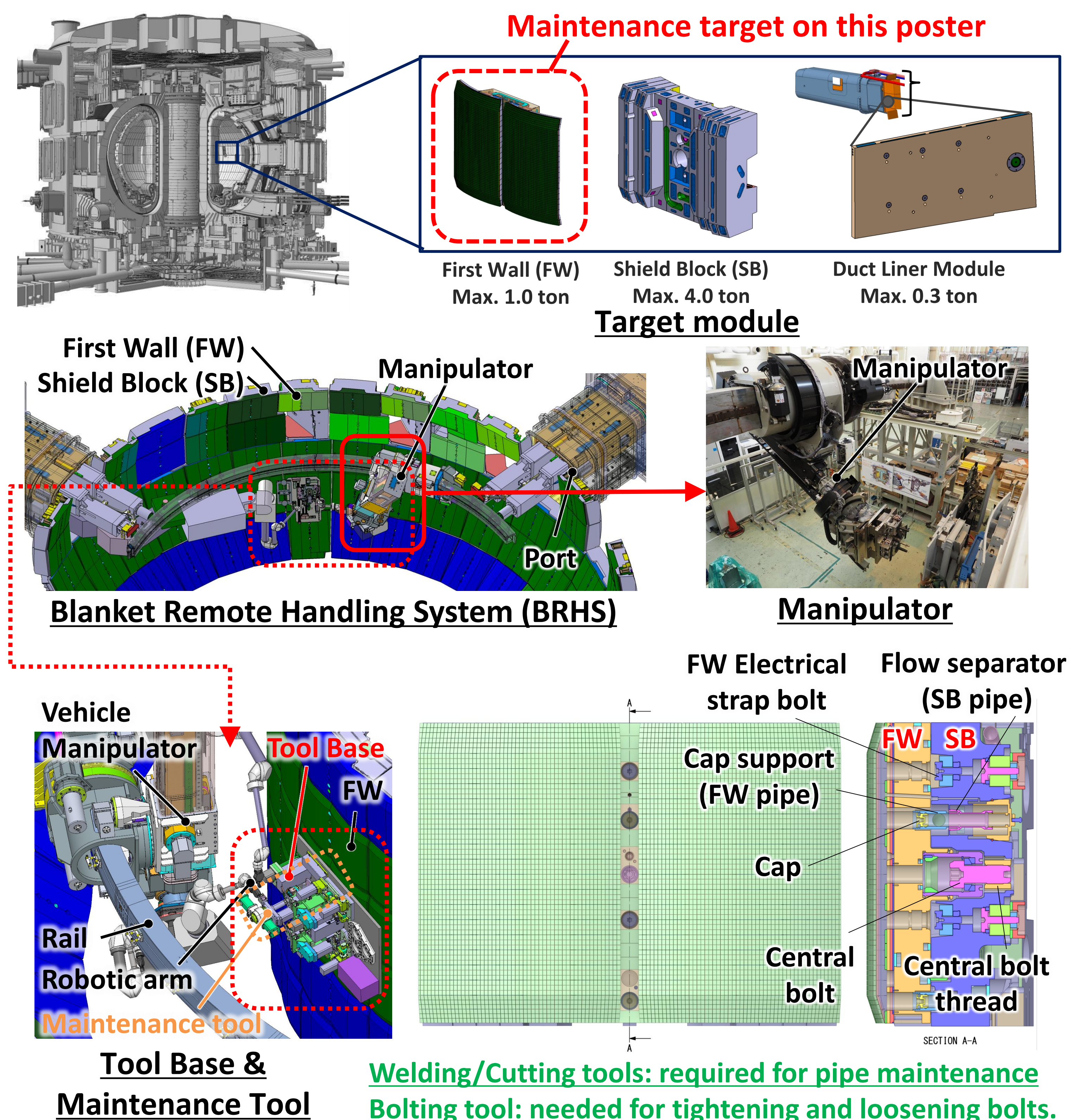


Conclusion

- Completed the preliminary design of the Tool Base, Cutting Tool, Welding Tool and Bolting Tool for the First Wall maintenance.
- Demonstrated the feasibility of the Gripping Finger element through two types of the tests.
- Clarified the cutting condition for ≤ 0.3 mm the pipe deformation with the Cutting Tool.
- Confirmed the feasibility of full circumferential welding using the pipe sample cut with the Cutting Tool.
- Demonstrated that the Bolting Tool was capable of absorbing assumed misalignments and applying a high torque of 8.4 kNm.

Overview

Overview of ITER Blanket RH System and First Wall Tools

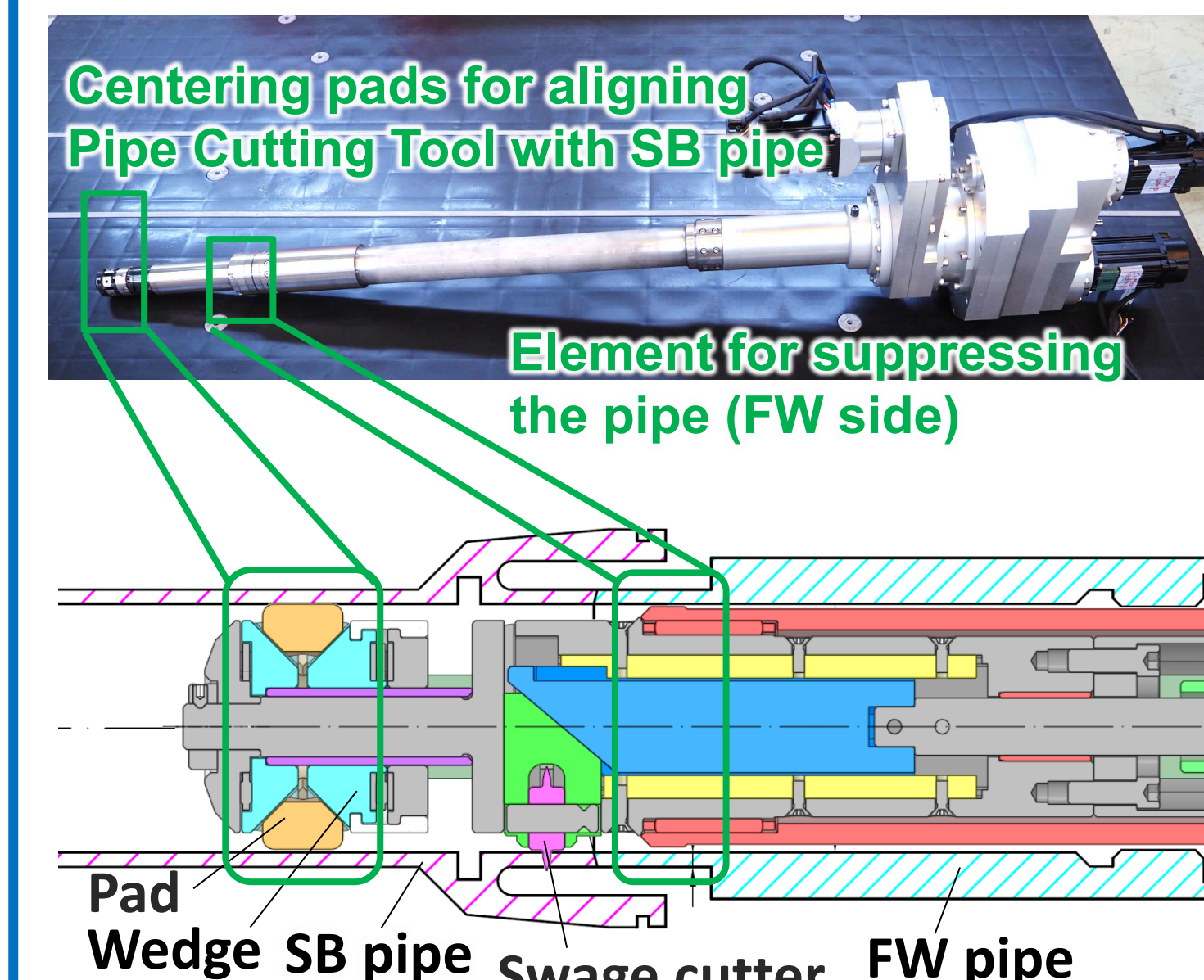


Development results of Maintenance Tools

Cutting Tool

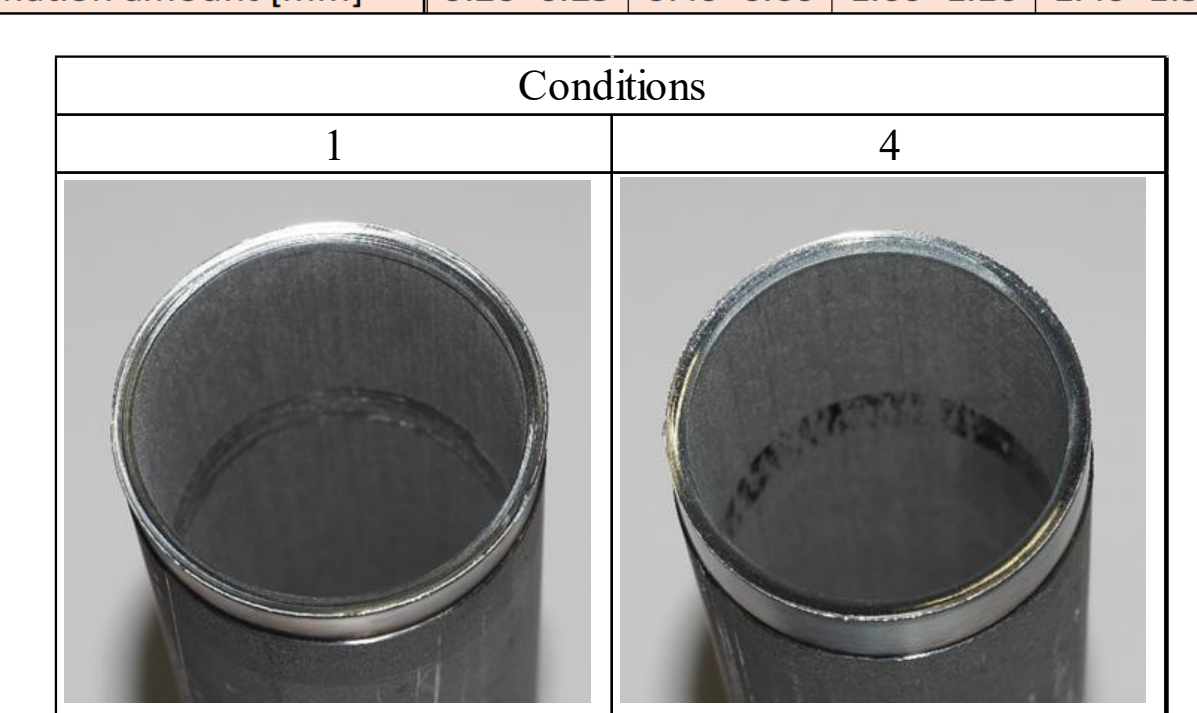
Challenge: Pursuit of a centering mechanism for the target maintenance piping and cutting conditions to minimize pipe deformation during cutting.

- ✓ Achievement of tool centering but occurrence of cutter co-rotation during cutting.
- ✓ Clarification of the cutting condition for ≤ 0.3 mm the pipe deformation.



Cutting conditions and results

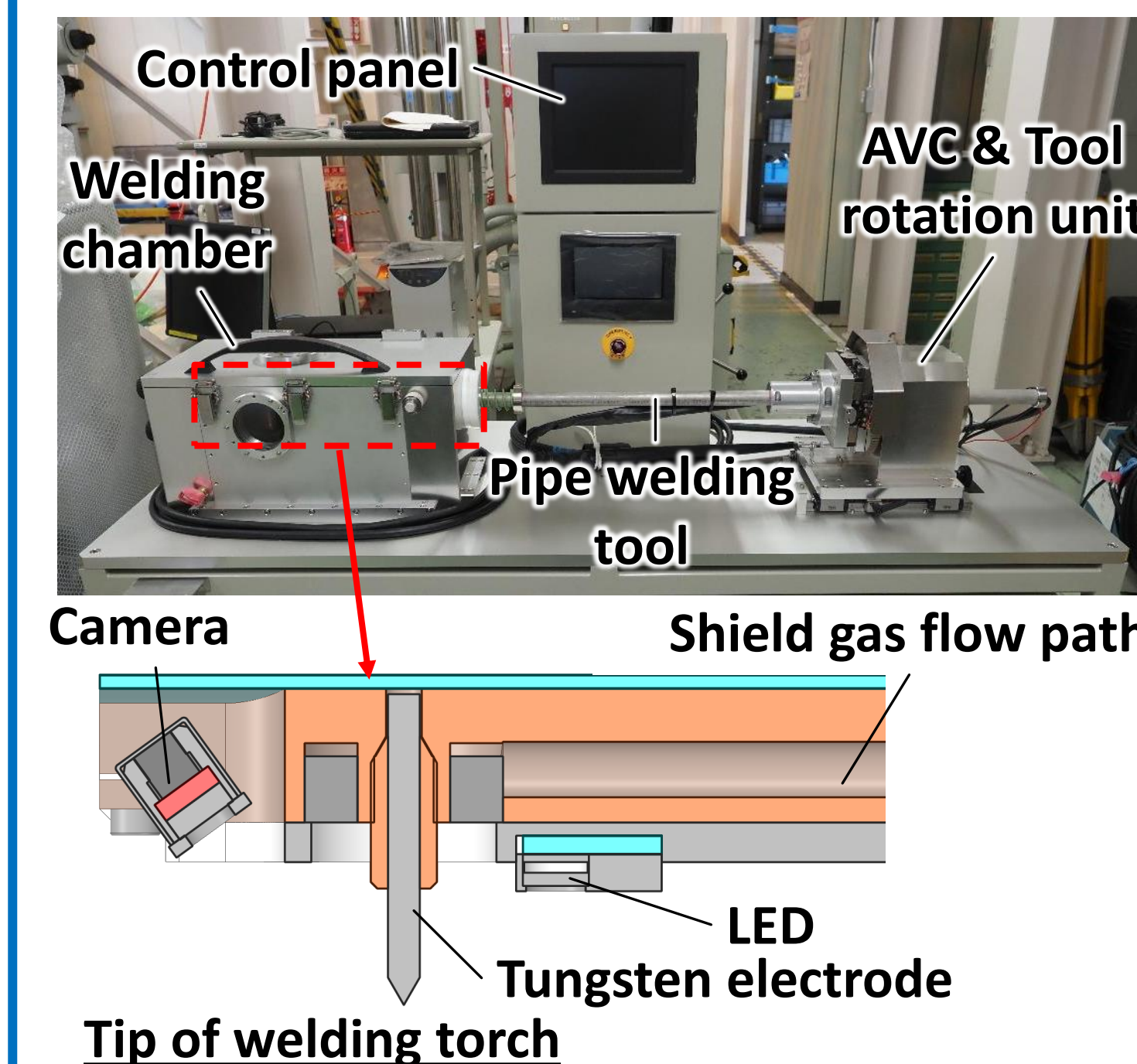
Cutting Conditions	1	2	3	4
Cutter Feed rate [mm/s]	0.004	0.01	0.02	0.04
Cutter Rotation speed [rpm]	5	5	5	5
Cutting Results				
Deformation amount [mm]	0.20~0.25	0.40~0.60	1.00~1.10	1.40~1.55



Welding Tool

Challenge: Clarification of the impact of pipe bevel deformation cut with the Cutting Tool on welding quality.

- ✓ Full circumferential weldability were verified.



Welding conditions

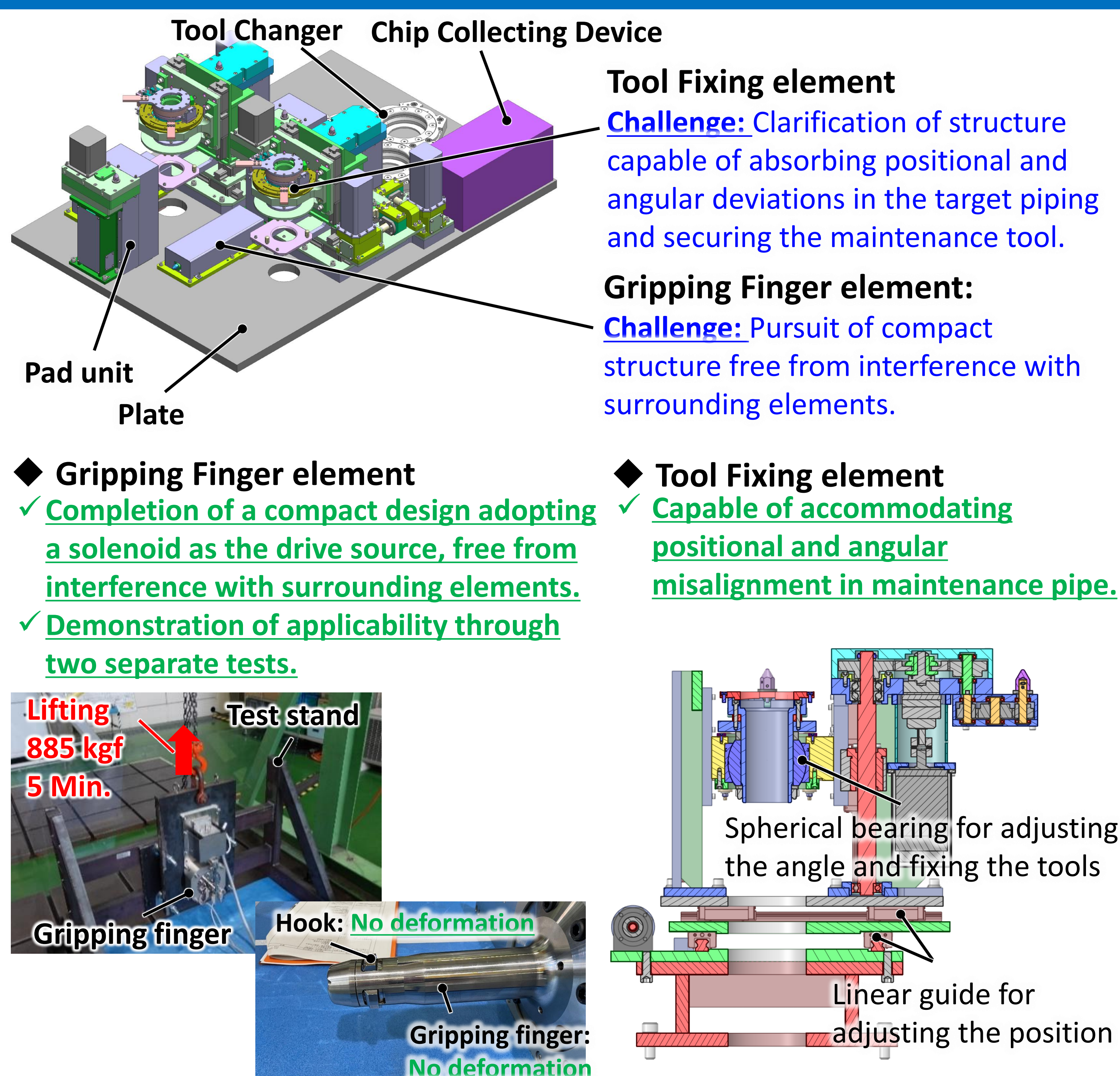
Item	Specification
Welding posture	Horizontal
Operation current and voltage	See the Table 4
Shield gas	Ar 50% + He 50%
O ₂ concentration at inside of pipe sample	Less than 100 ppm
O ₂ concentration at outside of pipe sample	Less than 100 ppm
Misalignment of pipes groove	Less than 0.05 mm

Welding results

Position	180 deg (Near the welding start and end point)	Cutter blade feeding speed [mm/s]			
		0.004	0.01	0.02	0.04
270 deg					

Development results of Maintenance Tools

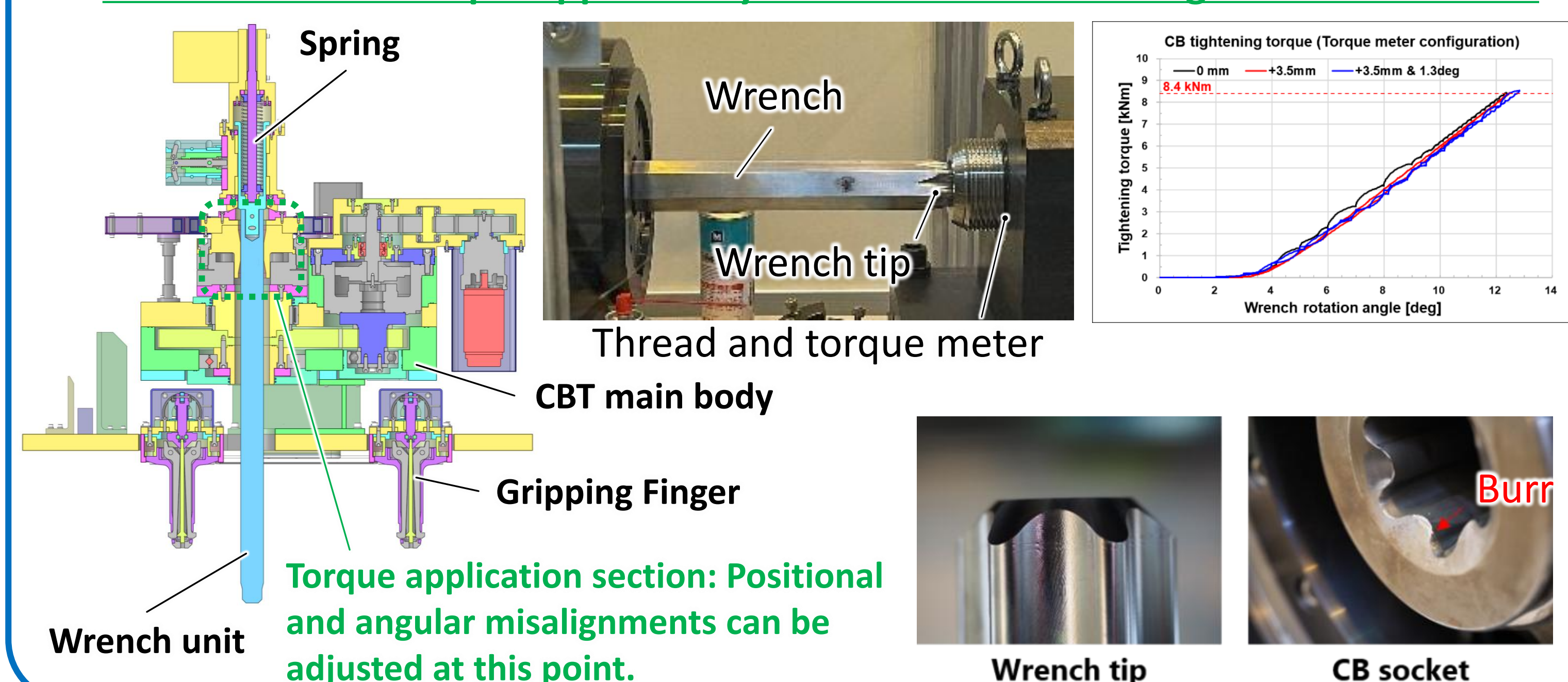
Tool Base



Bolting Tool

Challenge: Pursuit of a structure capable of absorbing the assumed misalignment (3.5 mm & 1.3 deg.) on the blanket side and applying a high torque of 8.4 kNm.

- ✓ Confirmation of torque applicability under maximum misalignment conditions.



Future plan

- ◆ **Tool Base:** Will prototype the tool fixing element and evaluate its effectiveness.
- ◆ **Cutting Tool:** Will proceed with design modifications to prevent rotation of the centering element during cutting.
- ◆ **Welding Tool:** Will continue to investigate welding conditions that enable full penetration.
- ◆ **Bolting Tool:** Will proceed with the detailed design.
- ◆ **Handling/Combination test:** Will conduct handling tests to install the Tool Base/Bolting Tool onto the manipulator and place it on the FW, and integrated tests with the Cutting/Welding Tool mounted on the Tool Base.