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SESSION:

RADIATION SHIELDING MATERIALS AND OTHER MATERIALS RELATED TOPICS ON COTS

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Talk:

Initiative for PFAS Issues

JAXA Initiatives for PFAS Issues

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JAXA
Explore to Realize

1. What are PFAS issues?

What is PFAS?

Per- and polyfluoroalkyl substances and sometimes referred to as "forever chemicals“, which resist grease, oil, water, and heat. They are now in hundreds of products including stain- and water-resistant fabrics and carpeting, cleaning products, paints, some cookware, and food packaging. They are found in contaminated soils, fish, and wildlife, and which are then eaten by humans. Some PFAS are detected in human blood and drinking water in the contaminated area.

Impacts of PFAS restriction

- On JAXA projects
- On JAXA supply chain

2. Study of PFAS impacts on JAXA projects and supply chain

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

2. Study of PFAS impacts on JAXA projects and supply chain

Spacecraft using cooling fluid

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

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

2. Study of PFAS impacts on JAXA projects and supply chain

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.

3. Gross Leak Test with Perfluorocarbon

Alternative for 3M Fluorinert

■ JAXA investigated the alternatives for 3M Fluorinert™

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

3. Gross Leak Test with Perfluorocarbon

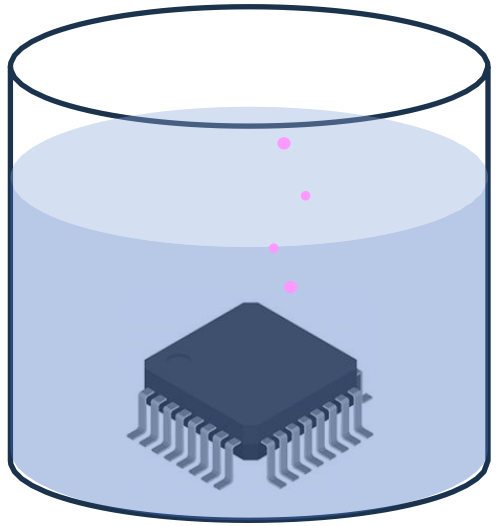
Gross leak (test condition C with Perfluorocarbon)

- Place the device into Type I detector fluid with low boiling point and pressurize the chamber for a certain period of time.
- Remove the device from the detector fluid and place it into Type II indicator fluid with high boiling point at 125 degrees C.
- Observe the bubbles for 30 seconds.

TABLE II. Physical property requirements of perfluorocarbon fluids. 1/

Property	Type I	Type II	Type III	ASTM test method
Boiling point (°C)	50-95	140-200	50-110	D-1120
Surface tension (Dynes/cm) at 25°C		< 20		D-971 D-1331
Density at 25°C (gm/ml)	> 1.6	> 1.6	> 1.6	
Density at 125°C (gm/ml)		> 1.5		
Dielectric strength (volts/mil)	> 300	> 300	> 300	877
Residue (µgm/gm)	< 50	< 50	< 50	D-2109
Appearance	Clear colorless			NA

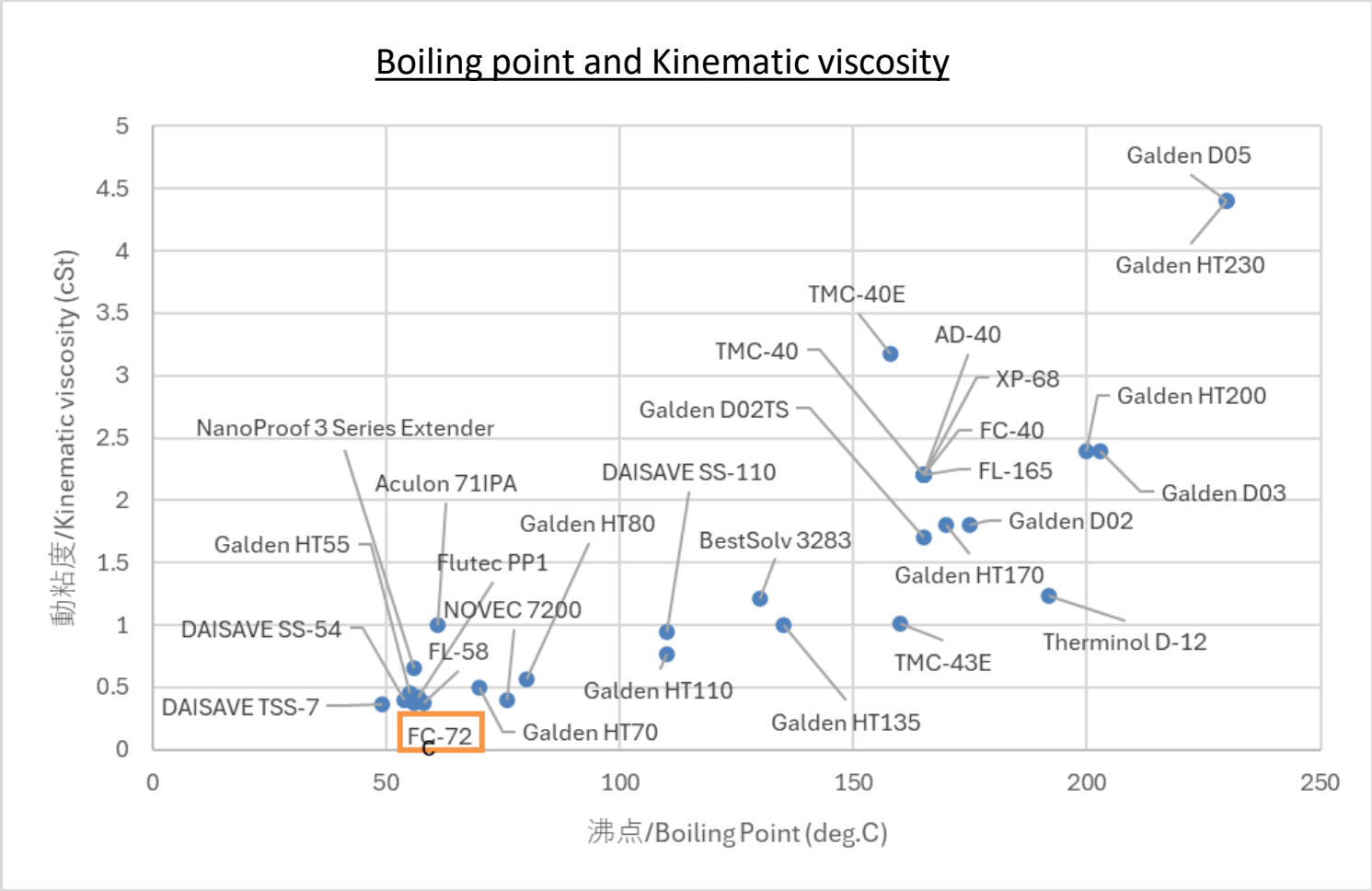
1/ Perfluorocarbons contain no chlorine or hydrogen except in its decomposition stage.



2. Gross Leak Test with Perfluorocarbon

Study on alternative chemicals

- Type I: FC-72, Type II: FC-40
- Type I has low kinematic viscosity.

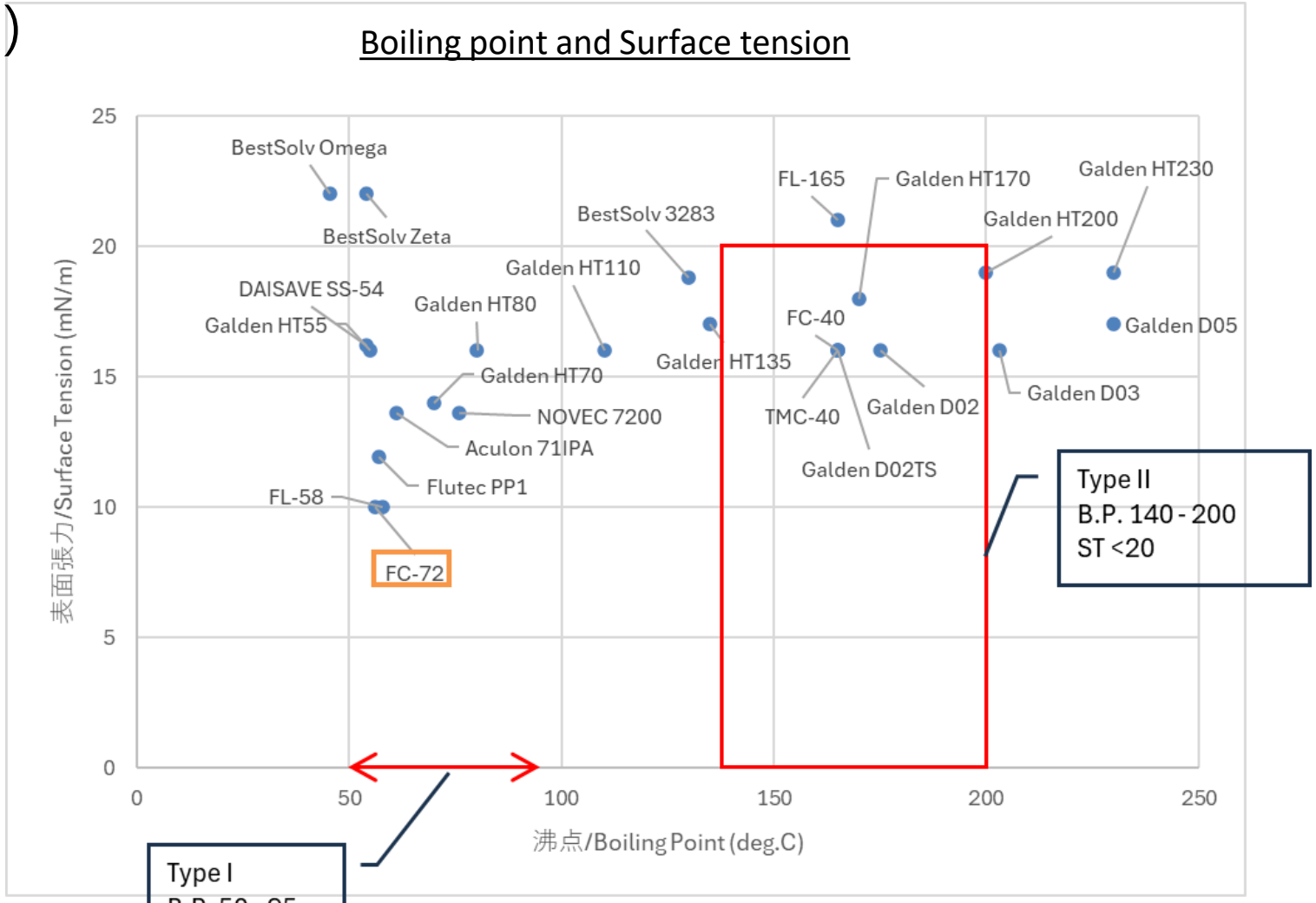


3. Gross Leak Test with Perfluorocarbon

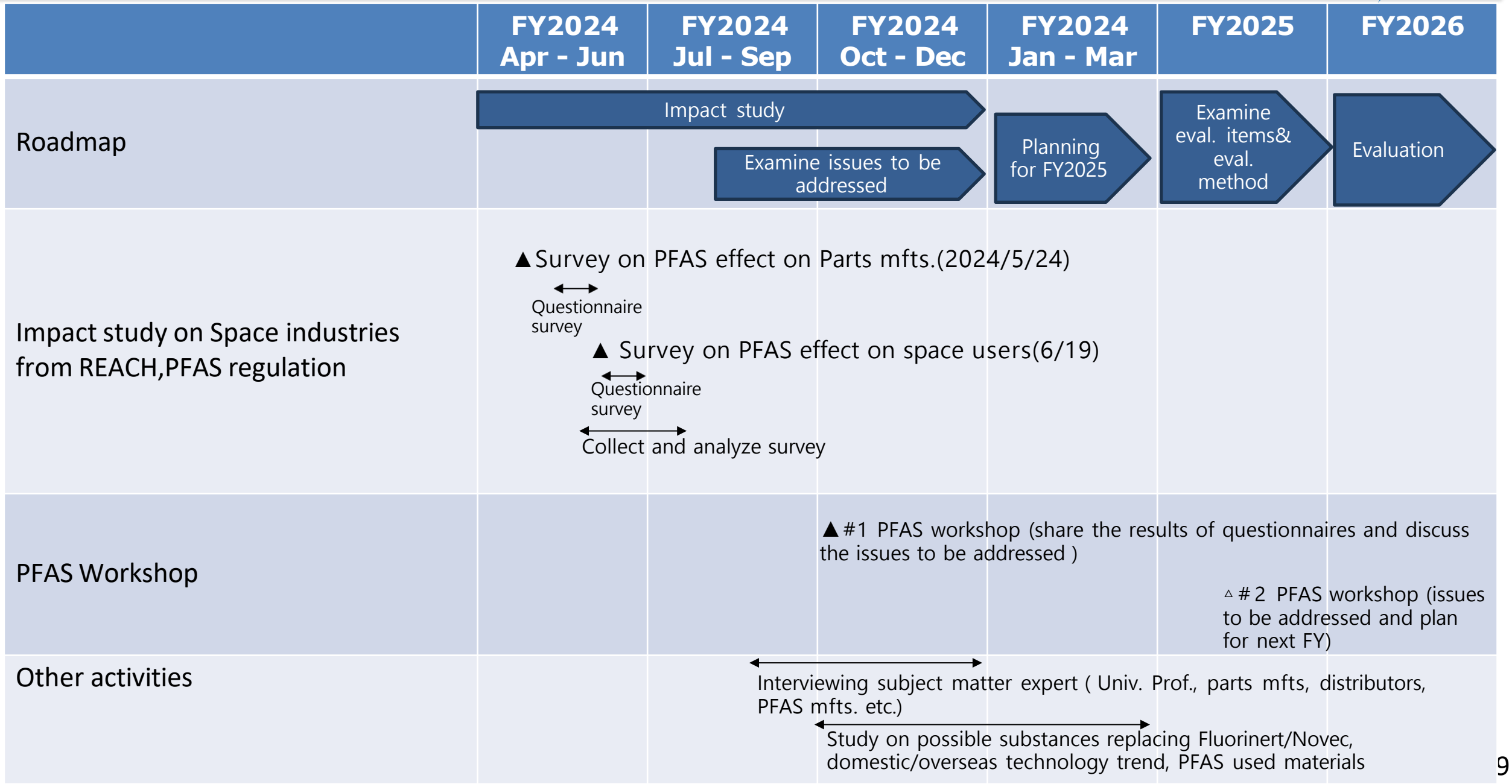
Study on alternative chemicals

- Type I: FL-58 (Fluorez Technology) and Type II: TMC-40 (TMC Industries)、Galden D02TS（ Solvay ）

Boiling point and Surface tension



4. PFAS Impact and JAXA Initiatives



5. Future plans

FY2025 JAXA's plan to address PFAS issues

(1) Further study on the alternative materials
- Alternative materials to Fluorinert/Novec
- Alternative cooling medium other than Fluorinert/Novec
- Evaluation of newly developed material by a Japanese manufacturer.

(2) Study on application using alternative materials
- Study on the methods necessary for the use of alternative materials.

(3) Study on new test method replacing gross leak test.
- Study on the possibly new or already existing test method which can replace the gross leak test with perfluorocarbon.

(4) Coordinate with ESA and NASA
- Continue to exchange information and possibly have regular meetings among ESA/NASA/JAXA for coordination.

Thank you for your attention!

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