils and fats. Climate test chambers, freezer tunnels, packaging systems.

A high-pressure pilot plant for studying extractions and reactions with supercritical gases. Special facilities for microbiological, physical and (bio)chemical research.

## International relations

Food and Agricultural Organization (FAO).  
World Health Organization (WHO).  
FAO/WHO Codex Alimentarius Committee.  
European Community (EC).  
International Union for Pure and Applied Chemistry (IUPAC).  
International Organization for Standardization (ISO).  
Office Internationale du Cacao et du Chocolat (OICC).  
International Association for Cereal Chemistry (ICC).

# TNO Biotechnology and Chemistry Institute

Utrechtseweg 48  
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Phone +31 3404 4 41 44

**Director:**  
J.W. van der Kamp, M.Sc.  
**Information officer:**  
K. Waterreus  
**Staff and personnel:**  
210

## Organization

R&D departments are: Molecular Plant Biotechnology (see page 46); Industrial Biotechnology and Biosafety; Microbiology; Biochemistry and Biophysical Chemistry; Analysis; Molecular Analysis.

## Scope of activities

- Analysis of all kinds of (chemical) compounds in foods, allied products and feedstuffs, involving trace elements, amino acids, carbohydrates, vitamins, additives and veterinary medicines. Often there is a relation to the quality or authenticity of the products or the study of aromas and flavours.  
Sensorial testing of foods and allied products with panels.
- Investigations into foods for the presence of pesticides, micotoxins and other undesirable residues.
- The investigation between packaging and their food contents in relation to their use.
- The use of specialized instrumental analysis like mass spectrometry, nuclear mass resonance and near infra red to determine or define (unknown) compounds or biological material.
- Development of methods for quick detection of microbiological infections in the production chains; research into the production of aromas, flavours and antimicrobial compounds (preservatives) through fermentation.
- Biosafety assessment of processes and production.
- (Bio)technological research into malting and brewing.
- Plant biotechnology on monocotyledonous plants.
- Research into biocatalysis and bioprocess technology, fermentation and fermentor technology and applied microbiology.

## Equipment and facilities

Automated and other advanced equipment for large-scale sample analysis; advanced analytical instruments like mass spectrometers, nuclear mass resonance, and near infrared methods. Laboratories for microbiological and biotechnological research. Continuously stirred and air-lifted fermentors (up to 200 l). Facilities for production, purification and characterization of enzymes. Down-stream processing facilities.

Ultra-modern malting and brewing pilot plants.

Modern laboratories for plant-biotechnological research.

### **International relations**

European Brewery Convention (Analysis Committee and Barley Committee).

Food and Agriculture Organization (FAO).

World Health Organization (WHO)

FAO/WHO Codex Alimentarius Committee.

European Community (EC).

International Union for Pure and Applied Chemistry (IUPAC).

International Organization for Standardization (ISO).

# TNO Toxicology and Nutrition Institute

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Phone +31 3404 4 41 44

**Director:**  
Prof. dr. R.J.J. Hermus, M.Sc.  
**Information officer:**  
K. Waterreus  
**Staff and personnel:**  
150

## Organization

R&D departments are: Human Nutrition; Experimental Biology; Biological Toxicology; Animal Nutrition and Physiology (ILOB).

## Scope of activities

- Research into the noxious effects of compounds that may enter the human body by indigestion, by breathing or through the skin. Most of this research, as well as studies of the nutritional value of specific food components, is carried out with the aid of animal tests or in-vitro tests.
- Epidemiological and clinical studies or studies under standard conditions in a metabolic ward of the relationship between man and his food.
- Determination of the state of nutrition and health of people by analysis of blood and urine and metabolic research into syndromes related to ill-balanced nutrition.
- Studies of the relationship between medicines and food of human beings.
- Clinical trials for human medicines testing in a metabolic ward under controlled food conditions.
- Metabolic studies of the digestion of feed and their components and medicines in animals.

## Equipment and facilities

Metabolic units for nutrition research and controlled clinical trials on medicines. Equipment for determination of body composition, for preparing test animal rations, for inhalation toxicity tests and for making large number of histological preparations. Laboratory animal test rooms for very toxic or carcinogenic compounds. Scanning electron microscope. Nutrient data collection (NEVO). Modern analytical instruments like high pressure liquid chromatographs connected to computer systems, spectrometers, fluorimeters, enzyme automatons, auto-analysers, liquid scintillation and gamma counters.

Metabolic units for studies on digestion with animals. C-unit for studies with radio-isotopes and well-equipped surgery room.

## International relations

World Health Organization (WHO). FAO/WHO Codex Alimentarius Committee. International Agency for Research on Cancer (IARC). European Community (EC). Organization for Economic Cooperation and Development (OECD).

# RUL-TNO Centre for Phytotechnology

Wassenaarseweg 64  
2333 AL Leiden  
The Netherlands  
Telex 40022 civo nl  
Fax +31 71 27 49 99  
Phone +31 71 27 49 14

**Management:**  
Prof. dr. E.J.J. Lugtenberg (RUL)  
Dr. F. Heidekamp (TNO)  
Dr. A.J. Vijverberg (RUL)

**Information officer:**

K. Waterreus

**Staff and personnel:**

35

## Organization

The Centre for Phytotechnology represents the collaboration on plant biotechnology between the TNO Department of Molecular Plant Biotechnology (see page 43) and the Department of Plant Molecular Biology from the Leiden University (RUL).

## Scope of activities

- Molecular biology and cell biology of monocotyledonous plant species with particular emphasis on the molecular basis of dormancy, on lipid metabolism and protein secretion in germinating barley seeds.
- Research (protein engineering) on anti-nutritional factors in plants (in particular lectins present in leguminous plant species) aiming at a more economic inactivation of lectins prior to consumption.
- Research on the genetic transformation of plants with particular emphasis on monocotyledonous and leguminous plant species using modern plant cell biological methods (including ballistics).
- Research on the regeneration of monocotyledonous and leguminous plant species from multi- and unicellular (cell suspensions, calli, explants, protoplasts, microspores) levels, anthers.
- Production and application of (monoclonal) antibodies for research and for analysis of components of interest in plant material (including non-destructive seed analysis).
- Isolation of natural food preservatives.

## Equipment and facilities

Plant growth chambers for controlled growth of plants. Equipment (particle gun) for genetic transformation of plants. Flow cabinets and tissue culture rooms for in vitro culture and regeneration of plants. Equipment for cell biological and biochemical research including spectrophotometers, fluorimeters, liquid chromatographs, liquid scintillation counters. Containment laboratories for research using radio-isotopes and for recombinant DNA research with micro-organisms and plants. Greenhouses. Non-destructive seed analyser.

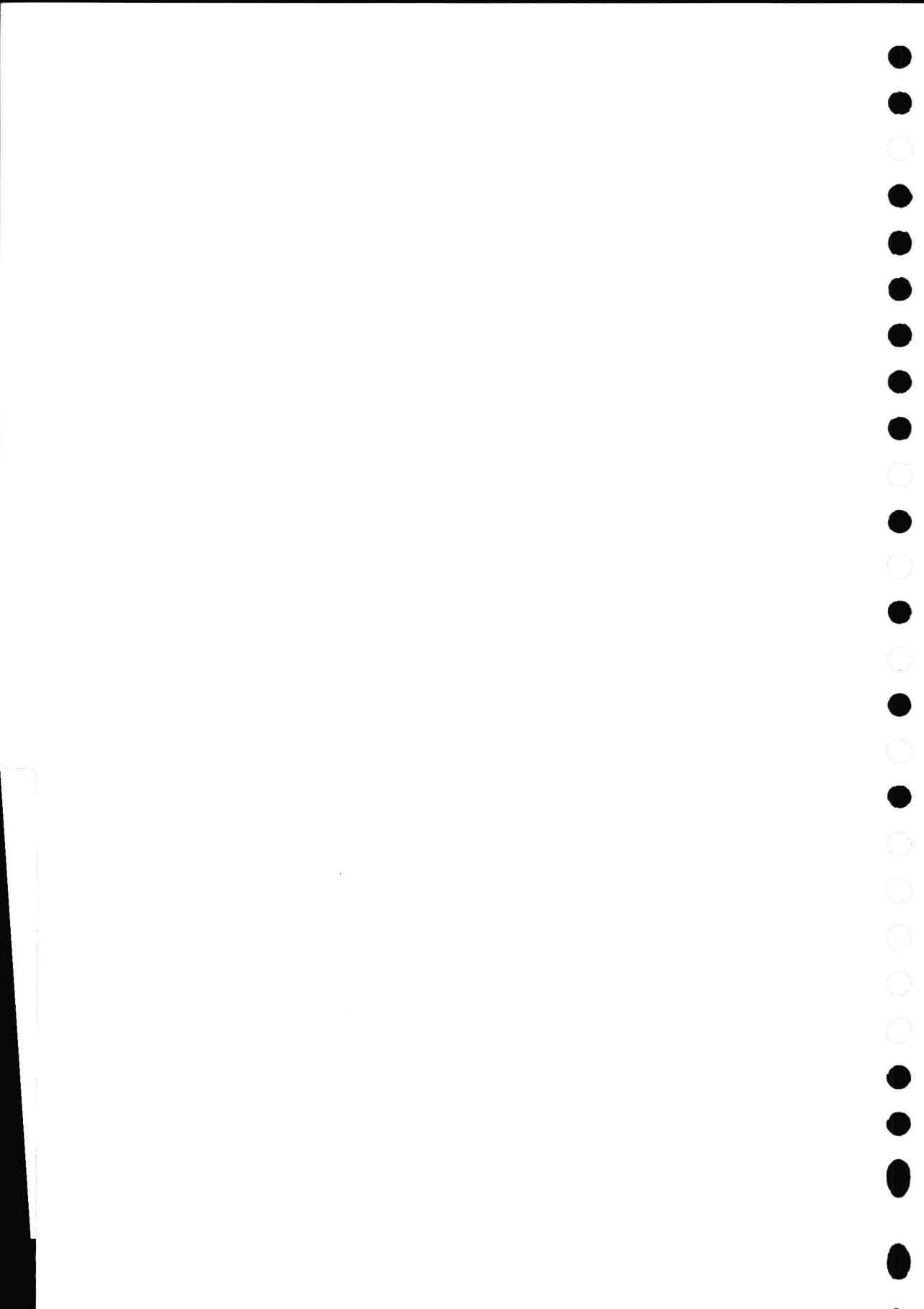
## International relations

Carlsberg Research Centre (Copenhagen). Max Planck Institute (Cologne). Swedish University of Agricultural Sciences (Stockholm).



*TNO Health Research*

TNO Health Research aims at improving the prevention and treatment of human diseases and disorders by making fundamental and problem-oriented, medical-biological, psycho-social and epidemiological knowledge applicable to public health and health care.



# TNO Health Research

Zernikedreef 9  
P.O. Box 2215  
2301 CE Leiden  
The Netherlands  
Fax +31 71 18 19 10  
Phone +31 71 18 18 18

**Division director:**  
Dr. W.F. Stevens

## **Organization**

TNO Health Research comprises the following institutes:

- TNO Institute of Applied Radiobiology and Immunology (including TNO Radiological Protection Service)
- TNO Medical Biological Laboratory
- TNO Institute of Ageing and Vascular Research (including the Centre for Medical Technology)
- TNO Institute of Preventive Health Care.



# TNO Institute of Applied Radiobiology and Immunology

Lange Kleiweg 151  
P.O. Box 5815  
2280 HV Rijswijk  
The Netherlands  
38191 repgo nl  
Fax +31 15 84 39 98  
Phone +31 15 84 28 42

**Director:**  
Prof. dr. J.J. Haaijman  
**Deputy directors:**  
Prof. dr. J.J. Broerse  
H.W. Julius, M.Sc.  
Dr. C. Pries  
**Staff and personnel:**  
251

## Organization

The TNO Institute of Applied Radiobiology and Immunology is a merger of the former TNO Radiobiological Research Institute, TNO Primate Centre and TNO Radiological Protection Service.

The scientific work is organized in the following departments: Radiobiology and Oncology; Cell Biology; and Chronic and Infectious Diseases.

The institute also comprises a Department of Laboratory Animals.

## Scope of activities

Applied and fundamental biomedical research in the fields of radiotherapy, diagnostic use and health hazards of ionizing radiation, dosimetry of ionizing and non-ionizing radiation, gene therapy, cell (immunology) and molecular biology, retrovirology, biological response modifiers, multiple drug resistance, phylogenetic and immunogenetic studies on tissue antigens of non-human primates.

Some of the research topics are:

- effects of ionizing radiation on normal tissues and radiation-induced carcinogenesis for the assessment of health hazards of ionizing radiation;
- cellular and molecular aspects of radiation-induced transformation; radiation effects on tissues (dose rate and fractionation effects); combined exposure to radiation and cytostatic agents, combination of hyperthermia with radiation;
- identification, isolation, and factors that regulate proliferation and differentiation of pluripotent stem cells and committed stem cells; bone-marrow transplantation projects interrelated with clinical treatment of bone-marrow aplasia, leukemia, and combined immunodeficiency;
- solid tumour models and experimental leukemia; normal tissue damage and the effects of combining radiation with other treatment modalities;
- pharmacokinetics of cytostatic agents; molecular biological analysis of multiple drug resistance in leukemia;
- experimental gene therapy at the level of haemopoietic stem cell for the correction of single enzyme defects;
- animal models for research in AIDS: simian and feline immunodeficiency viruses (SIV and FIV); production of stable haemopoietic human/mouse chimeras; interaction between the SIV-tat gene product and cellular genes;

- gnotobiotics for fundamental purposes and clinical applications (e.g. anti-infection and haematological support to cancer patients undergoing intensive radiotherapy and chemotherapy);
- the molecular organization of the hepatitis-delta virus genome, development of diagnostic assays and candidate vaccines;
- the testing of the efficacy of various vaccine preparations and antiviral drugs in non-human primates;
- immunological and molecular biological characterization of malaria in non-human primates;
- development of a rhesus monkey model for rheumatological arthritis and multiple sclerosis; study of responsible auto-antigens and cells in the auto-immune process, testing of new therapeutic modalities. The efficacy of bone-marrow transplantation in the treatment of auto-immune diseases is tested in rodents;
- production, characterization and therapeutic application of biological response modifiers such as interferons and interleukins;
- international reference centre for tissue typing in primates (under the auspices of the International Council for Laboratory Animal Science (CLAS)).

### **Equipment and facilities**

Facilities for housing circa 850 macaques (including a sizable breeding colony of rhesus monkeys), approx. 115 chimpanzees (including a breeding nucleus of 30 females producing circa 10 baby chimpanzees a year) and an marmoset breeding colony of about 50 animals.

Specially designed isolation facility for research into high-risk agents in non-human primates. P3-4 conditions available for experiments.

Radiation sources include:

- X-ray machines, specific dosimetric equipment for photons and neutrons;
- a Co-60 source ( $11 \times 10^{12}$  Bq) for dosimetry experiments; an Sr 90/Y-90 beta source;
- two Cs-137 gamma sources ( $1 \times 10^{12}$  Bq and  $19 \times 10^{12}$  Bq);
- a two-source Cs-137 gamma irradiation facility ( $27 \times 10^{12}$  Bq);
- a mammography installation (Senographe I CGR, tube voltage 20-40 kV, Mo-anode);
- a Van de Graaff K2N 3000 neutron generator (radiobiology and dosimetry research).

Flow cytometers, all interfaced with computer systems.

Facilities for the handling and counting of radio-isotopes.

A biochemical and a bacteriological unit; a unit for tumour virology.

Rooms especially equipped for surgery in large and small animals.

Computer facilities consisting of a Data General MV 10,000 time sharing system and several special purpose systems; a linear accelerator (Philips MEL SL75).

## **International relations**

International Atomic Energy Agency.

The Institute's Radiation Biology research programme is closely linked with the Biology and Health Protection Programme of EURATOM (European Commission on Atomic Energy). Long-term studies within the framework of the Institute's Radiation Biology programme are performed in collaboration with the European Late Effect Project Group (EULEP).

Cancer research projects are performed in collaboration with other European centres under programmes of the European Organization for Research on Treatment of Cancer (EORTC).

International Commission on Radiological Protection.

# Radiological Protection Service

(TNO Institute of Applied Radiobiology and Immunology)

Utrechtseweg 310  
P.O. Box 9034  
6800 ES Arnhem  
The Netherlands  
Fax +31 85 45 07 87  
Phone +31 85 56 30 55

**Director:**  
H.W. Julius, M.Sc.

## Organization

The Radiological Protection Service of the TNO Institute of Applied Radiobiology and Immunology comprises four sections: Individual monitoring for workers exposed to radiation; General radiation protection investigations and advice; R&D in external and internal radiation dosimetry including radon.

## Scope of activities

The Service covers the following fields:

- individual monitoring of workers exposed to external sources;
- National Dose Registration and Information Service (NDRIS);
- internal contamination measurements of individuals;
- calibration of radiation protection measuring instruments;
- radiological safety investigations and advice;
- quality assurance in diagnostic radiology;
- radio-ecological research projects (radon, models);
- gamma spectrometry of samples (e.g. building materials, food);
- development and application of TLD.

## Equipment and facilities

- Various calibrated Cs-137 and Co-60 sources (range:  $K_a$ :  $10\text{--}15^{-5}$  mGy/min);
- X-ray machines (10-250 kV);
- secondary standard for beta dosimetry (Sr/Y-90, TI-204, Pm-147);
- four automatic Thermoluminescence Dosimetry (TLD) systems;
- gamma spectrometer (Ge-detector in low background shielding);
- whole body counter;
- various radiation measuring instruments.

## International relations

Participation in international organizations, such as EURATOM, ISO, IEC. Cooperation with research institutes, e.g.: EML (New York, USA); GSF (Neuherberg, FRG); SCK (Mol, Belgium); NRPB (Harwell, UK).

# TNO Medical Biological Laboratory

Lange Kleiweg 139  
P.O. Box 45  
2280 AA Rijswijk  
The Netherlands  
Telex 38034 pmtno nl  
Fax +31 15 84 39 89  
Phone +31 15 82 28 42

**Director:**  
Prof. Dr. W.R.F. Notten  
**Deputy director:**  
Dr. C.J. Lucas, M.Sc.  
**Information officer:**  
A.G. Scheffer, M.Sc.  
**Staff and personnel:**  
174

## Organization

The institute comprises the following research departments and sections: Pharmacology, Biochemistry, Occupational Toxicology; Immunology and Medical Microbiology.

## Scope of activities

Research into the prevention and therapy of intoxication with chemical agents, microbial infections and radiation damage.

### *Research into chemical agents:*

- development of methods and strategies to quantify the external exposure via inhalatory and dermal route and to investigate factors influencing dermal exposure;
- development of methods and strategies for biological monitoring;
- establishment of health-based recommended occupation exposure limits;
- the (neurotoxic) effects of toxic materials and pertinent antidotes on intact animals and isolated organs;
- the mechanism of action of neurotoxic chemicals at the molecular level;
- effects on DNA; detection and identification of reaction products;
- cellular repair of damage in DNA;
- the mechanism of chemical mutagenesis;
- the relation between DNA damage and biological effects of mutagenic and carcinogenic compounds; evaluation of health risk involved in exposures to such compounds; skin protection; methods for biological monitoring and for detecting early health effects;
- general classification of and information about poisonous substances.

### *Microbiological research:*

- immunology of the respiratory tract;
- the mechanism of protection against aerogenic infection;
- bacteriology of laboratory animals.

### *Research on the biological effects of radiation:*

- effects on microorganisms and cells of higher organisms;
- the induction of DNA strand breaks and their persistence; the detection and identification of other DNA lesions;

- dosimetry of ionizing radiation on the basis of DNA damage induced;
- risk evaluation of skin exposure to UV; effects of microwaves on laboratory animals;
- the mechanism of action of radio-protective agents.

*Recombinant DNA research:*

- study of the regulation of the expression of genetic information in bacteria, eukaryotic microorganisms and mammalian cells;
- the development of vaccines based on parts of the coat protein of infectious viruses;
- the development of host/vector systems for various organisms suitable for the production of, among other things, proteins of medical interest.

*Immunological research:*

- the improvement of monoclonal antibody generation;
- the possible role of (synthetic) peptides in the antigen presentation in the immune system;
- AIDS and multiple sclerosis research;
- mucosal immunity;
- oral vaccination.

**Equipment and facilities**

Electron microscope, Laser scan microscope, Gas Liquid Chromatography, High Performance Liquid Chromatography, Atomic Absorption Spectrophotometer, and Mass spectrometer.  
 Isotope laboratories. CI, CII and CIII facilities for recombinant DNA experiments.  
 Facilities for handling mutagenic and carcinogenic substances.  
 Equipment for long-term inhalation studies; equipment for animal behavioural studies.

**International relations**

Various foreign universities.  
 North Atlantic Treaty Organization (NATO).  
 Anglo-Netherlands-Norwegian Collaboration Projects (ANNCP).  
 International Commission for Protection against Environmental Mutagens and Carcinogens (ICPEMC).  
 European Neuroscience Association (ENA).  
 International Neurotoxicology Association (INA).  
 European Community (EC).  
 Sister laboratories for Nuclear, Biological, Chemical (NBC) research in UK, USA, Belgium, France, West Germany and Norway.

# TNO Institute of Ageing and Vascular Research

Gaubius Laboratorium  
Zernikedreef 9  
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Phone +31 71 18 18 18

**Managing director:**  
Prof. D.L. Knook, Ph.D.  
**Director of research:**  
Prof. P. Brakman MD, Ph.D.  
**Assistent director:**  
Jhr. F.J. de Ranitz, MSc.

## Organization

The Institute is a merger of the former TNO Gaubius Institute, TNO Institute of Experimental Gerontology, and TNO Medical Technology Unit. Research has been organized in five departments: Endothelial Cell and Lipids; Pathology and Immunogerontology; Fibrinolysis and Proteolysis; Dementia and Cell Physiology; and the Centre for Medical Technology (see page 55).

## Scope of activities

Biomedical research with emphasis on understanding, diagnosis and alleviation of geriatric diseases and on diagnosis, therapy and prevention of vascular disease.  
Mechanism of organ ageing; molecular biology, cell- and organ physiology.  
Impact of nutrition on the process of ageing.  
Pathophysiology of immunological system with age.  
Life span studies of mortality and morbidity in animal models.  
Pathophysiology of the fibrinolytic system, including its relation to rheumatic disorder.  
Drug testing of hypolipidemic and fibrinolytic agents.  
Pathophysiology of the endothelium.  
Protein targeting and development of monoclonal antibodies.  
Medical technology (see Centre for Medical Technology, page 55).

## Equipment and facilities

General biochemical equipment.  
Culture of human cells and tissues.  
Ageing colonies of mice and rats.  
Histology and pathology facilities including electra microscopy.  
Transgenic mice technology.  
Facilities for producing and characterizing monoclonal antibodies.

## International relations

The Institute participates in: European Late Effects Group (EULEP); Eurage (EC concerted action ageing and diseases); and ECAT (EC concerted action for the detection of the tendency to trombosis).  
Research projects are carried out in close cooperation with research groups abroad and with internationally operating biotechnology companies.

# Centre for Medical Technology

(TNO Institute of Ageing and Vascular Research)

Gaubius Laboratorium  
Zernikedreef 9  
P.O. Box 430  
2300 AK Leiden  
The Netherlands  
Fax +31 71 18 19 00  
Phone +31 71 18 18 18

**Head:**  
J. Kraus, Ph. D.  
**Information officer:**  
J. Boter, B.Sc.

## Organization

The Centre is part of the TNO Institute of Ageing and Vascular Research. The Centre also includes the Health Care Technology Assessment (HCTA) programme of TNO Health Research.

## Scope of activities

- Assistance to health care institutions, the medical devices industry, governmental and private organizations, in medical technology. The Centre provides information and consultancy services.
- Research into the efficient, safe, reliable and interference-free use of medical devices and installations in hospitals and other health care institutions.
  - The evaluation of devices and installations with respect to performance, safety, human factors and other aspects for industries, hospitals and governmental bodies.

## Equipment and facilities

Measuring instruments and other facilities for testing the performance and safety aspects of medical appliances under various conditions. Database on medical devices, suppliers, literature, applicable standards and alerts.

## International relations

Test houses for medical equipment e.g.: TUV (Germany); SPRIMA (Sweden); B.S.I. (UK); and VTT (Finland).  
Advisory Institutions on medical equipment (e.g. ECRI in the USA).  
Governmental institutions in Italy, UK and France.  
World Health Organization (WHO).



# TNO Institute of Preventive Health Care

Wassenaarseweg 56  
P.O. Box 124  
2300 AC Leiden  
The Netherlands  
Fax +31 71 17 63 82  
Phone +31 71 18 11 81

**Director:**  
Dr. C.L. Ekkers  
**Deputy director:**  
Dr. A. Dijkstra and  
Dr. J.H.B.M. Willems  
**Information officer:**  
A.A. Jurriëns, M.Sc.  
**Staff and personnel:**  
165

## Organization

The scientific work is organized in the following departments: Public Health and Prevention; Children and Health; Environment, Behaviour and Health; Occupational Health Research; Work Research; Posture and Movement Research; Statistics and Informatics; Education. The institute also comprise two study groups on specific fields of research: Tuberculin Research Unit and Centre for Medical Informatics.

## Scope of activities

The institute supports preventive actions in society by means of applied scientific research, educational activities, advice and services. This support is given to the government, authorities and professional groups within the preventive health care system and to industry (employers and employees).

### *Public health and prevention:*

- analyses of public health problems in order to support health policy making;
- development and evaluation of collective preventive programmes;
- behavioural and environmental factors influencing health.

### *Children and health:*

- epidemiology and morbidity registration;
- development and evaluation (efficacy, process) of preventive actions;
- dental care and epidemiology.

### *Work and health:*

- epidemiology of diseases/accidents connected with work;
- mental stress connected with work;
- occupational health care;
- practical problems in work situations;
- work, technology and organization;
- access to employment for disabled and elderly;
- improvement of working conditions for female workers;
- physical factors and work;
- occupational disorders of the musculo-skeletal system.

*Elderly and health:*

- development and evaluation of collective preventive programmes;
- mobility and independent living;
- safety and prevention of accidents.

*Statistics and information systems:*

- In the field of preventive health care the institute contributes to the improvement of community and occupational health data systems with:
- advice on setting up computerized information systems and registrations;
  - advice on the statistical and methodological aspects of data analysis;
  - the development of expert systems and software for specific purposes.

*Education:*

Post-doctoral training is given to physicians on the following subjects: occupational health care; child health care; public health care; environmental health care. In addition, individual courses are given in social medicine, focused on one particular area. Furthermore, specific seminars and courses are organized.

**Equipment and facilities**

Laboratories for audiology, for experimental psychology and psychophysiology, for neurophysiology equipped with computer systems. Laboratory for posture and movement analysis. VAX-computer system for statistical analyses in epidemiological, psychological and sociological research projects.

**International relations**

World Health Organization (WHO).  
Commission of European Communities.  
Medical Research Council, London.  
International Labour Organization (ILO).  
National Institute of Health (USA).  
Fraunhofer Gesellschaft (Germany).  
Institutes of Public Health.  
Institutes of Occupational Health.  
International Union against Tuberculosis.  
Universities.





TNO Defence Research

The organization of defence research in the Netherlands is unique. Contrary to the other NATO countries where defence research laboratories occupy an isolated position, most of the research in the Netherlands is carried out by TNO Defence Research. The research is coordinated by the National Defence Research Council.



## TNO Defence Research

Schoemakerstraat 97  
P.O. Box 6006  
2600 JA Delft  
Fax +31 15 62 73 19  
Phone +31 15 69 69 00

**Division director:**  
C.M.N. Belderbos, M.Sc.

- TNO Defence Research consists of three institutes:
- TNO Physics and Electronics Laboratory
  - TNO Prins Maurits Laboratory
  - TNO Institute for Perception.

# TNO Physics and Electronics Laboratory

Oude Waalsdorperweg 63  
P.O. Box 96864  
2509 JG The Hague  
The Netherlands  
Fax +31 70 3 28 09 61  
Phone +31 70 3 26 42 21

**Managing director:**  
P. Spohr, M.Sc.  
**Director of research:**  
Dr. J.W. Maas  
**Information officer:**  
W.L. Smith  
**Staff and personnel:**  
583

## Organization

The institute comprises five R&D departments: Operational Research; Information Technology and System Development; Radar and Communication; Physics and Acoustics; and Technical Development.

## Scope of activities

### *Operations Research:*

The institute's operations research activities support decision-making processes on the procurement of matériel, operational requirements, tactics, training and force structure analysis. The primary areas of application include air defence, anti-armour warfare, submarine warfare, mine warfare, airbase operations and integrated logistics.

Topics are:

- defining relevant key factors;
- structuring the weighing process of conflicting factors;
- quantifying the consequences of policy issues;
- optimizing the deployment of systems based upon agreed effectiveness criteria;
- increasing the speed of decision processes by developing decision-support systems;
- improving military staff readiness by creating management games and tactical trainers.

### *Information Technology and Communication:*

- Information technology research is directed towards the integration of existing and new techniques for use in the design of military information systems. Current items of research are: data fusion; artificial intelligence; computer assisted instruction; neural computing; high-speed parallel processing; real-time simulation of sensors and visual systems; security of information systems; software engineering.
- Communications research serves to evaluate the use of military communication networks and radio links and to develop future system concepts. Current subjects include: tactical data links and net radio; network management; integrated services networks; mobile communication on HF, VHF and UHF; the influence of propagation effects on link reliability; security of communication systems.

*Sensor Technology:*

Efforts focus on sensors in the microwave range (radar), in optics and IR (infrared), and in acoustics. The activities encompass the characteristics of sensors proper as well as subjects closely connected with the use of sensors, such as propagation effects, target signatures and signal processing. Current items of research are:

- Radar  
Properties of multifunction radar for detection, tracking and target classification; active phased-array radar antennas with gallium-arsenide MMIC's (monolithic microwave IC's); SAR (synthetic aperture radar) technology; millimetre wave propagation; radar signatures of targets and backgrounds; ESM (detection, localization and classification of radar and radio transmitters); remote sensing of sea surface and land surface.
- Optics and IR  
Propagation effects in the atmosphere; CCD (charge coupled device) sensors; signal and image processing; integrated optics; laser sensors; IR signatures of targets and backgrounds; automated detection of heat sources; IR multi spectral discrimination.
- Acoustics  
Sound propagation in the ocean; sonar range predictors; target motion analysis; towed-array configurations, technology and signal processing; seismic sensors for battlefield surveillance.

*System Development:*

This area of activity covers the evaluation of weapon and sensor systems as well as the design and development of information and communication systems, sensor systems, trainers and simulators.

Current subjects include: command and control information systems; phased-array radar systems; SAR systems; towed-array sonar systems; CCD camera systems; IR detection and measurement systems; traffic control systems; communication terminals; trainers and simulators for education, tactical training and operator training.



# TNO Prins Maurits Laboratory

Lange Kleiweg 137  
P.O. Box 45  
2280 AA Rijswijk  
The Netherlands  
Fax +31 15 84 39 91  
Phone +31 15 84 28 42

**Managing director:**  
E.B. van Erp Taalman Kip, M.Sc.  
**Director of chemical Research:**  
M. van Zelm, M.Sc.  
**Director of technological Research:**  
H.J. Pasman, Ph.D., M.Sc.  
**Information officer:**  
Th.M. Groothuizen, B.Sc.  
**Staff and personnel:**  
280

## Organization

The Institute comprises two R&D departments, Technological Research and Chemical Research, with research groups on: Analytical Chemistry; Chemical Toxicology; Protection and Risk Analysis; Munition Functioning and Explosives; Ballistics and Rocket Technology; Weapon Effects; Explosion Prevention; Pulse Physics.

## Scope of activities

### *Technological research:*

Research on munitions, guided weapons and energetic materials to evaluate their effectiveness, reliability of functioning and safety in use. Research on the improvement of ballistic protection capabilities against the effects of explosions and projectile impact. Investigations regarding explosion prevention in the processing industry; promotion of safety during the storage and transport of explosive substances.

Areas of technological research include:

- Shock and explosion physics, gas dynamics, hydrodynamics, propagation and effect of shock waves in air (blast), soil and water. Materials research.
- Terminal ballistics; fragmentation parameters of high-explosive munitions, penetrating capability of armour-piercing projectiles, shaped charges. Ballistic protection.
- Vulnerability studies of weapon platforms and systems: vehicles, ships, fixed-wing aircraft, helicopters and missiles.
- Lethality models, survivability of systems, weapon- target mixes and interaction studies.
- Detonation wave research. Sensivity, initiating and metal-accelerating capability of explosives. Detonation trains. Deflagration to detonation transition.
- Pyrotechnics. Processing and manufacture of explosive substances and charges. Application of plastic binders.
- Thermal initiation (friction, shock, sparks etc.) in relation to explosion prevention and functioning of ignition trains.
- Rocket motors, mechanical properties of solid rocket propellants. Lifetime prediction. Combustion studies in solid fuel ramjets.
- Interior ballistics.

- Risk analysis of ammunition storage. Protective structures. Effects of accidental explosions.
- Study of decomposition processes of substances having explosive properties with regard to stability and compatibility and explosion behaviour of solids and liquids.
- The prevention and fighting of gas, vapour and dust explosions; general explosion safety promotion in manufacture, transport and use of gases and aerosols. Dispersion of gases and aerosols in the atmosphere.
- Pulsed power research; physics of power compression and switching of high currents.
- Hypervelocity electromagnetic launch research; studies of sliding contacts, plasmas and accelerators. Hypervelocity impact dynamics. Multi-dimensional electromagnetic dynamic computer simulations.

*Chemical research:*

R&D in the field of protection of humans against toxic substances (chemical warfare agents in particular), and other chemical problems of interest to the armed forces.

Areas of chemical research include:

- Study of mechanism of action of toxic compounds and development of effective antidotes for prophylactic and therapeutic application.
- Identification and quantitative determination of toxic compounds in the environment with the aid of modern analytical chemical techniques and development of detection and alarming systems.
- R&D on effective means for the protection of humans against toxic compounds: breathing protection; skin protection and decontamination; purification of air.
- Study of problems in the field of weapon control and disarmament and verification measures connected with it.
- Dispersion of gas and aerosol clouds in relation to risk analysis.
- Small-scale energy supply.

**Equipment and facilities**

Ballistics laboratories. Explosion prevention laboratory. Equipment for testing explosives. Pulse physics laboratory.

Special laboratory for the synthesis and investigation of highly toxic chemicals. Laboratory for the synthesis of radioactive-labelled chemical compounds.

Equipment for testing means of protection.

**International relations**

North Atlantic Treaty Organization (NATO). European Community (EC). Organization for Economic Cooperation and Development (OECD). United Nations (UN).

# TNO Institute for Perception

Kampweg 5  
P.O. Box 23  
3769 ZG Soesterberg  
The Netherlands  
Fax +31 3463 5 39 77  
Phone +31 3463 5 62 11

**Director:**  
Dr. A. van Meeteren  
**Assistant director:**  
Prof. J. Moraal  
**Information officer:**  
J. Boogaard  
**Staff and personnel:**  
115

## Organization

Research is conducted by the following groups: Vision, Speech and Hearing, Cognition, Ergonomics/Human Factors, Traffic Behaviour, Thermophysiology, Human Skill and Task Load.

## Scope of activities

Basic and applied research in the main areas of human information processing in relation to the task environment.

### *Sensory processes:*

- Vision: observer performance with electro-optical devices; target detection and acquisition; visual search; colour vision; ergonomics of visual aids.
- Speech and hearing: speech transmission and speech processing; voice control; tone perception and hearing thresholds; noise annoyance; hearing loss and protection; acoustics.
- Vestibular sensing: effect of g-forces on spatial orientation; dose-effect relations of the vestibular system, motion sickness.
- Heat-balance: climatic conditions, clothing and physical effort; protection in cold conditions; work-rest schedules for heavy work in protective clothing.

### *Information Processing:*

- Cognitive skills: memory; (distributed) decision making; command and control systems; knowledge elicitation for expert systems; pattern recognition.
- Process control: information presentation on VDU's; network analysis in complex processes; monitoring behaviour of operators; computer graphics.
- System control: ship control modelling; remotely piloted vehicles (RPV's); vehicle handling; attention distribution in the visual field; information systems for roadways and vehicles.

### *Ergonomics/Human Factors:*

- Workplace design: mock-ups and simulations; multi-purpose workstations; control-room design; interfaces for vehicle control; lighting and illumination.
- Roads and traffic: illumination, signs, delineation; ergonomics of vehicle design and roads; accidents and road environment.

- Clothing and packing: backpacks and equipment for the military; professional civilian clothing; the effects of clothing and equipment on task performance.
- Visual ergonomics: readability of printed material; visual aids.

*Human skill and task load:*

- Mental load: measurement of mental load and the development of standard equipment.
- Stress: stress-evoking working conditions; vulnerability for stress; physiological correlates of fatigue and stress; the effects of stress on task performance.
- Selection and training: dimensions of skill development, advanced computerized learning systems, training aids and simulation; validation of training aids; selection for heavy tasks (flying, diving); the retention of skills.

**Equipment and facilities**

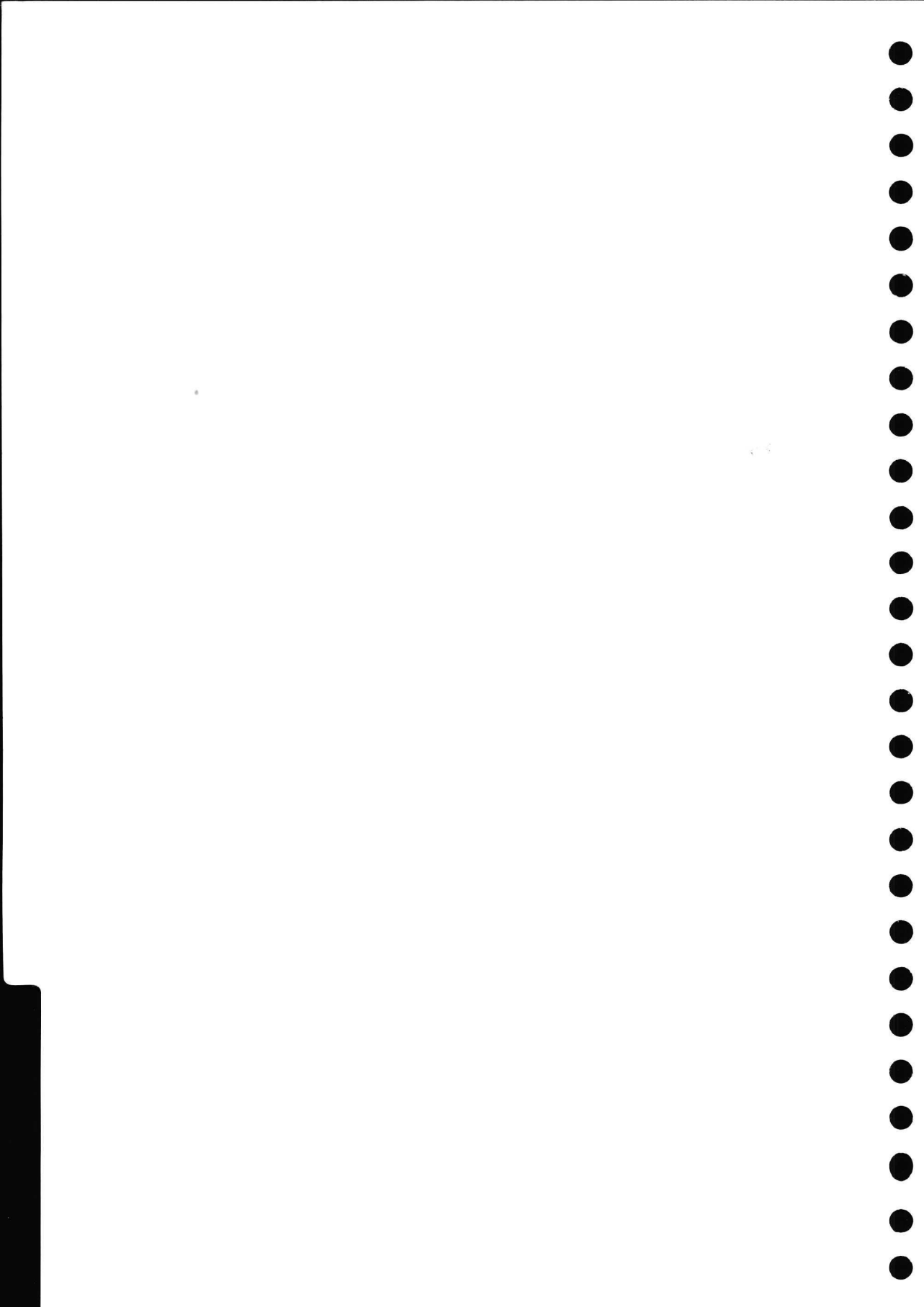
Visual and auditory test facilities (high-noise, anechoic and reverberation rooms), speech communication evaluation equipment, driving and ship navigation simulator, instrumented car for road user studies, command and control laboratory, climate chambers, equipment for vestibular research (tilting room, longitudinal acceleration device, ship motion simulator, rotating chair).





*TNO Policy Research*

On the basis of strategic research, TNO Policy Research advises trade and industry, governments and service-rendering organizations on technological developments, technology management and spatial organization. In this regard, services are provided concerning innovation, creativity, quality care, and literature and patent searches.



## TNO Policy Research

Schoemakerstraat 97  
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The Netherlands  
Fax +31 15 56 48 01  
Phone +31 15 69 69 00

**Director:**  
Prof. W.C.L. Zegveld

TNO Policy Research comprises a number of institutes that perform policy research:

- TNO Institute of Spatial Organization
- TNO Centre for Technology and Policy Studies  
as well as
- TNO Technology Management Group,  
consisting of a number of units that are engaged in information and consultancy activities.



# TNO Institute of Spatial Organization

Research and consulting on urban and regional development,  
ecology, traffic, transport and logistics.

Schoemakerstraat 97  
P.O. Box 6041  
2600 JA Delft  
The Netherlands  
Fax +31 15 62 43 41  
Phone +31 15 69 68 68

**Director:**  
F.P.M. Vonk, M.Sc.  
**Deputy Director:**  
A.G.G. Op 't Veld, M.Sc.  
**Staff and personnel:**  
50

## Organization

The Institute comprises seven sections: Housing Business Demographics; Regional Economic Development and Technology; Ecology and Policy-making; Logistics; Traffic and Transport; and Strategic Urban Management.

## Scope of activities

- Research in the fields of urban and regional development, ecology, traffic, transport and logistics in Western Europe in general, and in the Netherlands in particular.
- Analysis of demographic developments and their consequences for e.g. physical planning, housing programming, including maintenance and improvement, labour market problems.
- Analysis of and research on economic and technological restructuring and modernization processes. Advice on economic and physical development and related land-use problems. Development and application of concepts and models concerning regional and sectoral economic developments.
- Research and advice on (future) transport demands; practical aspects of quantitative planning models; financial economic aspects, urban and regional processes and related land-use problems; environmental aspects in the broad sense; application of information technology and the structure of information systems.
- Analysing developments in the logistical organization of companies especially regarding transcompany and intercompany aspects; developing instruments for the strategic logistical decision making of companies.
- Spatially oriented information systems.
- Policy analysis related to urban and regional development, methods of strategic planning and decision making.
- Ecological aspects of urban and regional development and related decision making.

## International relations

Université de Lille, (France); John Hopkins University Baltimore (USA); Organization for Economic Cooperation and Development (OECD), Paris (France), Fraunhofer Gesellschaft (Germany).

# TNO Centre for Technology and Policy Studies

Laan van Westenenk 501  
P.O. Box 541  
7300 AM Apeldoorn  
The Netherlands  
Telex 36395 tnoap nl  
Fax +31 55 42 14 58  
Phone +31 55 49 35 00

**Director:**  
Dr. R.E.H.M. Smits, M.Sc.  
**Information officers:**  
Ms Y.F.M. Ploum  
J. Bonzet  
**Staff and personnel:**  
30

## Organization

The Centre comprises three research teams: Technology and Society; Organization and Technology; and Technology and Economic Strategies.

## Scope of activities

- Technology and economics: research to contribute to industrial and technological policy reviews; long-term research programmes on diffusion of technology; the evaluation and monitoring of different technology policy instruments; industry and service sector studies.
- Technology and labour: studies of the interaction between technological developments and the qualitative and quantitative changes in labour; studies to enhance the insight into the possibilities of guiding the processes of technological and organizational change; the exploration of feedback mechanisms of social criteria and norms to the technical design of production processes.
- Technology assessment: factors that influence the process of public or social decision-making on science and technology.
- Technology and education: effects of technological change on the educational system; the development of methods and instruments to prognosticate the effects of technology on the education system.
- Technology and daily life: possible effects of new technologies on the daily life of people and their impact on the future social organization.
- Technology and environment: the development of environmental technology policy; clean technologies and the restructuring of society.
- Technology, information and telecommunication: studies on telecommunication technology and regulation; introduction of telematic services and systems; telecommunication policy design.
- Communication of industrial risks and environmental regulation: studies of the public concern about industrial hazards; risk perception by individuals; problems associated with the communication of industrial risks to people.

## Equipment and facilities

Database and library on topics related to the scope of activities.

## International relations

ISI-Fraunhofer Gesellschaft (Karlsruhe, Germany), SPRU (Brighton, UK), IDATE (Montpellier, France), TPU Aston Business School (Birmingham, UK), CEM Tufts University (Medford, USA), EC- DGXIII (Brussels, Belgium).

# TNO Technology Management Group

Schoemakerstraat 97  
P.O. Box 6042  
2600 JA Delft  
The Netherlands  
Telex 38071 zptno nl  
Fax +31 15 56 08 25  
Phone +31 15 69 67 95

**Director:**  
J.P. Smeekes, MBA  
**Information officer:**  
Ms P.D. Flips  
**Staff and personnel:**  
52

## Organization

The Group provides consulting, training and information services from six professional units, specialized in different aspects of technology management: Centre for Information and Documentation; Innovation Consulting Group; Patent Information Office; Quality Management Project Group; Project Group on Industrial Innovation; and Technology Consultants.

## Scope of activities

Technology is a key resource of profound importance for industrial profitability and growth. The TNO Technology Management Group assists organizations who seek full utilization of this resource for their competitive position, both on strategic and on operational levels.

## **TNO Centre for Information and Documentation**

Schoemakerstraat 97  
P.O. Box 6043  
2600 JA Delft  
The Netherlands  
Telex 38071 zptno nl  
Fax +31 15 56 08 25  
Phone +31 15 69 68 00

**Director:**  
Ch.L. Citroen, M.Sc, FIInfSc  
**Information officer:**  
Ms J.T.L.H. Woei

### **Scope of activities**

- Information retrieval services. The Centre provides published technical, scientific, marketing, business and management information and factual data. Both specific literature searches as well as current awareness services. The Centre has access to over 1000 international databases, mostly on on-line interactive basis.
- Setting up inventories of on going technological research in different fields.
- Training for information managers regarding information retrieval systems.
- Consulting on automation of information, data base building and information management.
- Member of the European Association of Information Services (Eusidic).

## TNO Innovation Consulting Group

Schoemakerstraat 97  
P.O. Box 6042  
2600 JA Delft  
The Netherlands  
Telex 38071 zptno nl  
Fax +31 15 56 08 25  
Phone +31 15 69 68 23

**Director:**  
P.J. Jongejan, MBA  
**Information officers:**  
Ms B.I. Akerboom  
Ms C.M. van den Berg

### Scope of activities

The main objective is to increase the innovative performance of companies, using a combination of specialized consulting skills and the unique expertise of TNO in various fields of technology. Special working areas are:

- Consulting work for organizations in search of new activities; this work is characterized by a systematic approach from strategic analysis to business development, targeting for new products, services, markets and technologies.
- Supporting company management on the subject of vision building and strategy development, using creative and analytical techniques and research on trends in technology, market and society.
- Creative problem solving in deadlock situations in the areas of technology, market and management in need for break-through solutions.
- Training and workshops on 'Innovation Management', 'Strategy Development' and 'Creative Problem Solving'.

## TNO Patent Information Office

Patentlaan 2  
P.O. Box 309  
2280 AH Rijswijk  
The Netherlands  
Telex 31622 nider nl  
Fax +31 70 3 99 91 76  
Phone +31 70 3 98 66 66

**Director:**  
G.H.M. Koper  
**Information officers:**  
Ms H. Wagenaar  
Ms W.J.M. Zwart

### Scope of activities

The Office provides services in the field of patents and patent documentation for industrial firms and patent attorneys. Services are rendered to clients all over the world, and comprise: collection searches, novelty searches, validity searches, infringement searches, searches for counterparts, name searches, and information about the status of patent applications in various countries.

The Office has access to the collection of the European Patent Office as well as to the collection of the Dutch Patent Office, containing patents and patent journals from a large number of countries and volumes of some 850 technical periodicals, textbooks, manuals, abstract journals, and so on.

## TNO Quality Management Project Group

Laan van Westenenk 501  
P.O. Box 342  
7300 AH Apeldoorn  
The Netherlands  
Telex 36395 tnoap nl  
Fax +31 55 49 34 39  
Phone +31 15 49 34 40

**Director:**  
A. de Heer, B.Sc.  
**Information officer:**  
Ms P. Veldkamp

### Scope of activities

- Quality assurance  
Development of practical methods for setting up a quality strategy, meeting quality standards, assessing quality costs. Application in different branches of industry, as well as in the service sector. Workshops on quality management around ISO-9000 series. Development and application of computer-assisted assessment methods.
- Introducing and applying planning and structuring tools for organization efficiency, such as MBO.

## TNO Project Group on Industrial Innovation

Laan van Westenenk 501  
P.O. Box 910  
7301 BD Apeldoorn  
The Netherlands  
Telex 36395 tnoap nl  
Fax +31 55 49 32 06  
Phone +31 55 42 01 22

**Director:**  
G.J. Poelstra  
**Information officer:**  
Ms. J. Tijsseling

### Scope of activities

- Special forms of entrepreneurship and development assistance for newly established firms, mostly NTBF's. General consulting for small and medium-sized industrial firms.
- Organizing workshops for managers of small and medium-sized enterprises (SME's), addressing different aspects of company development, strongly based on the transfer of experience among participants (Starter Inns, Manager Inns).
- Advice to local and regional councils on SME-policy.



# TNO Technology Consultants

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Fax +31 15 56 08 25  
Phone +31 15 69 67 95

**Acting director:**  
J.P. Smeekes, MBA  
**Information officer:**  
Ms P.D. Flips (ad interim)

## Scope of activities

TNO Technology Consultants (TECO) provides consulting and research services to the management of R&D-intensive companies on questions concerning:

- policy, programming and organization of R&D;
- evaluation of new technologies and impact analyses;
- marketing of R&D results;
- R&D cooperation at intra- and inter-company level.

Technology consulting by TECO is based on the recognition of technology as a component of ever increasing importance within total company strategy. TECO deals with strategic issues of technology in cooperation with TNO specialists, whereas TECO consultants add their expertise on all relevant business aspects, such as patent information, market intelligence and competitor analysis.

*Institutions connected with INO*

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# TNO Committee on Hydrological Research

Schoemakerstraat 97  
P.O. Box 6067  
2600 JA Delft  
The Netherlands  
Fax +31 15 56 48 01  
Phone +31 15 69 69 00

**Chairman:**  
Prof. dr. J.C. van Dam, M.Sc.  
**Information Officer:**  
H.J. Colenbrander, M.Sc.  
**Staff and personnel:**  
3

## Organization

About 90 Dutch institutes, departments, services and other organizations, active in the field of hydrology and water management research, are members of the TNO Committee on Hydrological Research. The main organizations have a representative to the board of the Committee. The Bureau of the Committee is assisted by several working groups.

## Scope of activities

Fostering and promoting coordination and cooperation in the field of hydrology and water management research.  
Encouraging and facilitating the transfer of research results and technical know-how. The exchange of information; the organization of symposia and technical meetings, and the setting up of working parties.

## International relations

Committee on Water Resources (COWAR).  
Economic Commission for Europe (ECE).  
Hungarian Hydrological Society (HHS).  
International Association of Hydrogeologists (IAH).  
International Association for Hydraulic Research (IAHR).  
International Association of Hydrological Sciences (IAHS).  
International Commission on Irrigation and Drainage (ICID).  
International Institute for Applied System Analysis (IIASA).  
International Union of Geodesy and Geophysics (IUGG).  
United Nations Educational, Scientific and Cultural Organization - Division of Water Sciences (UNESCO).  
World Meteorological Organization (WMO) - Department of Hydrology and Water Resources and Commission for Hydrology.

# Bureau SAMWAT

Schoemakerstraat 97  
P.O. Box 6067  
2600 JA Delft  
The Netherlands  
Fax +31 15 57 12 01  
Phone +31 15 69 74 12

**Chairman:**  
Prof. dr. J.C. van Dam, M.Sc.  
**Information officer:**  
L.R. Wentholt  
**Staff and personnel:**  
4

## Organization

Bureau SAMWAT is the executive office of the Cooperative Association in the field of Research for Water Management. The Bureau is assisted by several regional research coordination groups, where information about research activities in the field of water is exchanged among participants in the Association (research institutes, national and provincial water authorities, Water Boards, and waterworks).

## Scope of activities

The principal aim of SAMWAT is to arrive at some form of coordination ('soft coordination') by providing up to date information on all aspects of research for water management. Major areas of attention are:

- collection, storage and retrieval of information about current research activities in the Netherlands, and about activities planned for the near future;
- hydrological data retrieval; the Bureau acts as an intermediary for researchers who need hydrological data;
- literature searches in library databases both in the Netherlands and abroad. The Bureau also provides access to reports and articles of all participants in the Association;
- the provision of information about computer models for water management available in the Netherlands.

Every six months SAMWAT organizes seminars on specific topics.

Furthermore, SAMWAT regularly initiates working parties to solve specific problems.

## Equipment and facilities

Database containing information about water management research projects. Access to various on-line databases containing hydrological data. Library specialized in water management and land development. Database for computer models for water management.

## International relations

International Ground Water Modelling Center (IGWMC).

World Meteorological Organization (WMO).

Hydrological Operational Multipurpose Subprogramme (HOMS).

# TNO Cleaning Techniques Research Institute

Schoemakerstraat 97  
P.O. Box 6062  
2600 JA Delft  
The Netherlands  
Fax +31 15 56 02 58  
Phone +31 15 69 77 75

**Director:**  
F.R. Bogtstra, M.Sc.  
**Staff and personnel:**  
40

## Organization

Institute with the legal status of foundation, affiliated to TNO.

## Scope of activities

Research and advice on products, machines and processes for cleaning in general. Fields of work include:

- cleaning techniques: study, performance testing, analysis and quality assessment of processes, detergents, machines and substrates to be cleaned;
- professional laundering, drying, dry-cleaning and finishing of textile;
- domestic laundering, drying, dishwashing and cleaning in general;
- cleaning in general (e.g. floor maintenance, office cleaning);
- hygiene of laundering, cleaning or dry-cleaning; disinfection and sterilization;
- management: quality assessment and insurance systems, education, organization of production, transport, client relations, automation, costing systems, and surveys;
- resources management and environmental aspects.

## Equipment and facilities

Pilot plant for professional laundering. Test bay for domestic laundering, drying, and dishwashing.

Laboratory-scale laundering and cleaning facilities.

Data acquisition systems for various process parameters. Equipment for analysing and testing textiles and other materials to be cleaned for detergent characterization, etc.

## International relations

The Institute is a member of:

- International Scientific and Technical Committee on Laundering (ISTCL);
- International Dry Cleaning Research Committee (IDCR);
- International Technical Committee for Textile Care Labelling.

# TNO Institute of Carbohydrate Research

Rouaanstraat 27  
9723 CC Groningen  
The Netherlands  
Fax +31 50 12 88 91  
Phone +31 50 13 03 41

**Director:**  
Dr. J.P. Geerts  
**Staff and personnel:**  
38

## Organization

The institute comprises research groups on: Plant Physiology and Genetics; Chemical Analysis; Organic Chemistry; Structure and Properties of Carbohydrates; Microbiology and Waste Water Purification; Biochemical Research; and Physical Research.

## Scope of activities

Scientific research into starch and its derivatives for the Dutch starch industry.

The Institute is also engaged on, among other subjects, the abatement of the serious waste water pollution that attends starch manufacturing processes.

Other topics of research are:

- powder physics;
- investigations into residues;
- analyses of new races.

## Equipment and facilities

Equipment for microbiological processes on a pilot plant scale.

Pilot plant for the preparation of starch.

Rheological equipment.

Analytical instruments (liquid chromatographs, gas chromatographs, spectrophotometers, etc.).

Glass house and climate rooms.

# TNO Certification

Laan van Westenenk 501  
P.O. Box 541  
7300 AM Apeldoorn  
The Netherlands  
Fax +31 55 42 32 88  
Phone +31 55 49 34 68

**Director:**  
B. Dane, M.Sc.

## **Organization**

TNO Certification is an independent foundation, affiliated to TNO.

## **Scope of activities**

TNO Certification provides quality certificates for two categories:

- products;
- quality systems.

### *Product certification*

Product certification entitles companies to use the TNO quality mark. All products for which a certificate is granted are provided with the quality mark, making the qualified product easy to recognize. Tests for certification take place in one of TNO's laboratories.

### *System certification*

The combination of TNO's know-how regarding quality systems and knowledge of production processes provides the necessary basis for the efficient and effective certification of quality systems. Once a system has been certified, the company involved may publicize the certificate acquired in all its documentation. For instance, copies of the certificate may be attached to offers and quotations. Certification auditing is carried out by expert staff.



# Maritime Research Institute Netherlands (MARIN)

Haagsteeg 2  
P.O. Box 28  
6700 AA Wageningen  
The Netherlands  
Telex 45148 nsmb nl  
Fax +31 8370 9 32 45  
Phone +31 8370 9 39 11

**Director:**  
Dr. M.W.C. Oosterveld, M.Sc.  
**Staff and personnel:**  
210

## Organization

MARIN is an independent non-profit organization, affiliated to TNO.

## Scope of activities

R&D in the fields of ship powering, ocean engineering and maritime operations for the shipping, shipbuilding and offshore industries and for navies, port authorities and other government and intergovernment bodies. Consultancy services; advice based on model tests, full-scale measurements and computations with advanced computer programs for the design and operation of ships, offshore structures, mooring facilities, fairways and harbours.

## Equipment and facilities

Advanced equipment and facilities for research in the field of hydromechanics and related fields. These facilities include a depressurized towing tank, a deep-water towing tank, cavitation tunnels, a sea-keeping basin, a shallow-water basin, a high-speed towing tank, a wave and current basin, manoeuvring simulators (full-vision, real-time simulator, micro-, instrument- and vessel-traffic service simulators), and various computer facilities.

## International relations

Bulgarian Ship Hydrodynamic Center (BSHC-Bulgaria), the Maritime Research and Consultancy Center (MRCC-Egypt), the Korean Maritime Institute of Machinery and Metals (KMI and KIMM - Korea). Hydrodynamic Laboratory Surabaya (HDL - Indonesia).

MARIN plays a leading role in the ITTC (International Towing Tank Conference) and is represented on many technical committees of the ITTC, ISSC (International Ship Structure Conference), of the ICMES (International Cooperation on Marine Engineering Systems), of the IMFS (International Marine Simulation Forum) and of the SNAME (Society of Naval Architects and Marine Engineers - USA).

# Netherlands Corrosion Centre

Jan van Eycklaan 2  
P.O. Box 120  
3720 AC Bilthoven  
The Netherlands  
Fax +31 30 28 76 74  
Phone +31 30 28 77 73

**Director:**  
J.H. van der Veen, M.Sc.

## **Organization**

Institute with the legal status of foundation, affiliated to TNO. The Netherlands Corrosion Service is part of the Centre.

## **Scope of activities**

- The aim of the Centre is to improve corrosion control and prevention by:
- promoting and coordinating research into corrosion phenomena and corrosion control methods;
  - disseminating information by means of publications, congresses, etc.;
  - maintaining contacts with international organizations.
- The Centre also acts as knowledge transfer service to industry on specific problems associated with corrosion.

## **International relations**

European Federation for Corrosion.  
National Association for Corrosion Engineers (USA).

# Netherlands Institute of Welding

Laan van Meerdervoort 2-B  
2517 AJ The Hague  
The Netherlands  
Phone +31 70 3 65 89 00

**Director:**  
J.B. van den Brug  
**Information officer:**  
H.J.M. Bodt, B.Sc.  
**Staff and personnel:**  
15

## Organization

Institute with the legal of foundation, affiliated to TNO.

## Scope of activities

- The coordination of collective research into the joining of materials: welding, brazing and cutting of metals, fusion jointing of plastics.
- The setting up and supervision of courses in welding; the courses concern the training of welders and welding executives.
- Information and instruction in the area of welding and allied techniques.
- The editing of a magazine on welding.

## International relations

European Council for Cooperation in Welding (ECCW).  
International Institute of Welding (IIW).

# Institute for Rehabilitation Research

Zandbergsweg 111  
6432 CC Hoensbroek  
The Netherlands  
Phone +31 45 22 43 00

**Director:**  
M. Soede, M.Sc., Ph.D.  
**Information officer:**  
Ms. E.T. Kooman  
**Staff and personnel:**  
45

## Organization

The Institute was established by SWOR, the Foundation for Scientific Research into Rehabilitation. SWOR is a grant-aided foundation in which TNO, the Lucas Foundation and the Maastricht University participate. The main task of SWOR is to have scientific research performed into rehabilitation and into provisions for handicapped people.

## Scope of activities

Research in the field of rehabilitation and handicap covers the following areas:

- Communication.  
Understanding communication/interaction problems of people with motoric and cognitive impairments; the development of aids for communication.
- Independence in living, working and transport.  
Organizational, ergonomic aspects of work and handicap. The development of technology to enhance independence (robot manipulators, environmental control).
- Research and development into equipment for wheeled mobility.
- Functionality of wheelchairs.
- Patient-related research.  
Research into causes of handicaps; quantification of the effects of rehabilitation and of methodological aspects.

## International relations

European Community (EC).  
Rehabilitation Engineering Society of North-America.  
International Society of Prosthetics and Orthotics.  
European Society for Research into Rehabilitation.  
International Society for Alternative and Augmentative Communication.  
University of Dundee, Microcomputer Centre.  
University of Delaware, Applied Science and Engineering Department.

## Centres for Micro-electronics

Schoemakerstraat 97  
P.O. Box 6067  
2600 JA Delft  
The Netherlands  
Fax +31 15 57 16 03  
Phone +31 15 69 71 18

**Director:**  
G.A. Schwippert, M.Sc.  
**Information officer:**  
H.J. Bosch, M.Sc.  
**Staff and personnel:**  
27

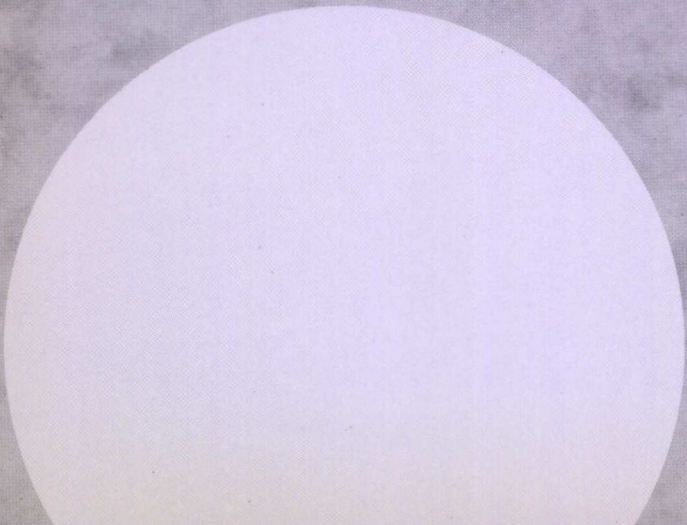
### Organization

The three Centres are part of a special foundation (SCME), which is affiliated to TNO. Locations are in Enschede, Eindhoven and Delft.

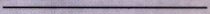
### Scope of activities

The Centres render services to industry and institutions, in particular to small and medium-sized enterprises, in their search for new possibilities and applications (concrete information) in the microelectronic field. In this respect the Centres enlist the services of existing databanks and suitable industries.

The Centres act both as consultants and intermediaries in microelectronics, management science and informatics. They assist in arranging courses and provide guidance to industry. The Centres assist in market analyses and in the development of products, systems and processes, technical automation, in the making of applications for credit, subsidy, patents, licences, etc. They also inform industry by various means, e.g. by newsletters and technical books on highlights and by seminars on specific themes.



TNO Addresses





## Addresses of TNO institutes and institutions connected with TNO

(situation on 1 April 1991; bracketed numbers refer to pages)

For information about international projects and relations:

### **TNO Bureau for International Coordination and Consultancy** (6)

Schoemakerstraat 97  
P.O. Box 6070, 2600 JA Delft  
Fax +31 15 62 73 13  
Phone +31 15 69 69 00

For information about specific research areas and R&D facilities:

### **TNO Marketing Department** (6)

Schoemakerstraat 97  
P.O. Box 6070, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 61 24 03  
Phone +31 15 69 69 69

For general information about TNO:

### **TNO Public Relations and Information Department**

Schoemakerstraat 97  
P.O. Box 6050, 2600 JA Delft  
Fax +31 15 62 73 35  
Phone +31 15 69 69 00

### **TNO Supervisory Board** (2)

Schoemakerstraat 97  
P.O. Box 6000, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 62 73 83  
Phone +31 15 69 69 00

### **TNO Board of Management** (2)

Schoemakerstraat 97  
P.O. Box 6000, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 62 73 83  
Phone +31 15 69 69 00

### **TNO Environmental and Energy Research** (7)

Schoemakerstraat 97  
P.O. Box 6010, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 69 72 85  
Phone +31 15 69 69 00

### *TNO Institute of Environmental and Energy Technology* (8)

Laan van Westenenk 501  
P.O. Box 342, 7300 AH Apeldoorn  
Telex 36395 tnoap nl  
Fax +31 55 41 98 37  
Phone +31 55 49 34 93

### *TNO Institute of Environmental Sciences* (11)

Schoemakerstraat 97  
P.O. Box 6011, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 61 68 12  
Phone +31 15 69 69 00

### *TNO Institute of Applied Geoscience* (14)

Schoemakerstraat 97  
P.O. Box 6012, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 56 48 00  
Phone +31 15 69 71 84

### *TNO Study Centre for Environmental Research* (15)

Schoemakerstraat 97  
P.O. Box 6013, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 61 31 86  
Phone +31 15 69 69 00



**TNO Building and Construction****Research (17)**

Lange Kleiweg 5, Rijswijk  
P.O. Box 49, 2600 AA Delft  
Telex 38270 ibbc nl  
Fax +31 15 84 39 90  
Phone +31 15 84 20 00

Departments of Computational Mechanics;  
Computer Integrated Construction;  
Building Technology; Structural  
Engineering; Strategic Studies and Quality  
Assurance; Centre for Fire Research. (18)

**Centre for Timber Research (18)**

Schoemakerstraat 97  
P.O. Box 151, 2600 AD Delft  
Fax +31 15 61 13 21  
Phone +31 15 69 69 00

**Centre for Mechanical Engineering and  
Department of Indoor Environment,  
Building Physics and Systems (18)**

Leeghwaterstraat 5  
P.O. Box 29, 2600 AA Delft  
Telex 38192 iweco nl  
Fax +31 15 56 41 02  
Phone +31 15 60 86 08

**TNO Industrial Research (23)**

Schoemakerstraat 97  
P.O. Box 6030, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 62 51 09  
Phone +31 15 69 69 00

**TNO Institute of Production and Logistics  
Research (24)**

Apeldoorn branch  
Laan van Westenenk 501  
P.O. Box 541, 7300 AM Apeldoorn  
Fax +31 55 41 98 37  
Phone +31 55 49 34 93

Eindhoven branch  
Horsten 2, Building O,  
5612 AX Eindhoven  
Fax +31 40 43 65 35  
Phone +31 40 47 45 17

**TNO Institute of Applied Computer  
Science (26)**

Schoemakerstraat 97  
P.O. Box 6032, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 62 33 13  
Phone +31 15 69 70 71

**TNO Road-Vehicles Research Institute (27)**

Schoemakerstraat 97  
P.O. Box 6033, 2600 JA Delft  
Telex 38071 zptno nl  
(Approval Dept: 38335 zptno nl)  
Fax +31 15 62 07 66  
Phone +31 15 69 69 00

**TNO Plastics and Rubber Research  
Institute (29)**

Schoemakerstraat 97  
P.O. Box 6031, 2600 JA Delft  
Fax +31 15 56 63 08  
Phone +31 15 69 69 00

**Zeist branch**

Utrechtseweg 48  
P.O. Box 108, 3700 AC Zeist  
Fax +31 3404 5 41 86  
Phone +31 3404 4 41 44

**TNO Product Centre**

Institute of Product Design and  
Development (31)  
Oostsingel 209  
P.O. Box 5073, 2600 GB Delft  
Fax +31 15 60 87 56  
Phone +31 15 60 89 09

TNO CAD Centre (32)  
Curaçaostraat 2  
P.O. Box 5073, 2600 GB Delft  
Fax +31 15 60 87 56  
Phone +31 15 60 89 08

*TNO Institute of Applied Physics* (33)  
Stieltjesweg 1  
P.O. Box 155, 2600 AD Delft  
Telex 38091 tpdtd nl  
Fax +31 15 69 21 11  
Phone +31 15 69 20 00

**Branch-specific Research Centres** (23)  
Schoemakerstraat 97  
P.O. Box 6034, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 56 03 02  
Phone +31 15 69 69 00

*TNO Centre for Packaging Research* (35)  
Schoemakerstraat 97  
P.O. Box 6034, 2600 JA Delft  
Fax +31 15 69 62 80  
Phone +31 15 69 69 00

*TNO Centre for Paper and Board  
Research* (36)  
Schoemakerstraat 97  
P.O. Box 6034, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 69 65 11  
Phone +31 15 69 66 74

*TNO Centre for Leather and Shoe  
Research* (37)  
Mr van Coothstraat 55  
P.O. Box 135, 5140 AC Waalwijk  
Telex 35083 lstno nl  
Fax +31 4160 4 17 35  
Phone +31 4160 3 32 55

*TNO Centre for Textile Research* (38)  
Schoemakerstraat 97  
P.O. Box 6034, 2600 JA Delft  
Fax +31 15 56 03 02  
Phone +31 15 69 66 58

*TNO Centre for Coatings Research* (39)  
Schoemakerstraat 97  
P.O. Box 6034, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 61 28 34  
Phone +31 15 69 64 61

**TNO Nutrition and Food Research** (41)  
Utrechtseweg 48  
P.O. Box 360, 3700 AJ Zeist  
Telex 40022 civo nl  
Fax +31 3404 5 72 24  
Phone +31 3404 4 41 44

*TNO Food Technology Institute* (42)  
Utrechtseweg 48  
Telex 40022 civo nl  
P.O. Box 360, 3700 AJ Zeist  
Fax +31 3404 5 72 24  
Phone +31 3404 4 41 44

*TNO Biotechnology and Chemistry  
Institute* (43)  
Utrechtseweg 48  
P.O. Box 360, 3700 AJ Zeist  
Telex 40022 civo nl  
Fax +31 3404 5 72 24  
Phone +31 3404 4 41 44

*TNO Toxicology and Nutrition Institute* (45)  
Utrechtseweg 48  
P.O. Box 360, 3700 AJ Zeist  
Telex 40022 civo nl  
Fax +31 3404 5 72 24  
Phone +31 3404 4 41 44

*RUL-TNO Centre for Phytotechnology* (46)

Wassenaarseweg 64, 2333 AL Leiden  
Telex 40022 civo nl  
Fax +31 71 27 49 99  
Phone +31 71 27 49 14

**TNO Health Research** (47)

Zernikedreef 9  
P.O. Box 2215, 2301 CE Leiden  
Fax +31 71 18 19 10  
Phone +31 71 18 18 18

*TNO Institute of Applied Radiobiology and Immunology* (48)

Lange Kleiweg 151  
P.O. Box 5815, 2280 HV Rijswijk  
Telex 38191 repgo nl  
Fax +31 15 84 39 98  
Phone +31 15 84 28 42

Radiological Protection Service (51)

Utrechtseweg 310  
P.O. Box 9034, 6800 ES Arnhem  
Fax +31 85 45 07 87  
Phone +31 85 56 30 55I

*TNO Medical Biological Laboratory* (52)

Lange Kleiweg 139  
P.O. Box 45, 2280 AA Rijswijk  
Telex 38034 pmtno nl  
Fax +31 15 84 39 89  
Phone +31 15 82 28 42

*TNO Institute of Ageing and Vascular Research* (54)

(incl. Centre for Medical Technology;  
p. 55)  
Gaubius Laboratorium  
Zernikedreef 9  
P.O. Box 430, 2300 AK Leiden  
Fax +31 71 18 19 00  
Phone +31 71 18 18 18

*TNO Institute of Preventive Health Care* (56)

Wassenaarseweg 56  
P.O. Box 12, 2300 AC Leiden  
Fax +31 71 17 63 82  
Phone +31 71 18 11 81

**TNO Defence Research** (59)

Schoemakerstraat 97  
P.O. Box 6006, 2600 JA Delft  
Telex 38071 zptno nl  
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Phone +31 15 69 69 00

*TNO Physics and Electronics Laboratory* (60)

Oude Waalsdorperweg 63  
P.O. Box 96864, 2509 JG The Hague  
Fax +31 70 3 28 09 61  
Phone +31 70 3 26 42 21

*TNO Prins Maurits Laboratory* (62)

Lange Kleiweg 137  
P.O. Box 45, 2280 AA Rijswijk  
Telex 38034 pmtno nl  
Fax +31 15 84 39 91  
Phone +31 15 84 28 42

Pulse Physics Laboratory (62)

Schoemakerstraat 97  
2628 VK Delft  
Fax +31 15 62 12 68  
Phone +31 15 69 70 11

*TNO Institute for Perception* (64)

Kampweg 5  
P.O. Box 23, 3769 ZG Soesterberg  
Fax +31 3463 5 39 77  
Phone +31 3463 5 62 11

**TNO Policy Research** (67)

Schoemakerstraat 97  
P.O. Box 6040, 2600 JA Delft  
Fax +31 15 56 48 01  
Phone +31 15 69 69 00

*TNO Institute of Spatial Organization (68)*

Schoemakerstraat 97  
P.O. Box 6041, 2600 JA Delft  
Fax +31 15 62 43 41  
Phone +31 15 69 68 68

*TNO Centre for Technology and Policy Studies (69)*

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P.O. Box 541, 7300 AM Apeldoorn  
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Phone +31 55 49 35 00

*TNO Technology Management Group (70)*

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P.O. Box 6042, 2600 JA Delft  
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Phone +31 15 69 67 95

*TNO Centre for Information and Documentation (71)*

Schoemakerstraat 97  
P.O. Box 6043, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 56 08 25  
Phone +31 15 69 68 00

*TNO Innovation Consulting Group (72)*

Schoemakerstraat 97  
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Telex 38071 zptno nl  
Fax +31 15 56 08 25  
Phone +31 15 69 68 23

*TNO Patent Information Office (73)*

Patentlaan 2  
P.O. Box 309, 2280 AH Rijswijk  
Telex 31622 nider nl  
Fax +31 70 3 99 91 76  
Phone +31 70 3 98 66 66

*TNO Quality Management Project Group (74)*

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Telex 36395 tnoap nl  
Fax +31 55 49 34 39  
Phone +31 55 49 34 40

*TNO Project Group on Industrial Innovation (75)*

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Phone +31 55 42 01 22

*TNO Technology Consultants (76)*

Schoemakerstraat 97  
P.O. Box 6042, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 56 08 25  
Phone +31 15 69 67 95

**Institutions connected with TNO**

*TNO Committee on Hydrological Research (77)*

Schoemakerstraat 97  
P.O. Box 6067, 2600 JA Delft  
Telex 38071 zptno nl  
Fax +31 15 56 48 01  
Phone +31 15 69 69 00

*Bureau SAMWAT (78)*

Schoemakerstraat 97  
P.O. Box 6067, 2600 JA Delft  
Fax +31 15 57 12 01  
Phone +31 15 69 74 12

*TNO Cleaning Techniques Research Institute (79)*

Schoemakerstraat 97  
P.O. Box 6062, 2600 JA Delft  
Fax +31 15 56 02 58  
Phone +31 15 69 77 75

*TNO Institute of Carbohydrate  
Research* (80)  
Rouaanstraat 27, 9723 CC Groningen  
Fax +31 12 88 91  
Phone +31 50 13 03 41

*TNO Certification* (81)  
Laan van Westenek 501  
P.O. Box 541, 7300 AM Apeldoorn  
Fax +31 55 42 32 88  
Phone +31 55 49 34 68

*Maritime Research Institute Netherlands  
(MARIN; 82)*  
Haagsteeg 2  
P.O. Box 28, 6700 AA Wageningen  
Telex 45148 nsmb nl  
Fax +31 8370 9 32 45  
Phone +31 8370 9 39 11

*Netherlands Corrosion Centre* (83)  
Jan van Eycklaan 2  
P.O. Box 120, 3720 AC Bilthoven  
Fax +31 30 28 76 74  
Phone +31 30 28 77 73

*Netherlands Institute of Welding* (84)  
Laan van Meerdervoort 2-B,  
2517 AJ The Hague  
Phone +31 70 3 65 89 00

*Institute for Rehabilitation Research* (85)  
Zandbergsweg 111, 6432 CC Hoensbroek  
Phone +31 45 22 43 00

*Centres for Micro-Electronics* (86)  
Schoemakerstraat 97  
P.O. Box 6067, 2600 JA Delft  
Fax +31 15 57 16 03  
Phone +31 15 69 71 18

## Colophon

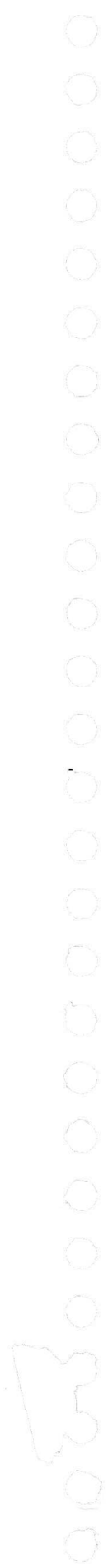
*Production and coordination:*  
TNO Marketing Department

*Design:*  
Studio (B), The Hague

*Photographs:*  
Kaldenbach & de Vries, The Hague  
Piet Janmaat, Rijswijk  
(photograph TNO Building and  
Construction Research)

*Printed by:*  
Lakerveld bv, The Hague

May 1991



The 'Key to research facilities' gives a broad outline of R&D facilities available with TNO, the Netherlands Organization for Applied Scientific Research. The information reflects the situation on 1 April 1991, unless otherwise stated.

At the beginning you will find an alphabetical list of keywords, which may provide easy access to the facilities and laboratories described. In cases where a headword covers several subjects, the subjects are listed both under the headword and as separate keywords.

General information about features of TNO, the nature and scope of work, and (inter)national contacts is given under 'TNO in perspective' (page 1).

A survey of R&D facilities, arranged according to TNO's seven divisions, is given in the respective sections (page 7 ff).

One of the primary tasks of TNO is to support clients (both in the private and public sector) by translating research results into practical applications and technological innovations, and by problem-solving. To facilitate your access to TNO, you are advised to contact first:

TNO Marketing Department  
P.O. Box 6070  
2600 JA Delft  
The Netherlands  
Fax +31 15 61 24 03  
Phone +31 15 69 69 69.

## A key to Research Facilities