



# Automatic Cleaning Machine for RF Power Couplers

## "Automate de Lavage Intégré pour Coupleurs Electromagnétiques"



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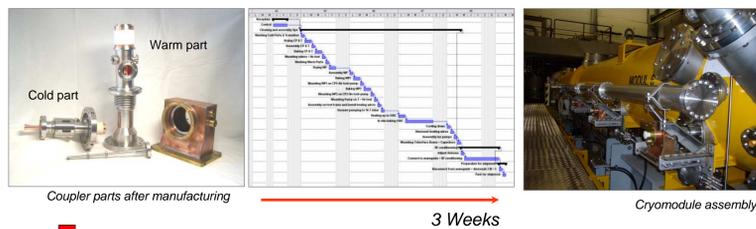
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### I. Introduction



Couplers are technological devices that permit RF power matching between RF source and cavities.

High cleaning quality requirement especially for the coupler cold part directly linked to the cavity.



The weak points of the actual cleaning procedure:

- ✓ Contamination risks due to the handling
- ✓ No repeatability
- ✓ Too long time duration: 5 days

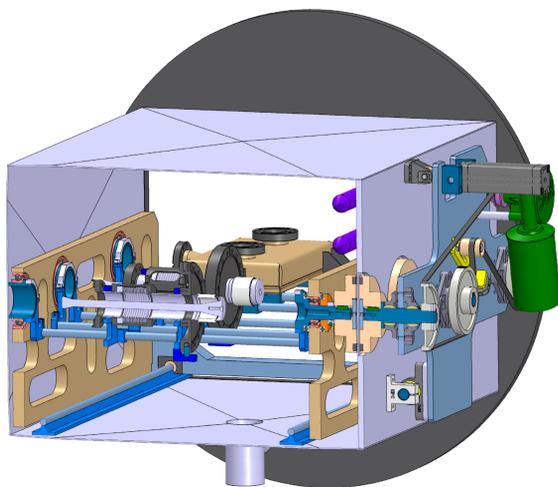
**Solution: a cleaning procedure automation**

The automatic cleaning system:

- ✓ No handling
- ✓ Full repeatability and control of each parameters
- ✓ Shorter time duration: 3 hours

### II. Cleaning system description

The cleaning system allows 2 cold parts and 1 test wave box cleaning in the same time

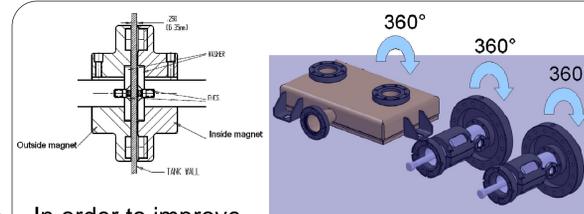


A cleaning cycle include the following steps:

- Ultrasonic cleaning with hot UPW & detergent
- Rinsing and resistivity measurement
- Drying with filtered N2 and humidity measurement

Main advantages:

- Steps sequence are fully automatic (no operator intervention, no timeout)
- All the parts are loaded from outside and recuperated in the ISO4 clean room.



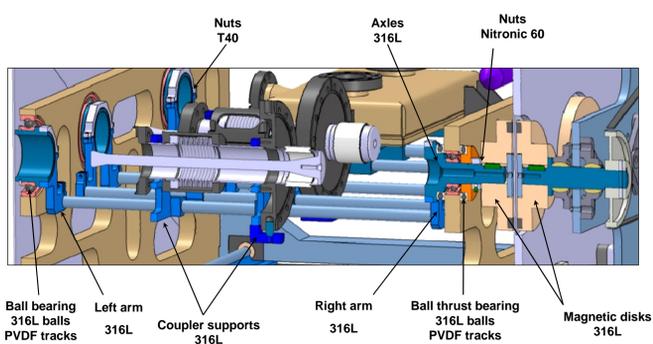
In order to improve the rinsing, all the parts are driven in rotation. Movement transmission into the inside, is performed by magnets to avoid exchanges between outside and inside system.

These movements may induce some mechanical frictions that could generate particles.

**The main challenge is to choose the right materials and to limit the contacts between the parts (ball bearing) to avoid system contamination.**

### III. Test for validation

Rotary holder system inside the cleaning chamber



In order to limit the mechanical frictions during rotary holder motion, ball bearing and thrust bearing are used.

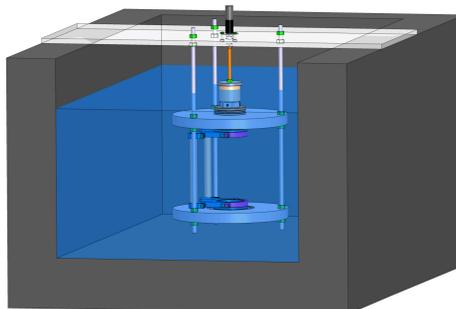
A control of particles bath contamination is assured by particles tests counting before and after a cleaning cycle.

A mechanical test bench was designed for this purpose.

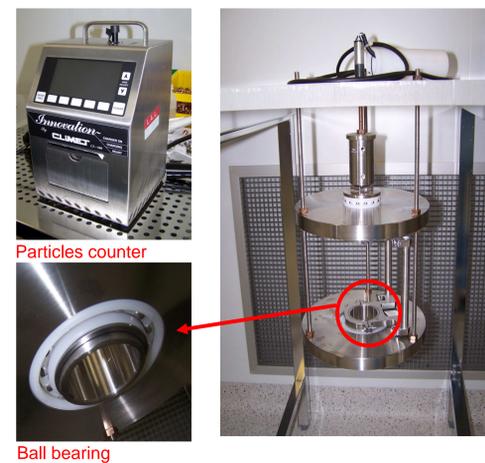
Test conditions:

- Ultrasonic bath → 2000 W 40 MHz
- Water → UPW 18MΩ.cm<sup>2</sup> at 50°C
- Detergent → 5% Tickopur R33
- Time duration → 3 hours

Test bench in ultrasonic bath



Test bench in ISO 4 clean room



Acceptance criterion for coupler cold part : <10 particles of 0.5µm per foot<sup>3</sup> during 1min

4 tests before

ID	0,3	0,5	1,0	5,0	10,0	25,0	HR	TEMP	DBIT
14:16:40	0	0	0	0	0	0	32,0	20,6	0,99
COMPT. TOTAL	VOL. ECHANGE: 1,0 P3								
ID	0,3	0,5	1,0	5,0	10,0	25,0	HR	TEMP	DBIT
14:19:00	6	2	1	1	0	0	32,4	20,6	0,99
COMPT. TOTAL	VOL. ECHANGE: 1,0 P3								
ID	0,3	0,5	1,0	5,0	10,0	25,0	HR	TEMP	DBIT
14:21:11	6	2	1	1	0	0	32,0	20,8	0,99
COMPT. TOTAL	VOL. ECHANGE: 1,0 P3								
ID	0,3	0,5	1,0	5,0	10,0	25,0	HR	TEMP	DBIT
14:23:20	5	2	1	1	0	0	31,6	21,0	0,99
COMPT. TOTAL	VOL. ECHANGE: 1,0 P3								

4 tests after

ID	0,3	0,5	1,0	5,0	10,0	25,0	HR	TEMP	DBIT
14:24:41	1	1	0	0	0	0	32,0	21,4	0,99
COMPT. TOTAL	VOL. ECHANGE: 1,0 P3								
ID	0,3	0,5	1,0	5,0	10,0	25,0	HR	TEMP	DBIT
14:26:51	4	1	1	0	0	0	31,6	21,4	0,99
COMPT. TOTAL	VOL. ECHANGE: 1,0 P3								
ID	0,3	0,5	1,0	5,0	10,0	25,0	HR	TEMP	DBIT
14:41:03	12	3	1	0	0	0	30,8	21,7	0,99
COMPT. TOTAL	VOL. ECHANGE: 1,0 P3								
ID	0,3	0,5	1,0	5,0	10,0	25,0	HR	TEMP	DBIT
14:46:17	0	0	0	0	0	0	30,4	21,7	0,99
COMPT. TOTAL	VOL. ECHANGE: 1,0 P3								

Tests results satisfy the acceptance conditions, both before and after the cleaning cycle.

### IV. Conclusions and outlooks

The Automatic Cleaning Machine will permit the preparation steps improvement and the decrease of their time duration. First tests shown that despite the mechanical frictions on the rotary holder support, the amount of generated particles still below to the acceptance value (<10 particles of 0.5µm per foot<sup>3</sup> during 1min). The Machine keep the possibility to include afterward a HPR system (High Pressure Rinsing), a water particles counting online and for 1,3 GHz coupler (type TTF3, XFEL) the warm parts and push rod cleaning. The principal of this automatic machine will be of particular interest for big scale coupler preparation: ILC >16 000 couplers !!

