8th ESA MNT Round Table
Micro & Nanotechnology for Space Applications

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European Space Agency

www.esa.int

Agenda

- Workshop objectives
- Program schedule
- Social event
- Logistics
- Opening Introduction: TEC-Q Department Head

Objectives

- To promote information exchange on Micro & Nanotechnology research and development within Europe
- To gain an overview of current level of maturity, major developments and achievement in field
- To report on ESA and other NSAs activities on Micro- Nanotechnology
- To progress further on MEMS qualification and standardisation
- **To identify key work priorities and actions to be considered for future development programs**

Workshop schedule

- Twelve technical sessions (52 papers)
  - Reliability, Testing and Qualification
  - Packaging and integration (2 sessions)
  - RF MEMS
  - Radiation and Miniaturisation
  - Nanotechnologies
  - Optical sensors and actuators
  - AOCS
  - Strategy and roadmaps
  - Propulsion
  - MOEMS based instruments & missions
  - MNT in space projects
- Poster session (4 Posters)

DAY 1 SCHEDULE

Session 1: Reliability, Testing & Qualification

Chair: Francis Pressecq (CNES) - Nicolas Saillen (ESA)

13:35 - 16:05

Coffee Break

Session 2: Packaging & Integration 1

Chair: Antonia Neels (CSEM) - Tommaso Ghidini (ESA)

16:20 – 18:00

DAY 2 SCHEDULE

Session 3: RF MEMS

Chair: Olivier Vendier (TAS) - Tapani Narhi (ESA)

08:50 - 10:30

Coffee Break

Session 4: Radiation & Miniaturisation

Chair: Dietmar Vogel (Fraunhofer) - Christian Poivey (ESA)

10:55 - 13:00

Lunch Break

Session 5: Nanotechnologies

Chair: Frederic Courtade (CNES) - Laurent Pambaguian (ESA)

14:00 - 16:05

Coffee Break

Session 6: Optical Sensors & Actuators

Chair: Johan Leijtens (Lens Research & Development) - David Binns (ESA)

16:20 - 19:00

Conference Dinner

DAY 3 SCHEDULE

Session 7: AOCS

Chair: Remco Wiegerink (MESA+) - Roger Jansson (ESA)

08:50 - 10:30

Coffee Break

Session 8: Strategy & Roadmaps

Gregoire Bourban (SSC) - Eike Kircher (ESA)

10:55 - 13:00

Lunch Break

Session 9: Propulsion

Tobias Bandi (CSEM) - Mark Ford (ESA)

14:00 - 16:05

Coffee Break

Session 10: Packaging & Integration 2

Chair: Alexendre Val (3D-plus) - Kjetil Wormnes (ESA)

16:20 - 17:35

DAY 4 SCHEDULE

Session 11: MOEMS based Instruments & Missions

Chair: Bruno Rodrigues (Lusospace) - Luis Venancio (ESA)

08:50 -10:30

Coffee Break

Session 12: MNT in Space Projects

Chair: Georges Kotrotsios (CSEM) - Laurent Marchand (ESA)

10:55 – 12:35

Evening Dinner – ESTEC Restaurant

Marinated salmon, rillettes of salmon and a mousse of salmon

with a salad of cucumber and crème fraiche

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Pheasant breast stuffed caramelized apple and with duck confit

potato cake , sauerkraut and pancetta

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Grand Dessert of chocolate

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Vegetarian menu available

Logistics

- Presenters
  - Upload presentation material before each session
  - Biography forms online or at conference desk
    - (100 words max)
  - Presentation time 20 minutes maximum, 5 minutes for questions
  - Posters to be positioned on boards during lunch break

- Workshop bag
  - Proceedings booklet
  - Exhibitor material

- Lunch and coffee breaks
  - Coffee outside Newton in foyer
  - Lunch – self service, timing around 1300
    - (approx 1 hour duration)

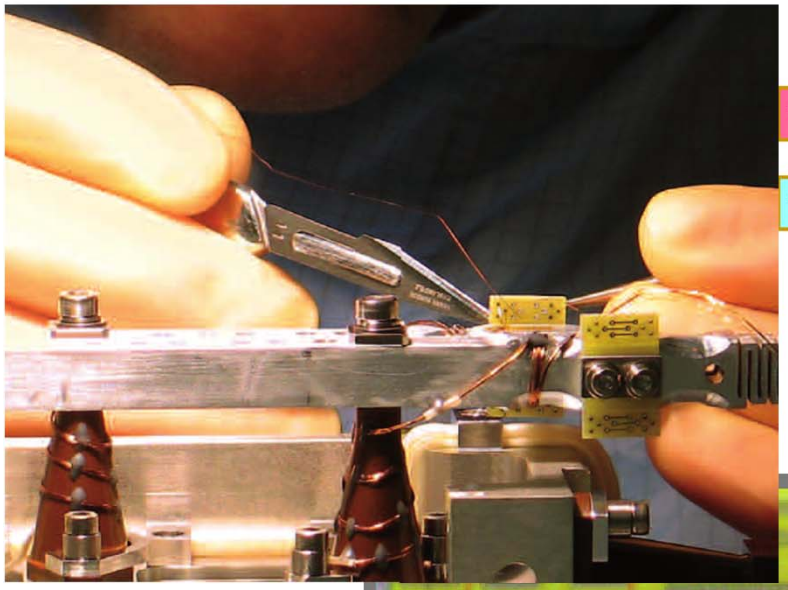
- Internet wireless access

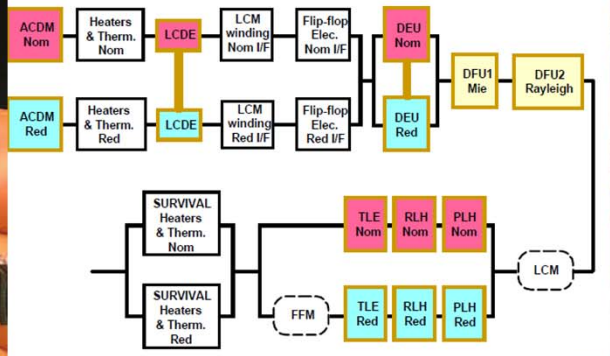
- Post workshop web access with presentations (restricted access)

Opening Introduction

- Wolfgang Veith: Head of TEC-Q
- Product Assurance & Safety Department

ESA PA&S – TEC-Q

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Heaters & Therm. Nom
LCDE
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Flip-flop Elec. Nom I/F
DEU Nom
ACDM Red
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DEU Red
DFU1 Mie
DFU2 Rayleigh
SURVIVAL Heaters & Therm. Nom
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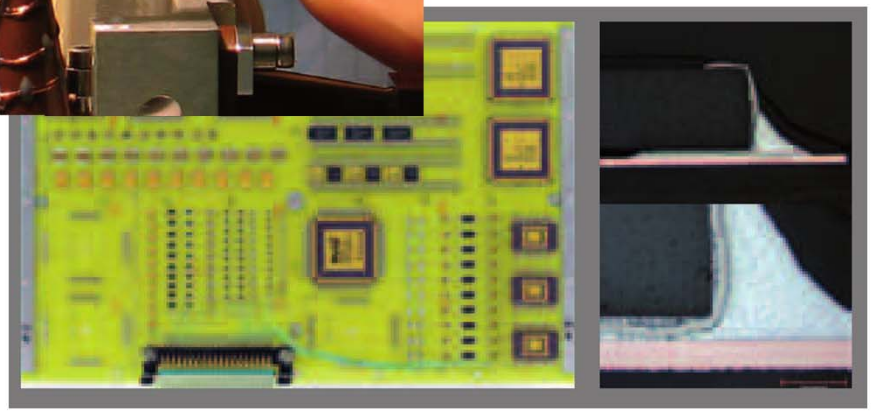
PLH Nom
FFM
TLE Red
RLH Red
PLH Red
LCM



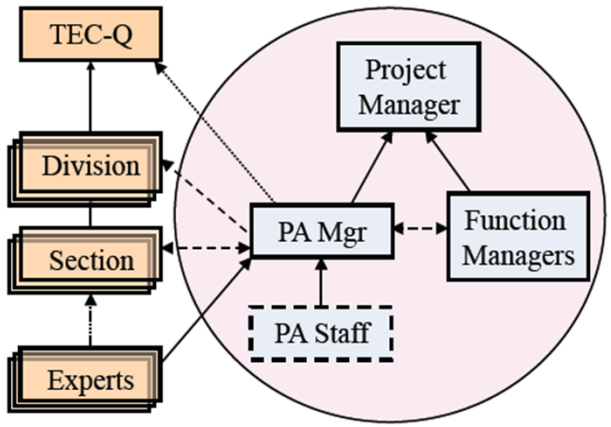
Main Activities

- Provision of PA-staff to projects (PA managers and PA engineers)
- Expert support in the areas of EEE-components, radiation, materials, cleanliness and contamination control, manufacturing/assembly (e.g. PCBs), supported by dedicated laboratories
- RAMS (dependability and safety)
- Software PA
- Standardisation (ECSS-system; ESCC-system for EEE-parts)
- Quality Management Systems, incl. preparatory activities for certification of the Directorate
- Independent Safety Assurance

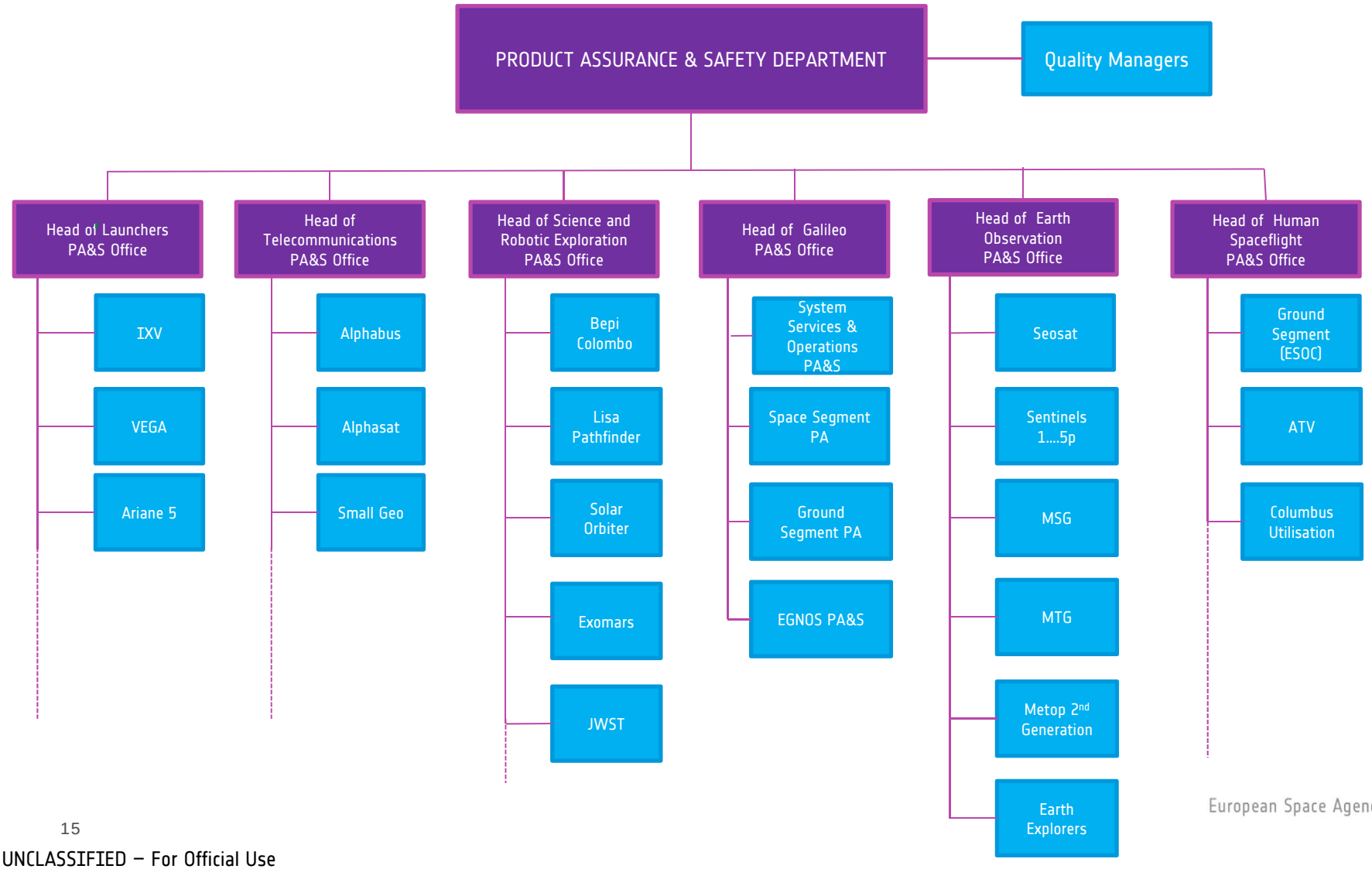
Provision of PA Staff to Projects

- Fundamental corporate core activity
- PA organisation has a significant level of independence
- About 35% of the TEC-Q Workforce is directly in projects !
- PA engineers

  RAMS engineers, Software PA engineers, Pl
  engineers, …
- PA managers

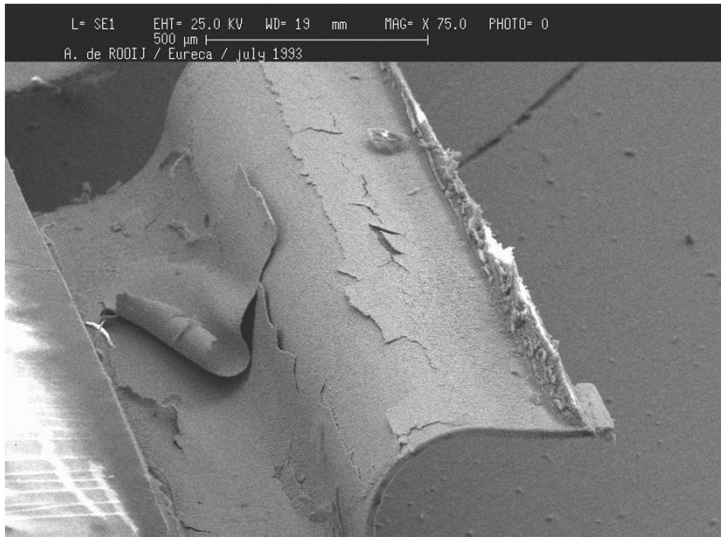


Organisation of PA Managers



Components,Materials, Processes & Mechanical Parts

- Management
  - Reporting, Approval, Documentation control
- Evaluation
  - Testing: Characterisation, Process Validation, Failure Analysis
- Selection
  - Criteria & Rules
- Procurement
  - Specification & Inspection
- Use
  - Criteria, Rules & Controls
- Contamination Control
- Electronic assembly
- Printed circuit boards (PCB)



REACH

- Environmental legislation is expected to have significant impact on running and future programmes
- ESA, together with European national space agencies and European industry is pursuing to get on “exemption” for the use of Hydrazine, since currently no feasible alternatives exist
- Nevertheless, likely prohibition of substances like Cr-VI, lead and many solvents and auxiliary materials is expected to have significant impact
- ESA-wide working group established in 2011. Report highlighted potential issues (in particular in the launchers-field) and recommended to establish a central “REACH-office”
- REACH-Office established in TEC-Q to support projects and harmonise contacts with partners and regulatory bodies.

Laboratories

- Test chambers (temperature, vacuum, radiation)
- Analytical tools (X-ray tomography, scanning electron microscopes, atomic force microscopes, gas chromatographs, mass spectrometers, …)
- Qualification of space materials, components and processes
- Failure analysis (destructive and non-destructive)
- Specific activities regarding lead-free components and assembly

ECSS Standardisation Activities

- Contribution to development of standards, regulated by ESA/ADMIN/CTEE(2007)1:
  - Establishes **ESSB** (ESA Standardisation Steering Board), top-level standardisation body
  - Supported by Management/Quality/Engineering Standardisation Boards (MSB, QSB, ESB)
  - ESSB publish the **LEAS** (List of ESA Approved Standards)
  - Adopt, as far as possible, common standards, mainly **ECSS**
  - ECSS is explicitly recognised by the ESA Council

- Application of standards in space projects, regulated by ESA/ADMIN/IPOL(2007)11:
  - Standards in the LEAS shall be applied by projects
  - Application/tailoring of the LEAS is the responsibility of project managers, and accepted by the Inspector General (for M&E standards) and TEC-Q (for Q standards)

- TEC-QR controls activities, supports the ESSB (and associated boards), and provides the ECSS secretariat

Certification and Accreditation Activities

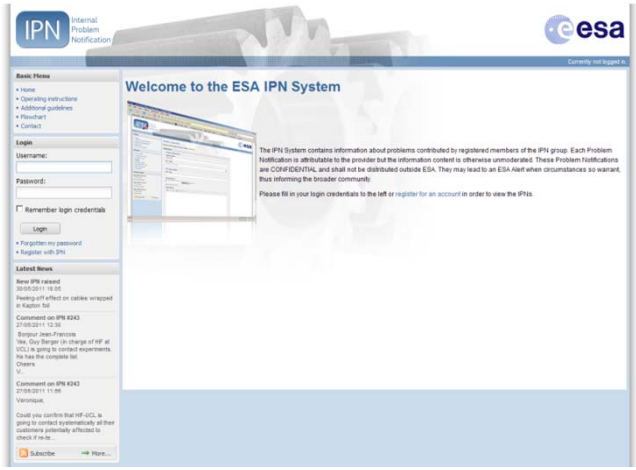
ISO 9001 Certification

- 3 ESA directorates are already certified (EOP, HSO, HFI)
- Work has also started in the Directorate for Technical and Quality Management under TEC-Q lead
- Potential budget-cuts my lead to a slow-down of this work
- Preparatory work for the certification of ESA has started (“IMS-project”)

EN 17025 Accreditation

- Part of the TEC-Q laboratories have achieved EN17025 accreditation in May 2011 (Radiation Effects Laboratory, Co-60 Facility)
- It is foreseen to extend the lab accreditation to other laboratory services, e.g. for materials and components testing, outgassing testing
- Work has started with the help of the National Physical Laboratory (NPL) in the UK
- Completion expected in mid-2013. Full accreditation still to be decided.

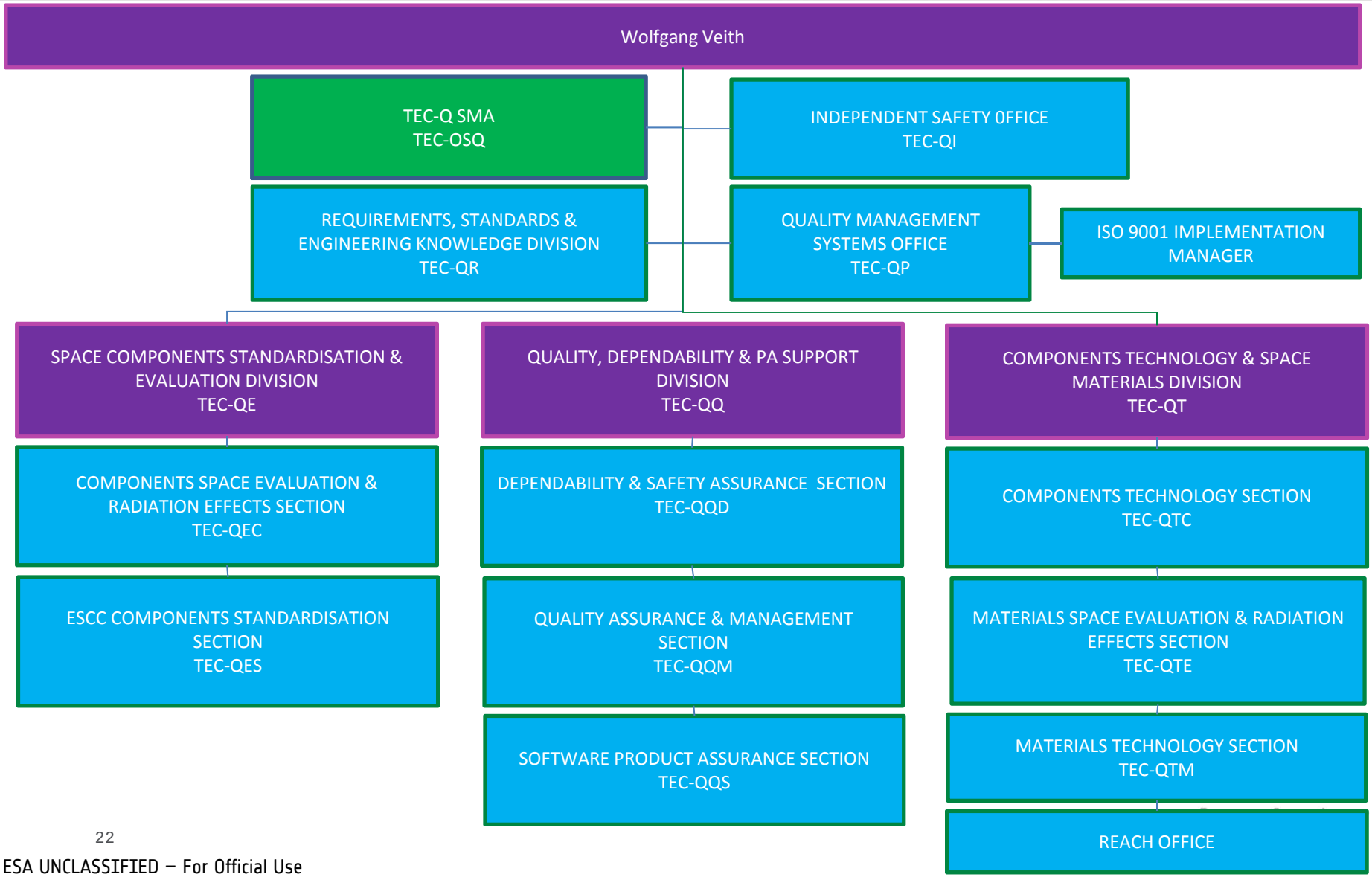
Tools



- ESA Alert System
- Internal Problem Notification
- NCTS (Non-Conformance Tracking System)
  used by an increasing number of ESA-projects
- ESCIES/ESCC (EEE-parts support)
- Materials, Outgassing, Parts Databases
- SharePoint
  universal information management tool
  supporting e.g. TEC-Q QMS, TEC-Q reporting system…
- RAMS software tools (available in TEC-QQD)
  - Reliability and Safety Analysis
  - Quantitative Risk Assessment
  - …

TEC-Q IT-support is being re-organized (hierarchically located in TEC-QP), to improve efficiency and exploit synergies

The Product assurance and Safety Department



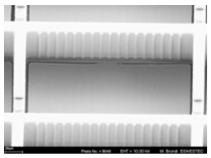
MNT main facts

- 4 ESA Projects now integrating MEMS on board
  - 2 Project Qualification Completed
  - 2 Project Qualification In Progress
- MNT smaller lighter but will fly only as mission enabler
- MNT now proposed as part of ECI-4
  - Main focuses: RF MEMS
  - MEMS reliability
  - Specific collaboration with Switzerland

Concrete cases:
MEMS Qualifications at ESA

ESA Project: JWST James Webb Space Telescope, NIR-Spec: Multi-image Near InfraRed Spectrometer

Reasons for MEMS: Capable of 100 images observations at one time, significant, improvement on the current technology capability (only one object at a time) & 171 X 365 shutters arrays,
4 arrays, all individually addressable and programmable => Extremely flexible
Status: MEMS Project qualification completed
Heritage for NGSC: MEMS bolometers

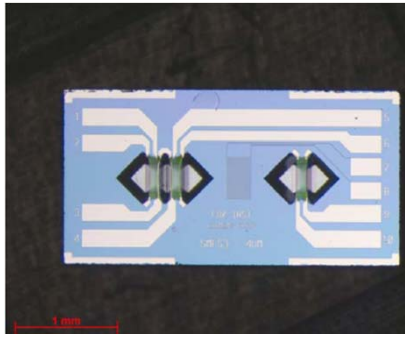


ESA Project: GAIA, Propulsion System

MEMS Flow Sensors because GAIA is the replacement for HIPARCOS spacecraft, n 1993: HIPARCOS Astrometric Accuracy was: 1-10 milliarcs, GAAI will be: 20 µarcs MEMS: Very accurate pointing required => order of µN thrust is mandatory, µN thrust only available with cold gas micro propulsion and need for very accurate (1 µN) and fast time response (10 Hz) flow sensor

Status: Project MEMS qualification completed

The flow sensor is an heritage from medical application



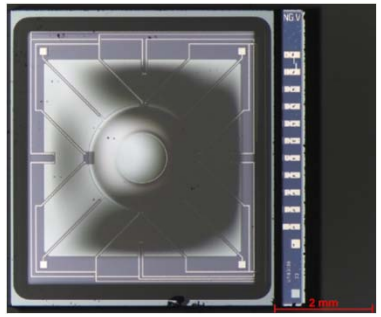
Concrete cases:
MEMS Qualifications at ESA

ESA Project: AEOLUS, laser O_2 cleaning system

MEMS Pressure Sensors because Very low pressure Range

Status, project qualification in progress

Heritage: MEMS pressure sensor for oil exploitation and gas sensing



ESA Project: Sentinel 3, AOCS (Attitude and Orbit Control System)

MEMS Rate Sensor, Reasons for MEMS: European Non Dependence
Status: MEMS Project qualification in progress
Heritage: automotive