# Cryomodule assembly procedure for cERL main linac

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# TTC topical meeting on SRF cryomodule clean room assembly

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# Compact ERL(cERL) project

Demonstrate the technologies needed for future multi-GeV class ERL, and show its beam performances

#### Parameters of the Compact ERL

	Parameters
Beam energy	<mark>35</mark> - 200 MeV
Injection energy	5 MeV
Average current	<mark>10</mark> - 100 mA
Acc. gradient (main linac)	15 MV/m
Normalized emittance	0.1 - <mark>1</mark> mm⋅mrad
Bunch length (rms)	1 - 3 ps (usual) ~ 100 fs (with B.C.)
RF frequency	1.3 GHz

☆ red numbers are parameters for initial stage





### ERL main linac cryomodule



### Comparison between VT and module-test



Q values are dropped after module assembly, due to severe field emission.

## Module assembly



He jackets were welded on cavities

Cavities, HOM dampers and input couplers were assembled.





Installed into cryomodule. Gate valves were mounted on both sides.



Assemble He line, magnetic shield, sensors and so on

## Procedure from VT to module assembly

#### [Before module assembly (After vertical test)]

- 1. Keep cavity with vacuum condition
- 2. Ar purge for He jacket welding
- 3. Flange exchange for He jacket welding (with Ar flow)
- 4. Transport to company
- 5. He jacket welding at company

#### [Module assembly]

- 6. Assembly of HOM damper and beampipe component
- 7. Assembly of cavity and HOM damper (with Ar flow)
- 8. Assembly of input coupler to cavity (with Ar flow)
- 9. Leak check  $\rightarrow$  Ar purge
- **10.** Assembly of gate valve
- 11. Leak check  $\rightarrow$  Ar purge

#### [After module assembly]

- 13. Move to accelerator room (radiation shield)
- 14. Vacuum pumping of inside cavity
- 15. Coupler aging
- 16. Cooling down

# Flange disassembly/assembly







- Dirty flange after VT
- Many particles from removed bolts.
- Is Ag plating bolt not good?
- How about Sn plating U-tightsheal?
- Do our procedure/environment have proble?

## String assembly / HOM assembly



- Parts are washed by ultra-pure water. But fabricated HOM damper can not wash.
- Cleaned by ion-gun and pumped out. Baking is also not possible



- Cavity and HOM dampers were assembled in class-10 clean room.
- Handling of dirty flanges, bolts and u-tightsheals could be again source of dust.

## **GV** assembly







- Gate-valves were assembled in portable clean booth.
- Dirty components, such as big end flange and bellows, should be covered.
- Handling of dirty flanges, bolts could be again source of dust.

# <u>Summary</u>

- For cERL main linac cryomodule, cavity performances were severely degraded after cryomodule assembly.
- Possible reasons are...
  - Flange exchange after vertical test?
  - Not enough cleanness of HOM dampers and there assembly?
  - Not enough cleanliness of gate valve assembly procedure?
- As we know, materials should be as clean as possible(=no particles). But how should we satisfy this condition against dirty materials, such as flanges, bolts, HOM dampers, gate valve etc?