Reference:

M. Kurahashi, *JAXA Initiatives for PFAS Obsolescence on Japanese Space Supply Chain,* 6th ESA REACH Workshop, ESA ESTEC, Noordwijk, the Netherlands, 17th June 2025

Author affiliation:
Miki Kurahashi, Safety and Mission Assurance Department, Japanese Aerospace Exploration Agency (JAXA)

JAXA Initiatives for PFAS Obsolescence on Japanese Space Supply Chain

6th ESA REACH Workshop
June 17, 2025

Miki Kurahashi
Safety and Mission Assurance Dep.
Japan Aerospace Exploration Agency

Outline

1. Impact of PFAS Restriction on JAXA
   - ➢ On JAXA projects
   - ➢ On JAXA supply chain
2. JAXA Initiatives for PFAS issues
3. Impact of Restriction of Other Substances
4. Future Plans

1. Impact of PFAS Restriction on JAXA

Impacts of PFAS restriction:

- On JAXA projects
  - Spacecraft, launchers, satellites

- On JAXA supply chain
  - Survey to JAXA qualified manufacturers and users in the Japanese space sector

1. Impact of PFAS Restriction on JAXA

Impacts of PFAS restriction on JAXA projects

➢ PFAS use cases in launchers and spacecraft

Parts	Brand	PFAS material
Cable	-	PTFE
	-	ETFE
	-	TFE
	-	PFA
Terminals	-	PTFE
Packing/sealing	-	Kynar（homopolymer and copolymer of VDF; vinylidene fluoride produced by ARKEMA)
	-	PTFE/FEP
Tubes	-	PTFE
	-	Kynar
	-	FEP（Copolymer of TFE and HFP）
	-	Teflon
Cooling medium	FC-72	-
	NOVEC 7200	-
Insulator	beta cross	-
	-	Silver Teflon

1. Impact of PFAS Restriction on JAXA

Study of PFAS impacts on JAXA projects

Spacecraft using cooling fluid

- There are very limited number of satellites using PFAS as cooling fluid.

Outboard	Developer	Cooling fluid
Satellites, heat pipe	JAXA	Ammonia
Astro-E	JAXA	Solid neon
		Liquid helium
ISS	JAXA	FC-72

3M's discontinued product

1. Impact of PFAS Restriction on JAXA

Impacts of PFAS restriction on JAXA supply chain

- May 2024: JAXA conducted a survey on the impact of PFAS restrictions and PFAS depletion issues on JAXA qualified components manufacturers and components users.
- October 2024: JAXA held the first PFAS workshop to share the survey results with the component manufacturers and users.
  - Over 80 attendees from Japanese space sector

    ❖ JAXA qualified cable company uses PFAS in its major products and if restricted the company's existence is in stake.

    ❖ Some JAXA qualified components require Gross leak test (per MIL-STD-883) and there are concerns about depletion of PFAS fluid used for the leak test.

2. JAXA Initiatives for PFAS Issues

Alternative for 3M Fluorinert

■ JAXA investigated the alternatives for 3M Fluorinert™

Manufacturer	Brand
3M Japan	Fluorinert, NOVEC
Daikin	DAISAVE
Solvex	SOLBLE
Solvay Specialty Polymers	Galden
Best Technology, Inc.	BestSolv Zeta
Best Technology, Inc.	BestSolv 3283
F2 Chemicals, Ltd.	Flutec
TMC Industries, Inc.	TMC
Eastman Chemical Company	Therminol
Aculon.Inc	NanoProof
Nantong A.D Dawning Material	AD
Fluorez Technology	FL

■ JAXA studied the products with the characteristics similar to the 3M Fluorinert™

■ Specific boiling point, viscosity, density, surface tension, etc. were evaluated.

■ It is hard to find alternatives…

2. JAXA Initiatives for PFAS Issues

	FY2024 Apr - Jun	FY2024 Jul - Sep	FY2024 Oct - Dec	FY2024 Jan - Mar	FY2025	FY2026
Roadmap		Impact study		Planning for FY2025	Examine eval. items& eval. method	Evaluation
		Examine issues to be addressed				
Impact study on Space industries from REACH,PFAS regulation		▲Survey on PFAS effect on Parts mfts.(2024/5/24) Questionnaire survey				
		▲ Survey on PFAS effect on space users(6/19) Questionnaire survey				
		Collect and analyze survey				
PFAS Workshop				▲#1 PFAS workshop (share the results of questionnaires and discuss the issues to be addressed)	△#2 PFAS workshop (issues to be addressed and plan for FY2025 (2025/August)	
Other activities			Interviewing subject matter expert (Univ. Prof., parts mfts, distributors, PFAS mfts. etc.)			
				Study on possible substances replacing Fluorinert/Novec, domestic/overseas technology trend, PFAS used materials		

3. Impact of Restriction of Other Substances

Lead-free transition and impact on JAXA

The transition to lead-free solder began in the 2000s due to environmental concerns and industry trends. Lead-free components, primarily with Sn-based and Au-based finishes, are now widely adopted, but challenges like tin whisker growth and reliability persist.

- Established JERG-0-064 “Lead Free Parts application Standard for Space Equipments and Systems” in April 2024:

  - ✓ Requirements for use of lead-free components in space equipment in general, including launching vehicle and avionics equipment, satellites and probes.
  - ✓ It aims to ensure the quality and reliability of electronic systems in space environments, addressing challenges such as tin whisker growth and mixed assembly risks.
  - ✓ Currently only Japanese version is available
  - ✓ https://sma.jaxa.jp/TechDoc/Docs/JAXA-JERG-0-064.pdf

- In Japan, there is no regulation to limit use of Lead metal.

4. FY2025 Future plans

JAXA's plan to address PFAS issues

(1) Further study on the alternative materials

- Alternative materials to Fluorinert/Novec

(2) Hold the 2nd PFAS Workshop in August

- Participants from Japanese space sector

(3) Coordinate with ESA and NASA

- Continue to exchange information and possibly have regular meetings among ESA/NASA/JAXA for coordination.

JAXA's plan to address Lead-free transition

(1) Monitor lead-free transition in Europe

- If lead is totally banned in Europe, there will be much more impacts on Japanese space sector.