1. Denmark in European metrology

2003 was a year of transitions for DFM.

Europe is finishing a transition from a divided region to a unified region, where 10 new members are joining the European Union. For metrology this means welcoming 10 new national organisations to the harmonised European measurements infrastructure. Fortunately this transition has taken place during almost ten years and is well prepared, so that metrology issues are not preventing the new member states from making full profit from their European membership. DFM is proud having significantly contributed to this unification process.

In Denmark, metrology was investigated with the strategic aim of finding a permanent embedding for the decentralised Danish metrology organisation. This work carried out in a working group with participation from the Ministry for Science, Innovation, and Technology and members of the Centre for Danish Fundamental Metrology concluded just before Christmas. Here the Council for Technology and Innovation confirmed that the structure would be maintained; but DFM as the core institute needs further investigation. This will be carried out during 2004.

Internally at DFM, a simplification of the organisation was carried out to ensure the efficacy of administrative processes, and at the end of the year a substantial reduction in administration had been achieved. This is now being followed up by a modernisation of our administrative software. Simultaneously, the staff was stabilised after the reductions that took place as a result of the difficulties during 2002.

Despite these significant changes within and around DFM, the result of 2003 was fully satisfactory both technically and economically. Both calibrations and consulting services increased and gave satisfactory results. Refereed publications were not as high as planned but other scientific indicators were satisfactory. All in all, 2003 was a year that went according to the plans laid out prior to its beginning.

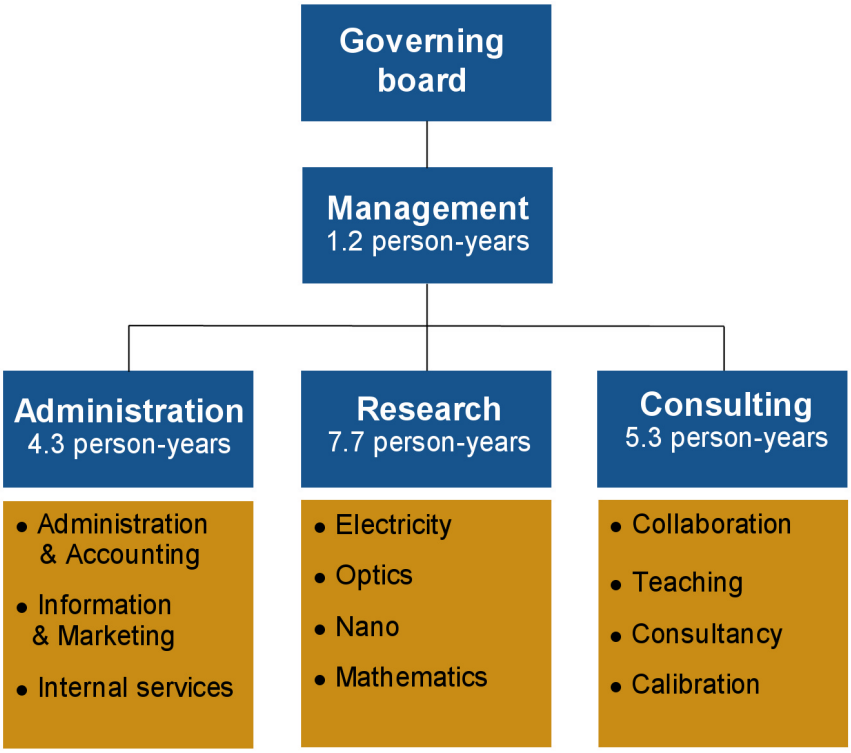
Section 2 describes in more detail the technical activities of the research and consulting sections as well as the administrative tasks at DFM. In section 3, the relations between Danish, European, and global metrology is described, and section 4 gives the consolidated statement of income. Annex 1 contains an account of particular activities, and annexes 2 to 6 contain a series of detailed information, concluding with the key figures for the period 1999-2003.

During 2003, DFM formulated its strategy for 2004-2006 and signed a three-year performance contract with the Ministry for Science, Technology, and Innovation for the period. The strategy plan, available on request, proposes an ambitious evolution of Danish metrology under the leadership of DFM; and we intend to use the stability of the three-year contract to fulfil the ambitions to their utmost. This will require substantial funding from sources that have hitherto taken metrology for granted without contributing to its financing.

Steen Konradsen	*Kim Carneiro*
Chairman of the Board	Director

2. Reports from the sections

DFM is operated by the Board of Governors and the Director. The Director executes daily management together with three section heads. From 2004 the Calibration Section was discontinued. Its maintenance and development activities were transferred to the Research Section, and calibration services to the Consulting Section. The new organisation is shown below together with the number of person-years allocated to the three sections in 2003.



2.1. Research

The research section is responsible for the development and maintenance of standards necessary to keep Denmark at an international level in metrology, and for providing metrology know-how requested by Danish industry. Standards are maintained in the fields of mass, volume, DC voltage, resistance, electrolytic conductivity, length, wavelength, and optical radiometry. Research activities are carried out through national and international projects with partners from industry, academia and other research institutions. They involve permanent staff as well as PhD and MSc students, and visiting scientists.

Electrical Metrology

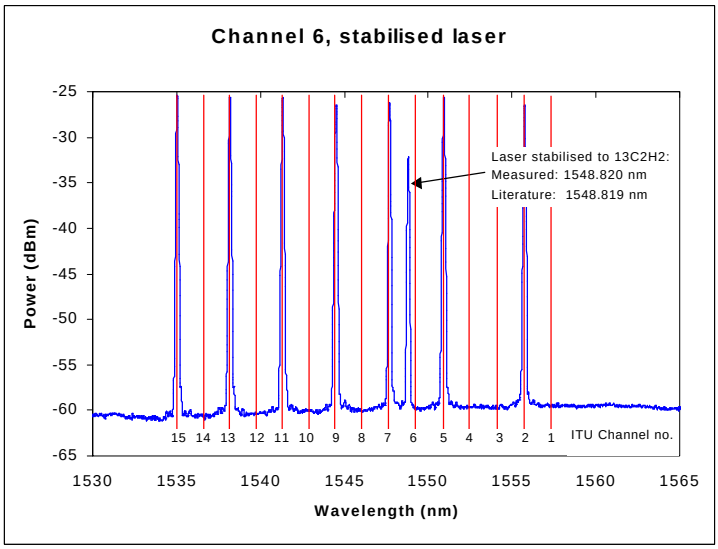
A rapidly growing sub-field is related to electrolytic conductivity, which is used for characterizing the purity of water – a crucial parameter in a wide range of industries, ranging from pharmaceuticals to microelectronics. Preliminary tests of a new primary cell indicate that it has a potential for becoming one of the most accurate in the World. A thermally controlled flow system is being tested for calibration of conductivity cells in ultra pure water. Traceability is planned from a calculable conductivity cell, and various ethylene glycol based reference solutions are being tested in connection with the measurements.

A guest scientist from the National Metrology Institute in China has participated in the

development of a cryogenic current comparator. This will facilitate a direct comparison of the quantized Hall resistance with a 100 Ω resistor and allow for scaling in the range 1 Ω to 10 kΩ.

Optical metrology

In optical communication an important concern is to maintain the individual lasers at their designated wavelengths, and two international projects have addressed this problem by developing absolute wavelength standards. DFM has developed two standards making use of molecular absorption lines. Both systems were successfully tested on a 534 km long 16 channel data transmitting optical network operated by TDC Denmark.

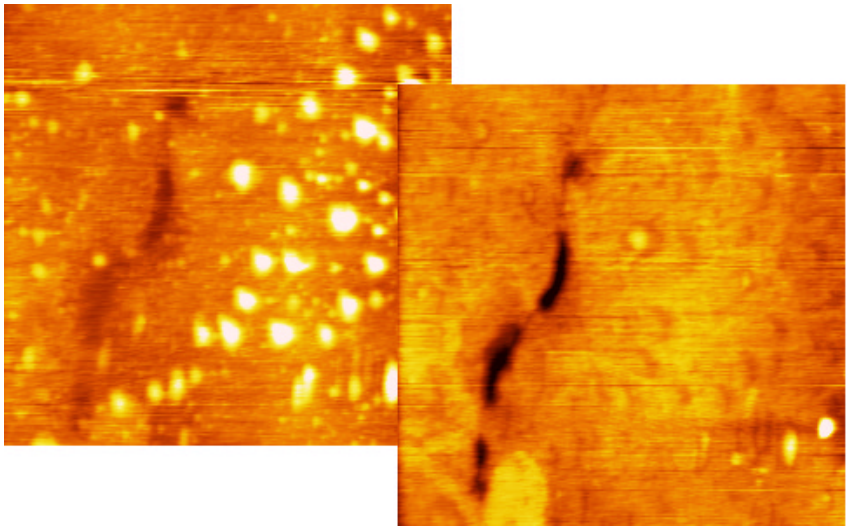


A laser locked to a molecular absorption line serves as an absolute wavelength standard in optical communication networks

The application of non-linear optical techniques for generating coherent radiation has progressed along two different lines: (1) Frequency doubling of a diode laser has produced 150 mW of blue radiation, which will target a specific transition in the magnesium atom. This is done under the auspices of the EU research training network CAUAC whose overall goal is to build atomic clocks based on laser cooled atoms. (2) Towards low frequencies, difference frequency generation of mid-infrared radiation from diode lasers has been the basis of the currently most precise characterisation of the fundamental vibration-rotation transitions in sulphur dioxide, a prerequisite for the use of infrared spectroscopy for quantitative gas analysis.

Nanometrology

Micro optical structures are increasingly used in sectors such as optical telecommunication, sensor technology, medical diagnostics and process control. The functionality of such structures relies on the interaction between an optical field and a geometrical structure, and there is a pronounced need for supporting the emergent industries with adequate measurement technologies. Realising this need, a Centre for Micro Optical Structures (CEMOST) was launched in 2003, coordinated by DFM. It involves three GTS institutes, two universities and six SMEs. So far six industry-specific projects have been initiated.



Atomic force microscopy on a gold surface in a liquid reveal the presence of bubbles with nanometer dimensions.

As the contact force is increased, the probe penetrates the bubbles and images the true surface

Mathematics

As the complexity of measurements increases, the difficulties in assigning values, uncertainties and coverage intervals to the measured quantities increase as well. Research at DFM aims at developing general techniques and computational tools for the evaluation of measurements that have many input and output quantities related to each other by an over-determined set of non-linear, implicit relations. A general least squares technique has been successfully implemented in the DFM mass laboratory, and its applicability has been further demonstrated in an optical measurement by which an ultraviolet detector has been calibrated using an infrared detector as reference.

As a participant in Working Group 1 of the joint Committee on Guides in Metrology (JCGM), DFM has contributed substantially to a first supplement to the *Guide to the expression of uncertainty in measurement (GUM).* The title of the supplement is *Numerical methods for the propagation of distributions*.

Maintenance of standards

Measurement standards and the associated experimental set-ups are maintained and upgraded in order to meet the ever-rising industrial demand for accurate measurements. In electricity, the measurement capability for electrolytic conductivity was expanded to 0,25 mS/m, allowing accredited certification of reference solutions relevant for users of ultra pure water. In optical radiometry, power measurement in the fibre optics regions was extended to 200 mW, and a stabilised fibre laser was developed, which will serve as a reference for calibration of wavelength meters.

International equivalence was maintained by participation in 5 international comparisons.

2.2. Consulting

The responsibility of the consultancy section is to represent Denmark in international metrological organisations, and to disseminate the knowledge generated at DFM to a wider community through activities such as teaching and consultancy. Also, following the sectional restructuring, calibrations for clients are now placed in this section.

National and international cooperation

As a member of the Metre Convention, Denmark has participated in the 22nd CGPM

(Conférence Générale des Poids et Mesures), and its standing in international metrology has been upheld through Danish membership of 7 Consultative Committees and Working Groups of CIPM (Comité International des Poids et Mesures).

In EUROMET, the organisation of European national metrology institutes, DFM participated in the General Assembly, chaired the technical committee for mass, and participated in the annual meetings of the committees for mass, electricity, length, photometry and radiometry, and in the working group on *Computer Guidelines*. DFM participated in the EU funded project MERA, Metrology in the European Research Area, both at the European and at the Nordic level (N-MERA).

The national metrological collaboration is taken care of through CDFM, the Centre for Danish Fundamental Metrology, and through DANIAmet, the circle of Danish primary and reference laboratories. In addition, DFM participated in IGAS, a group focusing on gas analysis, in TKAEK, the committee for accredited electrical calibration, and in the ITEK nano user group under Danish Industry.

Throughout the year DFM has received guests from Denmark and abroad, both in connection with specific collaboration, and in connection with information about metrology in general and DFM activities in particular.

Teaching

DFM has collaborated with DANAK and EUROLAB Denmark on developing and giving courses in software validation for accredited laboratories and in uncertainty in chemical measurements. A number of workshops were conducted for metrology experts from the EU accession countries Bulgaria, Cyprus, Lithuania, and Latvia, both in Denmark and in the respective countries.

A one-week course *Precision and nanometrology* was developed and given under the auspices of the EU project VisionOnline. This course is intended for conversion into an on-line version, and will provide DFM with its first experience in web-based interactive learning.

Training in atomic force microscopy in DFM's nanometrology laboratory

Consultancy

DFM has assessed the technical competence of laboratories for the accreditation bodies DANAK (Denmark), SWEDAC (Sweden), UKAS (Great Britain) and Norsk Akkrediter-

ing (Norway). On behalf of DANAK, DFM has chaired the EA Expert Group DC-LF, and participated in the Expert Group for Mass.

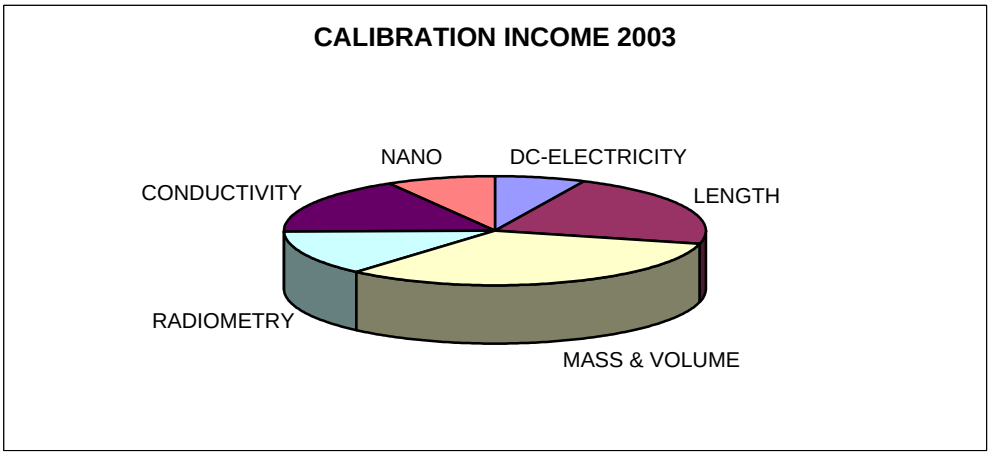
Three international projects were completed: Assistance to the national metrology institutes in Latvia and Lithuania with upgrading national reference standards and strengthening the metrological infrastructure, and the twinning project in Cyprus, which involved the one-year posting of a Danish adviser. This type of activity will continue, since a consortium consisting of DFM, FORCE Technology, DELTA and DANAK won a twinning project in Lithuania with a 1½year stationing of a DFM employee. Finally, DFM evaluated the metrology institutes in Bolivia and Turkey, and also chaired the international evaluation of the Istituto Elettrotecnico Nazionale Galileo Ferraris, IEN.

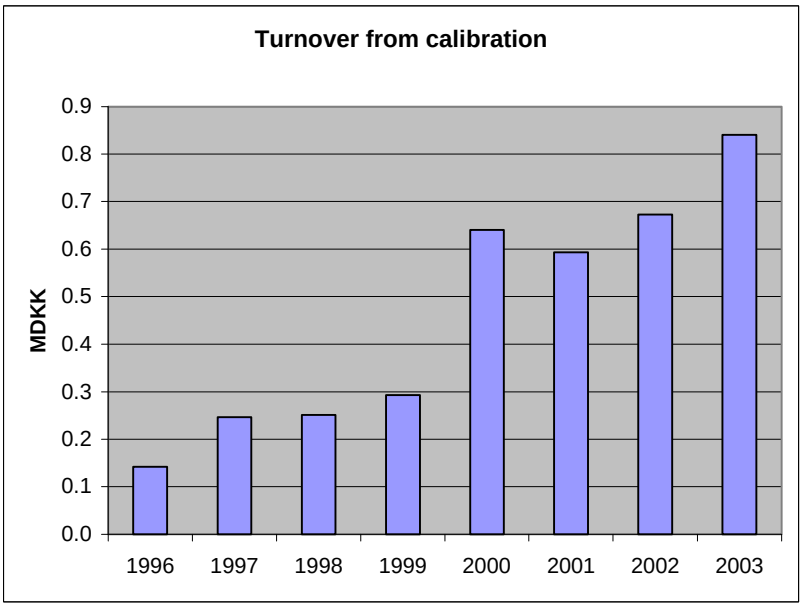
The DFM-GUM software for uncertainty calculations was sold in 8 copies.

Training in length calibration during the twinning project with Cyprus

Customer calibrations

Calibration for customers has resulted in the issuing of 119 certificates and 11 measurement reports, which represents a continuation of the growth experienced over recent years. While the traditional fields like electricity and length are at a stable level, a notable increase is observed for novel fields such as electrical conductivity, where reference water account for 29% of the certificates in 2003.





Calibration activities show a continued growth, and new fields account for an increasing share

2.3. Administration

In addition to general administrative tasks the section takes care of marketing, information technology, and premises. The one-person staff reduction was recovered in improved efficiency; but a substantial part of the administrative work is still carried out by the technical and scientific staff.

DFM's section head for administration, surrounded by the entire administrative staff

Considerable resources have been used on clearing old premises after taking new laboratories in use in 2002, and computer-wise much effort was devoted to protection against spam mail and computer virus. An upgrade of the financial management software was

begun, with the actual transition to take place in 2004. This will lead to easier procedures and reporting.

Marketing focused on customer satisfaction, exhibition at the biannual Danish conference *Måing & Kvalitet* in Odense, on the common web portal for the Advanced Technology Group (GTS) institutes www.teknologiportalen.dk, as well as on improving DFM's own home page. Finally DFM now uses *Danish Fundamental Metrology* as its calling name on all stationary and information material.

3. Danish, European, and global metrology

During 2003, Danish metrology continued its strong commitment to international collaboration and coordination in European and global organisations.

Since 1985, Denmark has operated a decentralised metrology organisation, with DFM as the core institute. The organisation is established and operated in the following way: The 11 subject fields of EUROMET are subdivided into 35 sub-fields relevant for the satisfaction of Danish needs, and for each of these sub-fields, a national metrology institute may be nominated. At present, 10 primary laboratories and 9 reference laboratories have been nominated for 19 sub-fields. DANIAmet is the member organisation for the nominated laboratories, in which 9 institutes, universities, and private companies take part. They are listed in Annex 2.

The four advanced technology institutes (GTS) form a closer collaboration within DANIAmet in the Centre for Danish Fundamental Metrology, CDFM, and in legal metrology, a similar organisation, Centre for Legal Metrology CLM, has been formed.

During 2003, the independent Danish Accreditation and Metrology Fund, DANAK, was split out from the Agency of Enterprise and Housing under the Ministry for Economy and Enterprise. Apart from operating the Danish accreditation service, DANAK is also supervising metrology on behalf of the government. DANAK reports to the new agency, *Sikkerhedsstyrelsen*, which took over the responsibility for metrology within government.

Since its foundation in 1987 EUROMET has been the cornerstone for collaboration between DANIAmet members and their European counterparts. It was therefore natural for DFM to take an active part in the implementation of EUROMET's new strategy for the development of metrology in the enlarged Europe through a more dedicated and committing collaboration and coordination between national metrology institutes. Hence, DFM participated in the MERA-project and contributed to the two MERA-workshops, held in Rotterdam in December 2002 and in Berlin in June 2003, as well as in the formulation of the new project IMERA.

During 2003, the Nordic and Baltic national metrology institutes, sponsored by the Nordic Innovation Centre, established the project NMERA to strengthen the Nordic profile in European metrology. DFM participated in the NMERA stakeholder workshop, held in Borås in May. In order to explore future scopes for Nordic collaboration, a series of technical workshops are planned during the spring 2004.

Through the organs under the Metre Convention, DFM took an active part in the global harmonisation of metrology; and DFM was among the first national metrology institutes to fulfil all criteria for the participation in the mutual recognition arrangement CIPM-MRA. This involves the declaration of all calibration relevant measurement capabilities and participation in key comparisons, both registered in the key comparison database, as well as the satisfactory presentation of its quality system for the QS-FORUM of EUROMET.

It takes a big table to accommodate all participants in the EUROMET Technical Committee meetings. The recent meeting for length had delegates from 27 countries.

4. Statement of income (in Danish, 18. regnskabsår)

LEDELSESPÅTEGNING

Bestyrelse og direktion har dags dato godkendt årsrapporten for 2003 for Dansk Fundamental Metrologi.

Årsrapporten er aflagt i overensstemmelse med Årsregnskabsloven under hensyn til de særlige forhold, som gælder for Dansk Fundamental Metrologi.

Vi anser den valgt regnskabspraksis for hensigtsmæssig, således at årsrapporten giver et retvisende billede af Dansk Fundamental Metrologis aktiver og passiver, finansielle stilling samt resultatet.

Kgs. Lyngby, 2004-02-24

Direktion

Kim Carneiro
Direktør

Bestyrelse

Knut Conradsen Næstformand	*Annette Dragsdal*	*Hans Dalsgaard Jensen* Medarbejderrepræsentant
Ole Bjørn-Jensen	*Steen Konradsen* Formand	*Anders Kühle* Medarbejderrepræsentant
Søren Stjernqvist	*Ernst Tiedeman*	

REVISIONSPÅTEGNING

Til bestyrelsen i Dansk Fundamental Metrologi

Vi har revideret den finansielle del af årsrapporten for Dansk Fundamental Metrologi for regnskabsåret 1. januar – 31. december 2003 bestående af ledelsesberetning (afsnit 1) ledelsespåtegning, revisionspåtegning, anvendt regnskabspraksis, resultatopgørelse for 2003, balance pr. 2003-12-31 og noter (afsnit 4).

DFM's ledelse har ansvaret for årsrapporten. Vort ansvar er på grundlag af vor revision at afgive en konklusion om årsrapporten.

Den udførte revision

Revisionen er udført i overensstemmelse med Ministeriet for Videnskab, Teknologi og Udviklings revisionsinstruks for GTS-institutter (udgivet af den daværende Erhvervsfremme Styrelse 1. januar 1997) under iagttagelse af god offentlig revisionsskik.

Vi har udført vor revision i overensstemmelse med danske revisionsstandarder. Disse standarder kræver, at vi tilrettelægger og udfører revisionen med henblik på at opnå høj grad af sikkerhed for, om årsrapporten er retvisende i alle væsentlige henseender. Ved en revision udføres på testbasis undersøgelse af beviser, der understøtter de i årsrapporten anførte beløb og oplysninger. En revision omfatter endvidere stillingtagen til den af ledelsen anvendte regnskabspraksis og til de væsentlige skøn, som ledelsen har udøvet, samt en vurdering af den samlede præsentation af årsrapporten. Det er vor opfattelse, at den udførte revision giver et tilstrækkeligt grundlag for vor konklusion.

Revisionen har ikke givet anledning til forbehold.

Konklusion

Det er vor opfattelse, at årsrapporten giver et retvisende billede af Dansk Fundamental Metrologis aktiver, passiver og den finansielle stilling pr. 31. december 2003 samt af resultatet af selskabets aktiviteter for regnskabsåret 1. januar – 31. december 2003 i overensstemmelse med Årsregnskabsloven.

Forvaltningen af de bevilgede midler er varetaget tilfredsstillende af Dansk Fundamental Metrologi.

København, 2004-02-24

Juul & Partnere

Niels Bjerregaard

Statsautoriseret revisor

ÅRSREGNSKAB FOR 2003 (18. REGNSKABSÅR)

Anvendt regnskabspraksis

Generelt

Årsrapporten for Dansk Fundamental Metrologi for 2003 er aflagt i overensstemmelse med årsregnskabslovens bestemmelser for klasse B-virksomheder.

Regnskabet er baseret på instituttets bogføring, men tallene er angivet i hele kroner (tusinde kroner for foregående år). Der kan derfor forekomme tilsyneladende afrundingsfejl ved sammentællingerne.

Ændring af anvendt regnskabspraksis

Der ingen ændringer i forhold til sidste års regnskabspraksis.

Indtægter

Indtægterne medtages i resultatopgørelsen i takt med arbejdets udførelse efter produktionskriteriet, hvilket medfører, at avancen på solgte ydelser medtages i resultatopgørelsen i takt med udførelsen af arbejdet, jævnfør nedenfor under igangværende arbejder.

Bevillinger forbrugt til udstyr, som regnskabsmæssigt afskrives, er indtægtsført i resultatopgørelsen.

Immaterielle anlægsaktiver:

Indretning af lejede lokaler pågået i 2002 måles til kostpris med fradrag af akkumulerede afskrivninger. Der foretages lineære afskrivninger baseret på aktivernes forventede brugstid, som for indretning af lejede lokaler er 15 år.

Materielle anlægsaktiver

Småanskaffelser med en anskaffelsessum på under 20.000 kr. udgiftsføres i resultatopgørelsen.

Udstyr med begrænsede anvendelsesmuligheder, fremstillet af underleverandører, udgiftsføres.

Mindre kontorinventar udgiftsføres.

”EDB-udstyr” afskrives lineært over 3 år.

”Andet udstyr”, anvendt til forskning og kalibrering, Videnskabeligt udstyr afskrives lineært over 4 år.

Igangværende arbejder:

Igangværende arbejder er optaget til salgsværdi omfattende medgået tid til salgspris med tillæg af afholdte udlæg.

RESULTATOPGØRELSE FOR PERIODEN

Noter		2003	2002 (1000 kr)
	Kundeomsætning	6 998 218	3 363
	Projektomsætning	5 429 133	5 769
	Resultatkontrakt	9 300 000	8 800
	BRUTTOINDTÆGTER I ALT	**21 727 351**	**17 932**
	Underleverandører	5 404 570	4 488
	Rejseomkostninger	1 164 577	752
	Andre udlæg	638 984	528
	UDLÆG I ALT	**7 208 131**	**5 768**
1	**NETTOINDTÆGTER**	**14 519 220**	**12 164**
2	Personaleomkostninger	9 076 550	9 946
	Andre omkostninger	3 543 315	3 435
	OMKOSTNINGER I ALT	**12 619 864**	**13 382**
	RESULTAT AF ORDINÆR DRIFT	**1 899 356**	**(1 218)**
	Afskrivninger	1 416 603	1 212
	RESULTAT FØR RENTER	**482 753**	**(2 429)**
3	Nettorenter	(204 317)	767
	ÅRETS RESULTAT	**278 436**	**(1 663)**

Årets resultat overføres til næste år.

BALANCE PR. 2003-12-31

Noter	AKTIVER	2003	2002 (1000 kr)
4	**FINANSIELLE ANSLÆGSAKTIVER**	**374 266**	**584**
5	**IMMATERIELLE ANLÆGSAKTIVER**	**4 153 369**	**4 455**
6	**MATERIELLE ANLÆGSAKTIVER**	**1 106 465**	**1 591**
7	Igangværende arbejder	3 621 020	**2 274**
	Tilgodehavender	1 379 415	**2 261**
	Debitorer	741 613	**913**
	Periodeafgrænsninger	6 955	**65**
	Tilgodehavender i alt	**5 749 003**	**5 512**
8	**Likvide midler i alt**	**1 825 303**	**4 911**
	OMSÆTNINGSAKTIVER I ALT	**7 574 306**	**10 423**
	AKTIVER I ALT	**13 208 406**	**17 053**

Noter	PASSIVER	2003	2002 (1000 kr)
	Overført resultat	8 377 785	8 099
9	**EGENKAPITAL I ALT**	**8 377 785**	8 099
	Forudbetalinger	1 471 406	872
	Kreditorer og skyldige omkostninger	2 316 215	6 884
	Feriepengeforpligtelse	1 043 000	1 198
	KORTFRISTET GÆLD I ALT	**4 830 621**	8 923
	PASSIVER I ALT	**13 208 406**	**17 053**

10 Eventualforpligtelser

Noter

1 Egenfinansierede forsknings- og udviklingsomkostninger, opgjort efter den af Videnskabsministeriet godkendte timesats, udgjorde i året kr. 399 943

2 DFM har i 2003 i gennemsnit beskæftiget 19 medarbejdere beregnet efter antal årsværk inklusive 2 ph. d. studerende

3 Nettorenter indeholder renteindtægter fra forudbetalinger til projektpartnere fra 2001 og 2002 påpåhhv. (kr. 23 379) og (kr. 20 006), der hensat til udbetaling i 2004, samt nedskrivning af Qmet anparter på(kr. 211 913)

4

Finansielle anlægsaktiver	**Qmet**	**Deposita**	**I alt**
Saldo 2003-01-01	211 913	374 266	586 079
Tilgang 2003			
Afgang 2003	211 913		211 913
Saldo 2003-12-31		374 266	374 266

Aktiviteten i Qmet ApS (Sølleröd) fortsættes, men pga. usikkehed om virksomhedens værdi er anpartnerne nedskrevet til kr. 0.

5 **Immaterielle anlægsaktiver**

Anskaffelsessum	**Lokaler**
Saldo 2003 01 01	4 530 949
Tilgang 2003	0
Afgang 2003	0
Saldo 2003 12 31	4 530 949
Afskrivninger	
Saldo 2003 01 01	75 516
Afskrivning 2003	**302 064**
Afskrevet årets afgang	0
Saldo 2003 12 31	377 580
Bogført værdi	4 153 369

6 **Materielle anlægsaktiver**

Anskaffelsessum	**EDB-udstyr**	**Andet Udstyr**	**Ialt**
Saldo 2003 01 01	3 660 686	24 310 284	27 970 970
Tilgang 2003	77 230	578 350	655 580
Afgang 2003	365 360	777 245	1 142 605
Saldo 2003 12 31	3 372 556	24 111 389	27 483 945
Afskrivninger			0
Saldo 2003 01 01	3 590 031	22 790 275	26 380 306
Afskrivning 2003	**82 788**	**1 056 991**	**1 139 779**
Afskrevet årets afgang	365 360	777 245	1 142 605
Saldo 2003 12 31	3 307 459	23 070 021	26 377 480
Bogført værdi	65 098	1 041 368	1 106 465
Vinding ved køb/salg	240	25 000	25 240
Afskrivning i alt	82 548	1 031 991	1 114 539

7 **Igangværende arbejder**

Offentlige danske institutioner	2 259 764
Udenlandske institutioner*	1 336 256
Danske virksomheder	0
Udenlandske virksomheder	25 000
Igangværende arb. i alt	**3 621 020**

Omkring 60% faktureres i 1. kvartal 2004

*) omfatter EU kommisionen

8

Likvide midler	**2003**	**2002 (1000 kr)**
Obligationer	0	1 500
Indestående i bank	1 212 890	2 314
Giro	87 330	135
Forudbet. projektpartnere	525 084	962
Likvide midler i alt	**1 825 303**	**4 911**

9 **Egenkapital**

Overført resultat 2002	8 099 349
Årets resultat	278 436
Overført resultat 2003	8 377 785

10 Der er søgt om fritagelse for told i alt kr. 30 906 for udstyr købt før 2002.

Annex 1 Accounts of particular activities

Participation in interlaboratory comparisons

Key comparison: Resistance at 100 Ohm, EUROMET.EM-K10 (#636)

Supplementary comparison of 1 Ohm and 10 kOhm resistors, EUROMET.EM-S18 (#710)

Comparison of Josephson array voltage standards by using a portable Josephson transfer standard, EUROMET.BIPM.EM-K10.a (#723)

Second international comparison of electrical conductivity measurements, CCQM-P47

High power fiber optic calibration, NORDTEST project 1654-03

Participation in committees and working groups

Consultative Committee for Electricity and Magnetism (CCEM)

Consultative Committee for Amount of Substance (CCQM)

CCQM's Working Group on Electrochemistry

BIPM Director's ad hoc Advisory Group on Uncertainty

Joint Committee on Guides in Metrology - Working Group 1 (GUM)

Working Group on Nanometrology under the Consultative Committee for Length (CCL)

Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV). Denmark is here represented by DPLA

Refereed publications in international journals and monographs

J. Garnæs, N.Kofod, A. Kühle, C. Nielsen and K. Dirscherl and L. Blunt, “Calibration of step heights and roughness measurements with atomic force microscopes”, Precision Engineering 27, 91-98 (2003), DFM-2003-P1

M. Holmberg, A. Kühle, J. Garnæs and A. Boisen, “Hybridisation of short DNA molecules investigated with in situ atomic force microscopy”, Ultramicroscopy 97, 257-261 (2003), DFM-2003-P2

Jan Hald and Valentina Ruseva, “High power 457 nm light source by frequency doubling an amplified diode laser”, Applied Optics 42, 5500-5507 (2003), DFM-2003-P3

F. Brinkmann, N.E. Dam, E. Deak, F. Durbiano, E. Ferrara, J. Füko, H. D. Jensen, M. Máriássy, R. Shreiner, P. Spitzer, M. Surdu and L. Vyskocil, "Primary methods for the measurement of electrolytic conductivity", Accred Qual Assur 8, 346-353 (2003), DFM-2003-P4

Maria Holmberg, Anders Kühle, Jørgen Garnæs, Knud A. Mørch, and Anja Boisen, ”Nanobubble Trouble on Gold Surfaces”, Langmuir 19, 10510-10513 (2003), DFM-2003-P5

A. Kühle, B-G Rosén and J. Garnæs, “Comparison of roughness measurement with atomic force microscopy and interference microscopy” Proceedings of SPIE, Volume 5188, 154-161 (2003), DFM-2003-P6

J.L. Sørensen, B. Julsgaard, C. Schori, J. Hald and E. S. Polzik, ”Quantum Noise Limited Laser Probing of Atomic Spin States” Laser Physics 13, 359-367 (2003), DFM-2003-P7

Dissertations

Susanne Søgaard, "Optical fiber grating based sensors", DFM-03-PhD1

Maria Holmberg, "Organic and Biological Molecular Layers on Functionalised Sensor Surfaces Studied with Atomic Force Microscopy", DFM-03-PhD2

Other publications and reports

Bendt Gerhard, Anders Kühle and Jes Henningsen, "DFM Annual Report 2002", DFM-03-R1

Jan Hald and Valentina Ruseva, "High power 457 nm light source by frequency doubling an amplified diode laser", DFM-03-R2

Lars Nielsen, "Bestemmelse af usikkerhed på volumen af injiceret dosis malt ved dynamisk vejning", DFM-03-R3, **Confidential.**

Henrik Blichfeldt, "FEU Program BUL0019 – 3.1 Quality System, Initial Assessment", DFM-03-R4

Henrik Blichfeldt, "FEU Program BUL0019 – 4.2 National standard laboratory, Initial Assessment", DFM-03-R5

Henrik Blichfeldt, "FEU Program BUL0019 – 3.1 Quality System, Assessment", DFM-03-R6

Kim Carneiro, "Examination and development of concepts for Bolivia's metrology structure", DFM-03-R7

Jes Henningsen and Hans Dalsgaard Jensen, "LIT 0127 – Pre-packing and Quality in Metrology – Visit to Lithuania 2002-11-27 to 29", DFM-03-R8

Jes Henningsen, "VMC peer evaluation Length", DFM-03-R9

Anders Kühle, "CEMOST – Hymite rapport nr. 1", DFM-03-R10, **Confidential.**

Maria Holmberg, "Erhvervsrapport – Strategy at DFM", DFM-03-R11, **Confidential**

Lene Savstrup Kristensen, "Twinning Cyprus, activity A1", DFM-03-R12

Henrik Weldingh, "Twinning Cyprus, activity A2", DFM-03-R13

Flemming Grud Madsen, "Twinning Cyprus, activity A4", DFM-03-R14

Birger Lind-Nielsen, "Twinning Cyprus, activity A8, Train. EU Legistation", DFM-03-R15

Birger Lind-Nielsen, "Twinning Cyprus, activity A23", DFM-03-R16

Michael Møller Nielsen, "Twinning Cyprus, activity A10+A11", DFM-03-R17

Henrik Weldingh, "Twinning Cyprus, activity A12+A13", DFM-03-R18

Lene Savstrup Kristensen, "Twinning Cyprus, activity A14", DFM-03-R19

Flemming Grud Madsen, "Twinning Cyprus, activity A16", DFM-03-R20

Jes Henningsen, "Twinning Cyprus, activity A20", DFM-03-R21

Stig Jarmer, "Twinning Cyprus, activity A21", DFM-03-R22

Henrik Blichfeldt, "Twinning Cyprus, activity A24", DFM-03-R23

Henrik Blichfeldt, "Twinning Cyprus, activity A26", DFM-03-R24

Birger Lind-Nielsen, “Twinning Cyprus, activity A19”, DFM-03-R25

Jan-Ulrik Holtoug, “Twinning Cyprus, activity A30”, DFM-03-R26

Lars Nielsen, “Twinning Cyprus, activity A32”, DFM-03-R27

Lene Savstrup Kristensen, “Twinning Cyprus, activity A3”, DFM-03-R28

Birger Lind-Nielsen, “Twinning Cyprus, Regulations on essential requirements for measuring instrument”, DFM-03-R29

Birger Lind-Nielsen, “Twinning Cyprus, activity A7”, DFM-03-R30

Birger Lind-Nielsen, “Twinning Cyprus, activity A5”, DFM-03-R31

Stig Jarmer, “Twinning Cyprus, activity A22”, DFM-03-R32

Jørgen Garnæs and Anders Kühle, ”Calibrations Count”, DFM-03-R33

Jes Henningsen, “CREW WP2-D9: Procedure for filling of reference cells”, DFM-03-R34

Jes Henningsen, “CREW WP1-D13: Stability of fibre laser standard”, DFM-03-R35

Jes Henningsen, ”CREW WP1-final report: Fibre laser standard”, DFM-03-R36

Anders Kühle and Jørgen Garnæs, “Måling af ruhed på polerede overflader med 3D teknikker” Teknisk Nyt Spcialt nr. 33, April 2003, DFM-03-R37

Lars Nielsen, ”Primærlaboratorium for masse – årsrapport 2002”, DFM-03-R38

Jan C. Petersen, ”Networkstest”, DFM-03-R39

B. Skands, K. Pedersen, M. Lund,”Improved SO_2 control with a new method for At-line measurement”, DFM-03-R40

Kim Carneiro, ”DFM Selvevaluering 2000-2002”, DFM-03-R41

Kim Carneiro, ”DFM’s Strategi for perioden 2004-2006”, DFM-03-R42

Maria Holmberg, ”Blodproteiner på Polymeroverflade”, DFM-03-R43

Henrik Blichfeldt, ”Audit of the Quality System at VMT, State Metrology Service, Vilnius, Lithuania”, DFM-03-R44

Ricky Ng, ”Non Linearity measurement of Photometers”, DFM-03-R45

Henrik Blichfeldt, “Twinning Cyprus, activity A25”, DFM-03-R46

Jes Henningsen, “Twinning Cyprus, activity A28”, DFM-03-R47

Henning Thomsen, “Twinning Cyprus, activity A15”, DFM-03-R48

Flemming Grud Madsen, “Twinning Cyprus, activity A17”, DFM-03-R49

Henrik Blichfeldt, “Twinning Cyprus, activity A27”, DFM-03-R50

Jes Henningsen, “Twinning Cyprus, activity A29”, DFM-03-R51

Hans D. Jensen, "Measurement of resistance - EUROMET.EM-K10 100 ohm", DFM-03-R52

Hans D. Jensen, "Measurement of resistance - EUROMET.EM-S18 10 kohm", DFM-03-R53

Hans D. Jensen, "Measurement of resistance - EUROMET.EM-S18 1 ohm", DFM-03-R54

Jan C. Petersen, “Preassessment Vilnius”, DFM-03-R55

Jan Hald and Lars Nielsen, “Implementation of a general least squares method in mass measurements”, DFM-03-R56

Anders Kühle, “CEMOST - OVC report no. 1”, DFM-03-R57, **Confidential**

Jan Hald, “Eurolab Computer Guideline Working Group, first meeting”, DFM-03-R58

Kim Carneiro, “Examination and development of concepts for Bolivia's metrological future“, DFM-03-R59

Lars Nielsen, “A bilateral comparison of a 1 kg platinum standard”, DFM-03-R60

Kim Carneiro, “Peer Review on Metrology for Romania, including the functioning and organisations of BRML”, DFM-03-R61

Kim Carneiro, “Peer Review on Metrology in Bulgaria, September 2003”, DFM-03-R62

Peter Høgh Hyllested, “ROM BRML Module 5, Final Report”, DFM-03-R63

Hans D. Jensen, Pia Refstrup and Niels-Ebbe Dam, "DFM report on CCQM P47 measurements", DFM-03-R64

Jan-Ulrik Holtoug, “Twinning Cyprus, activity A31”, DFM-03-R65

Anders Kühle, Francesca Borsetto, “CEMOST – OVC/LuKa report no. 2”, DFM-03-R66, **Confidential**

Preben Howarth, “Twinning Cyprus, activity A8, Strategy plan 2004-2006 WMS Cyprus”, DFM-03-R67

Preben Howarth, “Action plan, Strategy plan 2004-2006 WMS Cyprus”, DFM-03-R68

Preben Howarth, “Twinning Cyprus, activity A8, Training in Strategy plan, WMS Cyprus”, DFM-03-R69

Jørgen Garnæs, “Ibsen – CEMOST report no. 1 – chirp tipshape”. DFM-03-R70, **Confidential**

Jørgen Garnæs, ”LuKa – CEMOST report no. 1 – profile of gratings”, DFM-03-R71, **Confidential**

Jan Hald, ” FEU program BUL0019 - 5. Software: assessment of validation techniques”, DFM-03-R72

Jan-Ulrik Holtoug, “Re-assessment of Thermometry Metrology in Latvia”, DFM-03-R73

Ricky Ng, “Electrolytie conductivity measurement”, DFM-03-R74

Jørgen Garnæs, L. Koenders, R. Bergmans, J. Haycocks, N. Korolwv, T. Kurosawa, “Comparison on Nanometrology: Nano 2 – Step heigth”, DFM-03-R75

Kim Carneiro, “Development of Conformity Assessment Infrastructure in the field of Metrology (JVCS 60.6000.70_710; ZZ0117)”, DFM-03-R76

Lars Nielsen and Hans Dalsgaard Jensen, “Reassessment of LNMC laboratories in the fields of mass and electricity”, DFM-03-R77

Valentina Ruseva and Jan Hald, “Generation of UV light by frequency doubling in BIBO”, DFM-03-R78

Jes Henningsen, "Primærlaboratorium for Længde - Årsrapport 2002", DFM-03-R79

Hans D. Jensen, "Primærlaboratorium for DC elektricitet - Årsrapport 2002", DFM-03-R80

Jan C. Petersen, "Primærlaboratorium for Radiometri - Årsrapport 2002", DFM-03-R81

Contributions at conferences

Preben Howarth: “Impact of metrology and testing on trade: MetroTrade - the European project”, Metrotrade workshop: Traceability and measurement uncertainty in testing, BAM, January 2003, Berlin, Germany.

L. Nielsen: “Application of the Methods of Least Squares in Mass Measurements”, UNCERT 2003 - International Conference on the Uncertainty of Measurement, 9-10 April 2003, St Catherine's College, Oxford, UK.

S. Søgaard and J. Henningsen: “Tuning and modulation of a DFB fibre laser with integrated thin-film heater”, CREW Workshop and 182. PTB Seminar, April 10-11, 2003, Braunschweig, Germany.

J. Henningsen, S. Søgaard, J. C. Petersen: “Molecules as absolute wavelength references”, ibid.

J. Henningsen, S. Søgaard, J. C. Petersen: “Molecular wavelength references at Danish Fundamental Metrology”, ibid.

J.C. Petersen, J. Henningsen, C. Campbell, D.A. Humphreys, and B.F. Skipper: “Network Transmission Tests of optical Wavelength References"”, ibid.

A. Andersson, J.C. Petersen, H. Skoogh, P.-O. Hedeqvist, and M. Karlsson: “Experiences of sending a reference signal through DWDM multiplexer and 550 km fibre system”, ibid.

Kim Carneiro: “How stakeholders express their views on Metrology in Denmark”, Nordic Metrology Research Area Stakeholder views, 14-15 May 2003, Borås, Sweden.

H. Blichfeldt: “Role and development of the scientific metrology”, Standards in the Global Economy, Conference, SAMTS and DFM, 21 May 2003, Sofia, Bulgaria.

Maria Holmberg: “Poster: Nanobubbles on Surfaces”, Scanning Probe Microscopy, Sensors and Nanostructures, 23-26 May 2003, Oxford, UK

J. Henningsen, S. Søgaard, and J.C. Petersen: “Molecular wavelength references”, Danish Physical Society, Annual Meeting, 12-13 June 2003, Nyborg Strand, Denmark.

E.G. Grosche, J. Meissner, D. Humphreys, J. Henningsen and J.C. Petersen: “Certified Reference Materials for Optical Telecommunication Wavelengths”, Northern Optics 2003, 16-18 June 2003, Helsinki, Finland.

A. Andersson, M. Karlsson, P-O. Hedeqvist, J.C. Petersen, J. Tuominen, T. Niemi, and H. Ludvigsen: “DWDM Network Transmission Test of Optical Wavelength References”, Northern Optics 2003, 16-18 June 2003, Helsinki, Finland

Hans D. Jensen and Lars Nielsen: “Self-consistent uncertainty calculation in voltage and resistance metrology”, EUROMET Sub-Committee DC and Quantum metrology - Workshop on Uncertainty, 15-18 June 2003, Castá-Papiernicka, Slovakia.

Maria Holmberg: “Invited Talk: Investigation of DNA Hybridisation using in situ Atomic Force Microscopy”, Second International Conference on Biomedical Spectroscopy, 5-8 July 2003, London, UK.

Kim Carneiro, Maria Holmberg: “From surface characterization to Nanometrology”, Trends in Nanometre Metrology 16 July 2003, Warwick, UK.

Maria Holmberg: “Bubble Trouble”, STM 2003, 20-25 July 2003, Eindhoven, Holland

A. Kühle, B-G. Rosén, J. Garnaes: “Comparison of roughness measurement with atomic force microscopy and interference microscopy”, Advanced characterization techniques

for Optics Semiconductors and Nanotechnologies, SPIE – The International Society for Optical Engineering, 48th Annual Meeting, 3-8 August 2003, San Diego, USA

J. Hald and L. Nielsen: “Implementation of a General Least Squares Method in Mass Measurements”, Advanced Mathematical and Computational Tools in Metrology VI, September 2003, Torino, Italy

Jes Henningsen: “Precise line strengths and collision broadening parameters for the ν_3 band of SO_2 determined by difference frequency spectroscopy”, 18th Colloquium on High Resolution Molecular Spectroscopy, September 8-12, 2003, Dijon, France.

V. Ruseva, J. Hald, J. Henningsen, “Characterization and stabilization of light sources for Magnesium”, CAUAC Network meeting 2003, October 9-12, 2003, Riddagshausen, Braunschweig, Germany.

Kim Carneiro: “The role of metrology”, EuroNanoForum, 10-12 December 2003, Trieste, Italy.

Other talks

L. Nielsen, “Methods for the evaluation of Key Comparisons”, EUROMET Mass TC meeting, 27 February 2003, Bern, Switzerland.

J. Henningsen, "Optics at DFM", Staff from Department of Optics and Fluid Mechanics, Risø, 20 March 2003, DFM.

Hans D. Jensen: “Uncertainty in Testing”, EOTC Training Workshop, 5-6 May 2003, Riga, Latvia.

Preben Howarth: “The concept of Metrolgy - in short” Regmet workshop, September 2003, BIPM Paris, France.

J. Henningsen: “Novel coherent sources for precision spectroscopy in the mid-infrared spectral region”, Kemisk Institut, Københavns Universitet, September 9, 2003

Hans D. Jensen: Introduction presentation, "Metrology infrastructure in Denmark", 11 September 2003, Brüel & Kjær, Nærum, Denmark.

L. Nielsen, ”Overensstemmelsesvurdering inden for kalibrering”, Indlæg ved DANAK-kurset "Overensstemmelseserklæringer i prøvningsrapporter og kalibreringscertifikater", 7 Oktober 2003, Dahlerups Pakhus, Copenhagen.

L. Nielsen, ”NIF P1/DANAK W2 - Kalibrering af analysevægt”, Indlæg ved DANAK Brush-up om præstationsprøvninger, 18 November 2003, Symbion, Copenhagen.

J. Henningsen, "Traceability in dimensional metrology", Students from IPL, 19 November 2003, DFM.

Anders Kühle, Two lectures in atomic force microscopy in the course "10320 Materialefysiske analysemetoder”, Dept. of Physics, DTU, 21 February 2003.

Anders Kühle, One lecture in atomic force microscopy in the course “Single Molecule Biophysics” Niels Bohr Institute, University of Copenhagen, 28 April 2003.

Participation in national and international projects

Network on Advanced Mathematical and Computational Tools in Metrology	SofTools MetroNet	EU
Certified Reference Materials for Optical Telecommunication Wavelengths	CREW	EU
Cold Atoms and Ultra-precise Atomic Clocks	CAUAC	EU
Optical Communications Wavelength References	OCWR	Nordic Industry Fund
Industrial PhD	EF-836-ST	ATV
A Virtual Institute Supporting Industry Online in Precision Engineering, Microsystems and Nanotechnologies	Vision OnLine	EU
Improving Dialogue between EU Regulatory Bodies and National Metrology Institutes	REGMET	EU
Metrological Support to International Trade	METROTRADE	EU
Initiative and Co-ordination to prepare Laboratories in Newly Associated States for full implementation of the Low Voltage Directive (LVD)	INCOLAB	EU
Twinning Project Cyprus		EU
Prepackaging and Quality in Metrology in Lithuania		Danish Foreign Ministry
Metrology System Development in Latvia		Danish Foreign Ministry
Prepackaging and Scientific Metrology in Bulgaria		Danish Foreign Ministry
European Virtual Institute for Geometry Measurements	EVIGeM	EU
Centre for Microoptical Structures	CEMOST	VTU
High Power Fibre Optic Calibration		NORDTEST
Metrology in the Europea Research Area	MERA	EU
Nordic aspect of Metrology in the European Research Area	N-MERA	EU
Twinning Project Lithuania		EU

Annex 2 DANIAmet laboratories

DFM

Subfield: Mass measurement (primary laboratory)
Contact person: Lars Nielsen, DFM, 307 Matematiktorvet, DK-2800 Kgs. Lyngby
Telephone: +45 4525 5866. Telefax: +45 4593 1137. www.dfm.dtu.dk

DFM

Subfield: Length measurement (primary laboratory)
Contact person: Jes Henningsen, DFM, 307 Matematiktorvet, DK-2800 Kgs. Lyngby
Telephone: +45 4525 5865. Telefax: +45 4593 1137. www.dfm.dtu.dk

DFM

Subfield: DC electricity (primary laboratory)
Contact person: Hans Dalsgaard Jensen, DFM, 307 Matematiktorvet, DK-2800 Kgs. Lyngby
Telephone: +45 4525 5874. Telefax: +45 4593 1137. www.dfm.dtu.dk

DFM

Subfield: Optical radiometry (primary laboratory)
Contact person: Jan C. Petersen, DFM, 307 Matematiktorvet, DK-2800 Kgs. Lyngby
Telephone: +45 4525 5864. Telefax: +45 4593 1137. www.dfm.dtu.dk

Danish Primary Laboratory for Acoustics (DPLA)

Subfield: Acoustical measurements in gases and solids, vibrations (primary laboratory)
Contact persons: Erling Frederiksen (Microphones)
Torben R. Licht (Accelerometry)
Brüel and Kjær A/S, Skodsborgvej 307, DK-2850 Nærum
Telephone: +45 4580 0500. Telefax: +45 7741 2013. www.bkhome.com
Contact person: Knud Rasmussen, Institute of Acoustical Technology
Building 352, Technical University of Denmark, DK-2800 Kgs. Lyngby
Telephone: +45 4525 3937. Telefax: +45 4588 0577

Radiometer Medical A/S

Subfield: pH measurement (primary laboratory)
Contact person: Hans Bjarne Kristensen, Radiometer Medical A/S, Åkandevej 21, DK-2700 Brønshøj
Telephone: +45 3827 3827. Telefax: +45 3827 2727. www.radiometer.com

National Laboratory for Geometrical Metrology (NGM)

Subfield: Dimensional metrology (primary laboratory)
Contact person: Leonardo De Chiffre, NGM-CGM, B425 Produktionstorvet, Technical University of Denmark, DK-2800 Kgs. Lyngby
Telephone: +45 4525 4760. Telefax: +45 4593 0190. www.ipl.dtu.dk
Contact person: Sven Nytoft Rasmussen, NGM-Danish Technological Institute,

Gregersensvej, Box 141, DK-2630 Tåstrup
Telephone: +45 7220 3032. Telefax: 7220 2999. www.teknologisk.dk

Arepa Test & Calibration A/S

Subfield: AC electricity (primary laboratory)
Contact person: Torsten Lippert, Arepa, Mads Clausens Vej 12, DK-8600 Silkeborg
Telephone: +45 8720 6969. Telefax: 8681 2654. www.arepa.dk

Arepa Test & Calibration A/S

Subfield: HF electricity (reference laboratory)
Contact person: Orla Kristensen, Arepa, Mads Clausens Vej 12, DK-8600 Silkeborg
Telephone: +45 8720 6969. Telefax: 8681 2654. www.arepa.dk

Danish Technological Institute

Subfield: Water flow (primary laboratory)
Contact person: John Frederiksen, Danish Technological Institute, Teknologiparken, DK-8000 Århus C
Telephone: +45 7220 1235. Telefax: +45 7220 1212. www.teknologisk.dk

Danish Technological Institute

Subfield: Temperature measurement by contact (reference laboratory)
Contact person: Anette Brønnum, Danish Technological Institute, Teknologiparken, DK-8000 Århus C
Telephone: +45 7220 1313. Telefax: +45 7220 1212. www.teknologisk.dk

FORCE Technology

Subfield: Force and Pressure (reference laboratory)
Contact person: Lene Schou, FORCE Technology, Park Allé 345, DK-2605 Brøndby
Telephone: +45 4326 7160. Telefax: +45 4326 7011. www.force.dk

FORCE Technology

Subfield: Gaseous flow (reference laboratory)
Contact person: Gunnar H. Østergaard, FORCE Technology, Navervej 1, DK 6600 Vejen
Telephone: +45 7696 1600. Telefax: 7536 4155. www.force.dk

FORCE Technology

Subfield: Volume and Density (reference laboratory)
Contact person: Lene S. Kristensen, FORCE Technology, Park Allé 345, DK-2605 Brøndby
Telephone: +45 4326 7106. Telefax: +45 4326 7011. www.force.dk

DELTA Danish Electronics, Light & Acoustics

Subfield: Humidity (reference laboratory)

Contact person: Anders B. Kentved, Delta, Venlighedsvej 4, DK-2970 Hørsholm
Telephone: +45 7219 4000. Telefax: +45 7219 4001. www.delta.dk

FORCE Technology

Subfield: Flow of Liquids other than Water (reference laboratory)
Contact person: Lene S. Kristensen, FORCE Technology, Park Allé 345, DK-2605 Brøndby
Telephone: +45 4326 7106. Telefax: +45 4326 7011. www.force.dk

Risø National Laboratory

Subfield: Non-contact Temperature Measurement (reference laboratory)
Contact person: Sønnik Clausen, Risø National Laboratory, Frederiksborgvej 399, DK-4000 Roskilde
Telephone: +45 4677 4523. Telefax: +45 4677 4565. www.risoe.dk

Annex 3 Reference laboratories outside DANIAmet

A number of laboratories outside DANIAmet work for ministries and governmental agencies. The list below includes laboratories with a formal status as reference laboratory as well as laboratories doing similar work without a formal nomination.

The National Institute of Occupational Health

Subfield: Environmental Chemistry
Contact person: Jesper Kristiansen, LersøParkallé 105, 2100 København Ø
Telephone: 3916 5200. Telefax: 3916 5201.
Ministry: Ministry of Occupation

Danish Institute for Fisheries Research

Subfield: Food Chemistry
Contact person: Maike Timm Heinrich, DTU, Søltofts Plads, Building 221, DK-2800 Kgs. Lyngby
Telephone: +45 4588 3322. Telefax: +45 4588 4774
Ministry: Ministry of Food, Agriculture and Fisheries

Danish Institute of Agricultural Sciences

Subfield: Environmental Chemistry (soil and water)
Contact person: Niels Henrik Spliid, Forsøgsvej 1, Flakkebjerg, DK-4200 Slagelse
Telephone: +45 5811 3300. Telefax: +45 5811 3301.
Ministry: Ministry of Food, Agriculture and Fisheries

Danish Institute for Quality Assurance in laboratories in the Health Care, DEKS

Subfield: Laboratorie Medicin
Contact person: Inger Plum, 54M1, University Hospital Herlev, DK-2730 Herlev
Telephone: +45 4488 3454. Telefax: +45 4453 5369
Ministry: Ministry of the Interior and Health

Eurofins A/S

Subfield: Environmental Chemistry (Water, soil, sludge and waste)
Contact person: Ulla Lund, Agern Alle 11, DK-2970 Hørsholm
Telephone: +45 7022 4230 Telefax +45 7022 4255
Ministry: Ministry of Environment

FORCE Technology - Division of Energy and Environment

Subfield: Air emission monitoring
Contact person: Lars Gram, Gladsaxe Møllevej 15, DK-2860 Søborg
Telephone: +45 3955 5999 Telefax: +45 3969 6002.
Ministry: Ministry of Environment

National Environmental Research Institute, Department of Atmospheric Environment

Subfield: Ambient air pollution measurements
Contact person: Lone Grundahl, Frederiksborgvej 399, DK-4000 Roskilde
Telephone: +45 4630 1134. Telefax: +45 4630 1214
Ministry: Ministry of Environment

National Environmental Research Institute, Department of Environmental Chemistry and Microbiology

Subfield: Environmental Chemistry and Microbiology
Contact person: Pia Lassen, Frederiksborgvej 399, DK-4000 Roskilde
Telephone: +45 4630 1200 Telefax: +45 4630 1114
Ministry: Ministry of Environment

Danish Institute for Food and Veterinary Research

Subfield: Food chemistry/food microbiology
Contact person: Inge Meyland, Mørkhøj Bygade 19, DK-2860 Søborg
Telephone: +45 7234 6000. Telefax: +45 7234 7001
Ministry: Ministry of Food, Agriculture and Fisheries

Danish Institute for Food and Veterinary Research

Subfield: Microbiology
Contact person: Conny Wolstrup, Bülowsvej 27, DK-1790 København V
Telephone: +45 7234 6000. Telefax: +45 7234 6001
Ministry: Ministry of Food, Agriculture and Fisheries

Danish Medicines Agency, Medicines Control Division

Subfield: Microbiology, Biology, Chemistry, Radiopharmacy
Contact person: Finn H. Clemmensen, Axel Heides Gade 1, DK-2300 København S
Telephone: +45 4488 9595. Telefax: +45 4488 9599
Ministry: Ministry of the Interior and Health

Eurofins Denmark A/S

Subfield: Environmental Microbiology
Contact person: Vibeke From Jeppesen, Frydendalsvej 30, DK-1809 Frederiksberg C
Telephone: +45 7022 4233. Telefax: +45 7022 4255
Ministry: Ministry of Environment

Danish Plant Directorate

Subfield: Food Chemistry/ Environmental Chemistry
Contact person: Mogens Nagel Larsen, Skovbrynet 20, DK-2800 Kgs. Lyngby
Telephone: +45 4526 3600 Telefax: +45 4526 3610
Ministry: Ministry of Food, Agriculture and Fisheries

Departments of Forensic Chemistry Institute of Forensic Medicin

Subfield: Forensic Chemistry
Contact person: Bent Kæmpe/Else-Marie Heinsvig/Henning Willads Petersen, Københavns Universitet, Frederik V's vej 11, DK-2100 København Ø
Telephone: +45 3532 7900 Telefax: +45 3532 6085
Ministry: Ministry of Law

National Institute of Radiation Hygiene

Subfield: Ionising radiation and radioactivity
Contact person: Klaus Ennow, Knapholm 7, DK-2730 Herlev
Telephone: +45 4454 3454. Telefax: +45 4454 3450.
Ministry: Ministry of the Interior and Health

Statens Seruminstitut

Subfield: Microbiology
Contact person: Helle Bruhn-Rasmussen, Artillerivej 5, DK-2300 København S
Telephone: +45 3268 3268. Telefax: +45 3268 3868.
Ministry: Ministry of the Interior and Health

Annex 4 The 11 subject fields of metrology

Fundamental metrology in Denmark follows the EUROMET division into 11 subject fields, while the subfields reflect metrological activities in Denmark. Plans of action drawn up for each subject field serve as guidelines in the nomination of primary and reference laboratories and give suggestions for other initiatives. The years in which plans of action have been published are shown in parenthesis. Primary and reference laboratories are designated (P) and (R) respectively.

Subject field	**Subfield**	**Laboratory**
MASS (1989, 1997)	Mass measurement Force and Pressure Volume and Density	Danish Fundamental Metrology (P) FORCE Technology (R) FORCE Technology (R)
ELECTRICITY (1989, 1994, 2002)	DC electricity AC electricity HF electricity	Danish Fundamental Metrology (P) AREPA Test & Calibration (P) AREPA Test & Calibration (R)
LENGTH (1989, 1998)	Length measurements Dimensional metrology	Danish Fundamental Metrology (P) National Laboratory for Geometrical Metrology (NGM) (P)
TIME AND FREQUENCY (1992, 2000)	Time measurement Frequency	
THERMOMETRY (1992, 1999)	Temperature measurement by contact Non-contact temperature measurement Humidity	Danish Technological Institute (R) RisøNational Laboratory (R) DELTA Danish Electronics, Light & Acoustics (R)
IONISING RADIATIONS AND RADIOACTIVITY (1992, 2000)	Absorbed radiation dose – Industrial products Absorbed radiation dose – Medical products Radiation protection Radioactivity	
PHOTOMETRY AND RADIOMETRY (1990, 1996)	Optical radiometry Photometry Colorimetry Optical fibres	Danish Fundamental Metrology (P)
FLOW (1990, 1999)	Gaseous flow (volume) Water flow (volume, mass and energy) Flow of liquids other than water Anemometry	FORCE Technology (R) Danish Technological Institute (P) FORCE Technology (R)
ACOUSTICS (1992, 2000)	Acoustical measurements in gases Acoustical measurements in solids Acoustical measurements in liquids	Danish Primary Laboratory of Acoustics (P) Danish Primary Laboratory of Acoustics (P)
AMOUNT OF SUBSTANCE (1992, 1995)	Environmental chemistry Clinical chemistry Materials chemistry Food chemistry Biochemistry Microbiology PH measurement	Radiometer Medical A/S (P)
INTERDISCIPLINARY METROLOGY	No subdivisions	

Annex 5 Details of personnel

Board of Governors

Knut Conradsen, Vice President, Technical University of Denmark (Vice Chairman)
Hans Dalsgaard Jensen, Staff Scientist, PhD, DFM
Ole Bjørn Jensen, Managing Director, SCANPHARM A/S
Steen Konradsen, AREPA Test & Calibrering A/S (Chairman)
Anders Kühle,Staff Scientist, PhD, DFM
Ernst Tiedemann, Managing Director, FORCE Technology
Annette Dragsdahl, Chief Consultant, DANISH INDUSTRY
Søren Stjernqvist, Managing Director, TECHNOLOGICAL INSTITUTE

Management

Kim Carneiro, MSc (EE), PhD

Accountant

Juul & Partnere, Certified Accountant

Permanent Staff

Kim Carneiro, MSc (EE), PhD
Grethe Bjørndal Jensen, Secretary
Lars Nielsen, MSc (EE), PhD
Steen Rahbek, Technician
Hans Dalsgaard Jensen, MSc (EE), PhD
Jan Conrad Petersen, PhD
Jes Henningsen, MSc, Dr.scient.
Jørgen Garnæs, PhD
Bendt Gerhardt, MSc (Commerce) (till 28 February)
Preben Howarth, MSc, (ME), BSc (Economy)
Peter Høgh Hyllested, Technician
Carl Erik Torp, MSc (till 31 January)
Anders Kühle, MSc (EE), PhD
Henrik Blichfeldt, MSc
Jan Hald, PhD
Isabella Stendal, Secretary
Bo Bengtsen, Technician
Niels-Ebbe Dam, MSc, PhD
Maria Holmberg, PhD student, Technical University of Denmark (till 30 November)
Valentina Ruseva, PhD student, University of Copenhagen

Non-Permanent Staff, research students, and guests

Lene S. Kristensen, FORCE Technology
Ricky Ng, IAESTE student (from 4 June)
Francesca Borsetto, MSc Student (from 9 October)
Pia Refstrup, cand.scient. (from 15 September till 31 December)
Tuomi Ritari, PhD student, Helsinki University of Technology (from 1 September till 1 November)
He Qing, DANIDA fellow (from 1 September till 15 December)
Jørgen G. Blom, MSc (from 1 September)

Niels Gregersen, PhD student (from 1 November)
Ramona Matieu, PhD student (from 1 November)
Igor Pusnik, Jovan Bojkovski, Domen Hudoklin, Gaber Beges, Miha Hiti, Faculty of Electrical Engineering, University of Ljubljana, Slovenia, (from 28 July till 8 August)

Annex 6 Key figures

Economy (million Danish kroner)	1999	2000	2001	2002	2003
Turnover gross	14.7	17.9	16.9	18.0	21.7
Turnover net	12.5	14.2	13.9	12.2	14.5
Result of the year	-1.3	0.0	0.3	-1.6	0.3
Equity	8.4	10.6	9.1	8.2	8.4
Export turnover	3.5	5.0	3.0	4.5	7.4
Research and development					
R & D number of projects	17	17	15	15	13
- of this centre contracts	1	2	2	2	1
- of this international projects	13	9	7	8	11
R & D total turnover	11.9	13.0	13.2	14.6	15.1
- of this internally financed	3.64	0.8	1.0	2.0	0.4
R & D person-years	9.4	10.2	9.7	8	8.1
Number of customers					
Danish private companies	36	42	38	32	32
-of this small companies (< 50 employees)	16	18	22	13	14
- of this medium sized companies (50-200 employees)	8	13	7	8	7
- of this large companies (over 200 employees)	12	11	9	11	11
Publich Danish institutions	8	5	8	7	3
Foreign companies	32	22	29	19	28
Total number of customers	76	69	75	58	63
Staff according to education (person-years)					
Dr. & Ph.D.	10	10	9	10	9
M. Sc. including temporary staff	7	6	6	4	5
Technical	3	3	3	3	3
Administrative	2	3	3	3	2
Average number of staff members	22	22	21	20	19
Number of publications					
Refereed publications	21	15	17	5	7
Dissertations	1	4	2	1	2
Other reports	59	43	52	30	78
Conference contributions	29	17	26	17	22
Refereeing for international journals	27	82	54	21	10
Calibration certificates	49	80	78	92	130
Press cips	55	29	25	27	17
Teaching					
Number of days	17	32	25	25	60
Number of participants	200	337	232	242	141
Staff supervising / teaching at universities	3	7	6	2	2
Participation in external committies	6	6	3	18	20
- of this international	5	5	3	6	14
Efficiency					
Turnover per employee (1000 DKK)	668	814	805	900	1174
profit per emploeyee (1000 DKK)	-59	0	15	-80	15
Client turnover per Performance Contract DKK	0.3	0.5	0.4	0.4	0.8
R & D turnover per Performance Contract DKK	1.4	1.3	1.4	1.7	1.6