COOLING:
IMMERSION



Fluids Technical Committee Update

Kris Fletcher *Analog Devices Inc*

Vanja Boyd *ExxonMobil*

JanElsa Carty *Shell*

Peter Cooper *Promersion*

Spencer Kerns *Chevron Philips Chemical*

Alex McManis *ENEOS*

Roma Suris *Independent*

Fluids Committee Workstreams

Fluid Cleaning Guidelines — 2nd Wednesday, 7:00-8:00am PT / 16:00-17:00 CET — ITE cleaning, cleaning methods

fluid stability against oxidation — 4th Wednesday, 8:00-9:00am PT / 17:00-18:00 CET — **Oxidation Methodology**

Fluid Lifecycle Management — 3rd Wednesday, 7:00-8:00am PT / 16:00-17:00 CET — removing fluid from service, LCA

fluid specifications, definitions — 1st & 4th Wednesday, 7:00-8:00am PT / 16:00-17:00 CET — **Fluid Specifications**

Fluid Cleaning Guidelines

Workstream leads

- JanElsa Carty, JanElsa.Carty@ocproject.net
- Roma Suris, Roma.Suris@ocproject.net

Meeting date / time

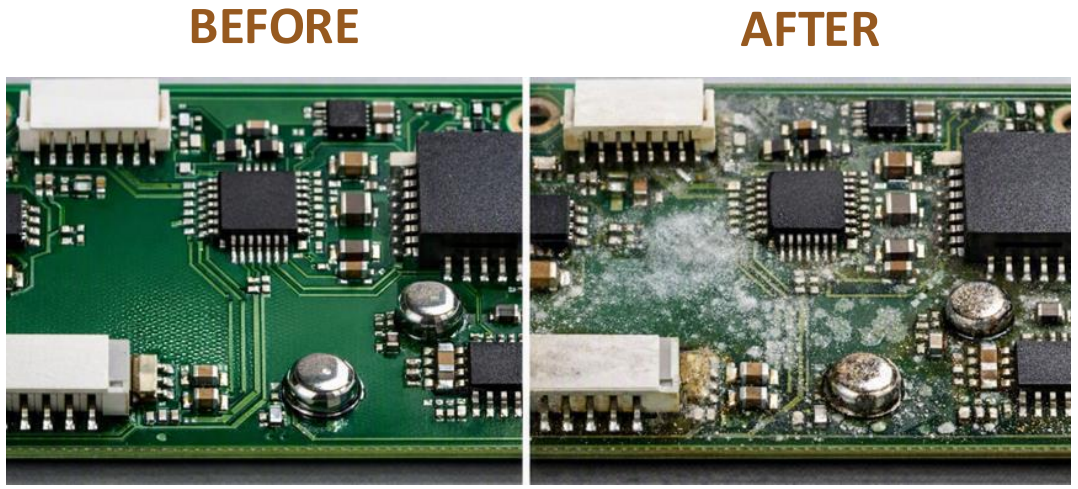
- 2nd Wednesday of the month
- 7:00-8:00am PT / 16:00-17:00 CET

Cleaning Guidelines

Cleaning Sensitive ITE – It's important to get it right!

Cleaning Solvent Chemistries

- Alcohol-based fluids
- Light hydrocarbon-based fluids
- Fluorinated liquids
- Chlorinated liquids



Risks of improper cleaning/drying can lead to residues that can cause metal leaching, corrosive solder flux

Cleaning Solvent Selection Criteria

- Proper cleaning solvent selection is essential to avoid ITE surface compatibility issues/catastrophic component damage.
- Cleaning fluid selection/fluid type needs to be compatible with IT equipment

Cleaning Fluid Hazards & Proposed Mitigation

Cleaning Solvent Type	Hazards
Alcohol-based	Absorb water Conductive Corrosive Volatile Flammability risk
Hydrocarbon-based	Relatively inert
Fluorinated liquids	Costly Potential environmental considerations/concerns
Chlorinated solvents	Toxicity concerns Environmental concerns Strict disposal regulations
Demineralized water **(not recommended!)**	No dielectric properties Evaporates slowly Leaves corrosive residues Ineffective on oil-based residues

Mitigation Measures

- Vendor SDS, technical & safe handling documentation should be visible and easily accessible
- Assure IT hardware and equipment compatibility
- Operators should wear proper personal protective equipment in line with the fluid SDS
- Spill response plan and spill recovery kits should be easily accessible
- Drying spaces should have ESD protection elements
- Follow required facility ventilation requirements

Summary: Cleaning Technologies

Manual Cleaning Techniques

- Spray
- Q-tip and Wipe
- Soak and Scrub
- Pressurized Solvent Spray



Vapor Degreasing Cleaning



Immersion Cleaning Methodologies

- Ultrasonic Cleaning
- Dipping Methodologies
- Spray Under Immersion
- Forced Flow Cleaning



Oxidation Methodology

Workstream leads

- Spencer Kerns, Spencer.Kerns@ocproject.net
- Vanja Boyd, Vanja.Boyd@ocproject.net

Meeting date / time

- 4th Wednesday of the month
- 8:00-9:00am PT / 17:00-18:00 CET

Oxidation

Oxidation Methodology Workstream Update

Whitepaper in the editing phase

White contents

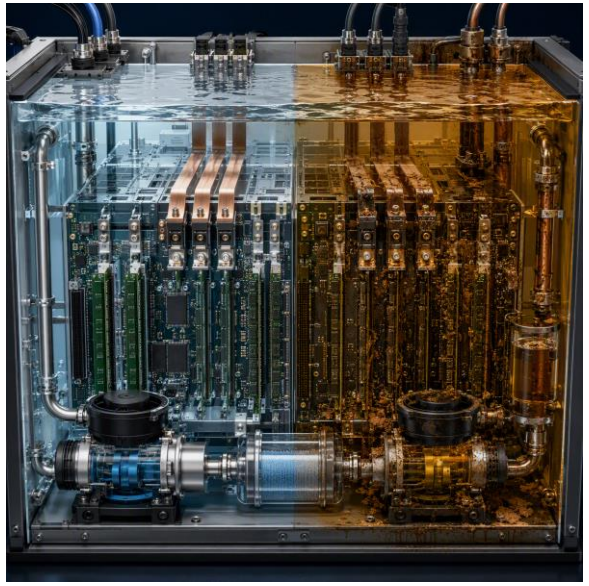
- Oxidation background
- Overview of industry standard oxidation methods
- Analytical methods to detect oxidation



Targeting community feedback in Q4/Q1 ‘27

Gap: Translating Fluid Oxidation to Hardware Risk

Oxidation testing outputs like Total Acid Number (TAN) and Dielectric Dissipation Factor (DDF) may correlate to fluid & hardware longevity



Oxidation is the initiating stressor

WHY TAN + DDF MATTER TO HARDWARE

TAN — Chemical attack

- Corrosion or tarnish of copper and other metals
- Potential seal, coating, and polymer degradation

DDF — Electrical loss

- More energy dissipated as heat
- Reduced dielectric margin and greater leakage-current concern
- High sensitivity to polar oxidation products, ions, and contamination

Call to Action: Share TAN and DDF data of aged fluids with the community!

Fluid Lifecycle Management Workstream

Workstream lead

- Alex McManis, Alex.McManis@ocproject.net

Meeting date / time

- 3rd Wednesday of the month
- 7:00-8:00 am PT / 16:00-17:00 CET

Lifecycle Guidelines

Fluid Lifecycle Management

COMPLETED

White Paper Ready for Community Review

Single- and Two-Phase Immersion Fluid: End-of-Life Options (v1.0)

- Monitoring and maintenance
- Recovery and reuse pathways
- Recycling guidance
- Responsible destruction options
- Technology-neutral framework

FLUID VALUE PRESENTATION HIERARCHY

MAINTAIN FLUID HEALTH

↓

RECOVER / RECLAIM

↓

RECYCLE

↓

DESTROY (LAST RESORT)

Preserve fluid value whenever technically, economically, and legally feasible.

NEXT

Fluid Circularity & Life Cycle Assessment (LCA)

- Carbon impact of virgin vs. reconditioned fluids
- End-of-life decision criteria
- On-site, regional, and centralized recovery models
- Fluid health metrics (Tan Delta, moisture, contamination)
- Standardized circularity methodology

Fluid Specifications

Workstream leads

- Kris Fletcher, Kris.Fletcher@ocproject.net
- Peter Cooper, Peter.Cooper@ocproject.net

Meeting date / time

- 1st & 4th Wednesdays of the month
- 7:00-8:00am PT / 16:00-17:00 CET

Specifications

Fluid Specifications

PUBLISHED TODAY

Immersion Requirements
Rev 2.1 • 2023

Section 4 — Foundational Document

Base Specification for Immersion Fluids

2022

2026 REVISION

BEING UPDATED

Immersion Requirements
Rev 3

WORK UNDERWAY

Base Specification for Immersion Fluids

BEGINS AFTER REV 3

Rev 3 Highlights: Immersion Fluids

01

Updated base fluid definitions

- New Section 4.1 defines four fluid families: hydrocarbons, esters, fluorochemicals, blends
- Hydrocarbon scope widened beyond synthetics: GTL/CTL, PAO, renewable and hydrotreated base oils
- Fluorochemicals now split by sub-class: PFC, PFPE, FK, HFE, HFO

02

Consistent temperature range for thermal properties

- Minimum of 4 data points
- Room temperature specified, ≤ 25 °C

Upper temperature limit

1P 70 °C

2P Boiling point − 10 °C

03

More accessible dielectric test methods

- High-frequency measurements achievable with widely available test methods
- VNA testing with resonator cavity or coaxial probe
- One test required between 20 GHz and 60 GHz; 20 / 40 / 60 GHz recommended to span PCIe Gen5/6 to 224G PAM4

What's Next

SECTION 4

finish minimum dielectric fluid requirements and quality management guidelines

SPECIFICATION

create specification(s) for single- and two-phase immersion fluids

fluids accepted on the OCP Marketplace today according to the Requirements Document v 2.1

many fluids in the pipeline to be accepted on the OCP Marketplace today according to the Requirements Document v 2.1

future fluids will be approved and listed on the OCP Marketplace according to Fluid Specifications specs

Better definitions. Faster qualification. A broader marketplace.

Call to Action!

- Get involved! Calling all fluid providers, tank manufacturers, analytical test houses, server / component ODMs, data center operators – weigh in and establish guidelines, standards of operation and specifications
- Join each io group to receive meeting invites, meeting summaries and email updates

Fluids Committee

Cleaning Guidelines

Oxidation

Lifecycle Management

Specifications