

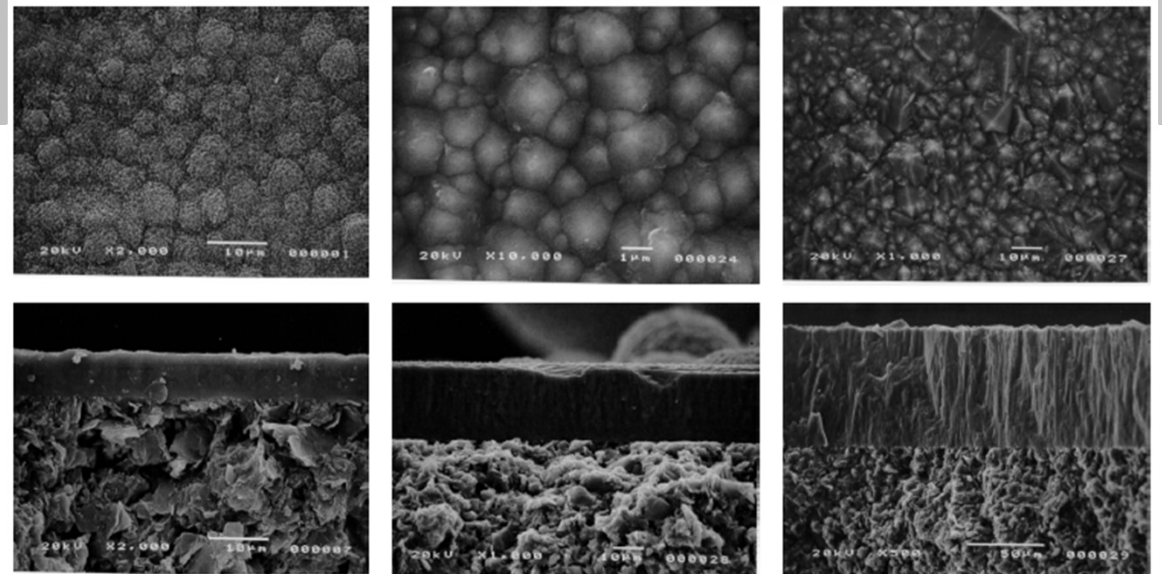
PRODUCT INTRODUCTION

Carbon **CVD•CVI** Reactor

Dynamic **ThermVac**

in pursuit of

the Best Vacuum Furnace



www.thermvac.co.kr

[Features of Carbon CVD•CVI]



Hot zone appropriate for either isotherm or temperature gradient



Horizontal • vertical gas flow all available depending on loading conditions



Muffle, nozzle and piping structures of easy maintenance



Turn key supply of the entire line from gas delivery to the exhaust scrubber



Longer life of each component

[Application of Carbon CVD•CVI]



Deposit Materials

(Pyrolytic) Carbon



Substrate

Carbon Composite

Graphite Bulk



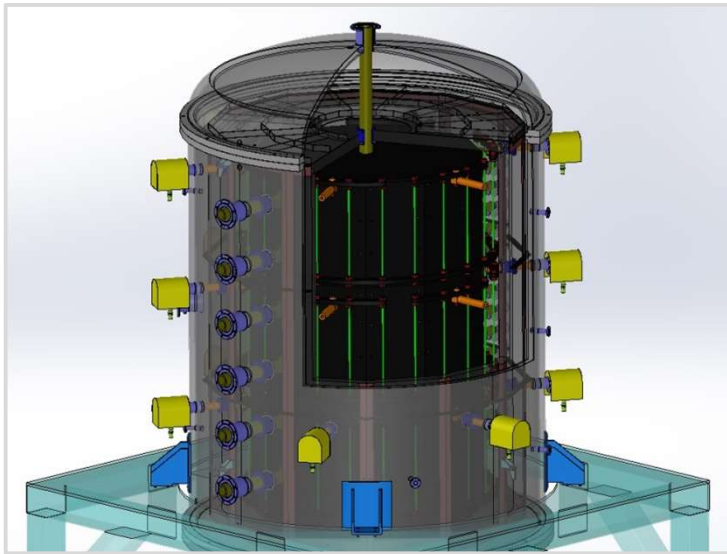
Process

TG CVI/ISO CVI

ISO CVD



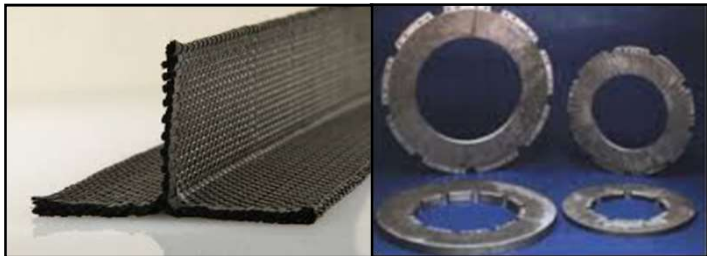
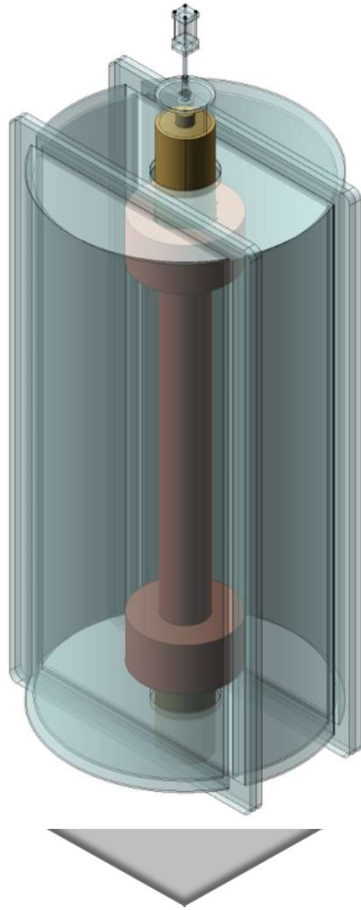
[Standard Specifications of ISO CVD•CVI]



Item	Specification
Furnace type	Vertical reactor of isothermal/baric process
Application	CVI or CVD of pyrolytic carbon
Load sample	Carbon, Carbon composite
Loading volume	254L ~ 3532L
Temperature	1000 ~ 1200°C[max. 1350°C]
Uniformity	±6~12°C[1000°C, no load, 3 points]
Heat-up rate	2 ~ 10°C/min
Temperature control	Multi zone PID control by T/C and SCR
Hot zone materials	Graphite
Retort muffle	Polygonal cylinder assembly
Process gas	CH ₄ , C ₃ H ₆ , N ₂ , Argon
Gas flow control	Parallel MFC & Flow meters
Process pressure	Partial 1.3KPa ~ 7KPa, Atmospheric 105KPa
Partial pressure control	Manometer & Throttle valve
Evacuation	Mechanical booster pump & Dry pump
Loading	Bottom door loading & rotating turn-table
Exhaust treatment	Vapor trap, Particle filter & Scrubber
System control	PLC control, Touch or PC interface
Electricity	AC 380V, 3ph



[Standard Specifications of TG CVI]



Item	Specification
Furnace type	Cram shell type vertical reactor
Application	Densification infiltration by temperature gradient
Load sample	Carbon composite preform
Loading volume	254L ~ 3885L
Temperature	Max. 1200°C
Heat-up rate	2 ~ 10°C/min
Temperature control	PID control by thermocouple and SCR
Heating elements	Graphite rod or plate
Reflector shield	STS316L sheet layer shield
Electrode package	Cu electrode, Graphite disc & plate spacers
Process gas	CH ₄ , C ₃ H ₆ , H ₂ , N ₂
Gas flow control	MFC, Flow meter & Throttle valve
Process pressure	Partial 15 ~ 95KPa, Atmospheric 100 ~ 130KPa
Partial pressure control	Manometer & Throttle valve
Evacuation	Mechanical booster pump & Dry pump
Door closing	Hydraulic clamp lock
Exhaust treatment	Cu pellet trap, Particle filter & Scrubber
System control	PLC control, Touch or PC interface
Electricity	Rectified DC



[Standard Dimension of CVD• CVI]

ISO CVD/CVI

Model code	TVCVD-ISO0609	TVCVD-ISO1015	TVCVD-ISO1218	TVCVD-ISO1520
Work zone(mm)	Φ600*900H	Φ1000*1500H	Φ1200*1800H	Φ1500*2000H
Capacity(kg)	200~300Kg	550~700Kg	750~1000Kg	1000~1300Kg
Uniformity	±6℃	±8℃	±10℃	±12℃
Electricity(kVA)	300KVA	500KVA	630KVA	840KVA

TG CVI

Model code	TVCVI-TG0609	TVCVI-TG1015	TVCVI-TG1218	TVCVI-TG1520
Work zone(mm)	Φ600*900H	Φ1000*1500H	Φ1200*1800H	Φ1500*2200H
Capacity(kg)	200~300Kg	550~700Kg	750~1000Kg	1000~1300Kg
Electricity(kVA)	DC 600KVA	DC 1000KVA	DC 1200KVA	DC 1500KVA



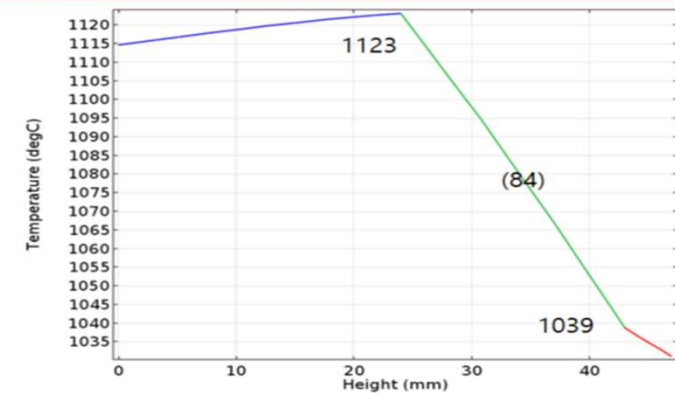
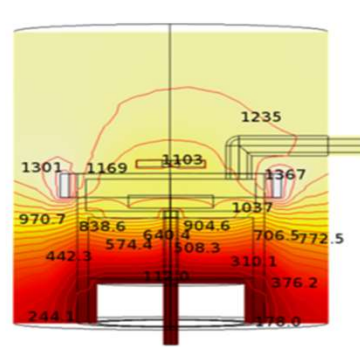
[CVI Simulation _ TG _ Insulation Thickness]

ThermVac

Top heater 1100°C
Side heater 1400°C

Bottom felt T 90mm

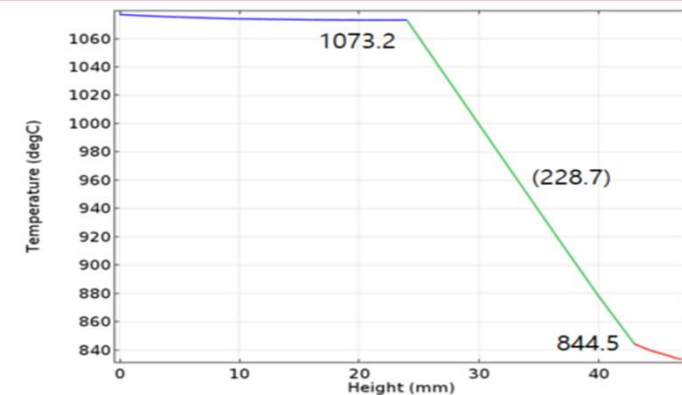
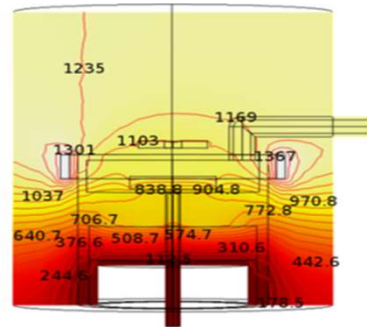
Cooling jacket 30°C



Top heater 1100°C
Side heater 1400°C

Bottom felt T 50mm

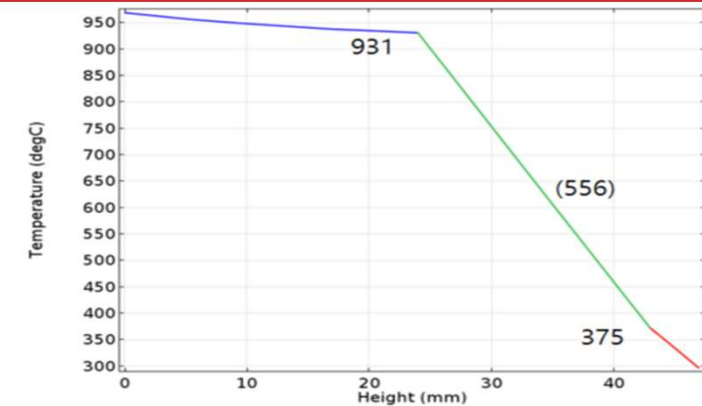
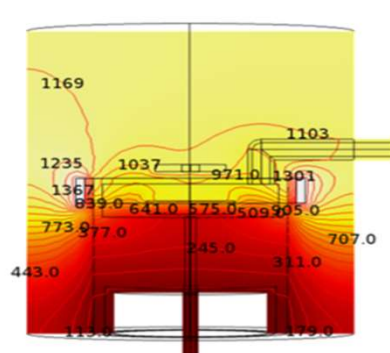
Cooling jacket 30°C



Top heater 1100°C
Side heater 1400°C

Bottom felt T 0mm

Cooling jacket 30°C



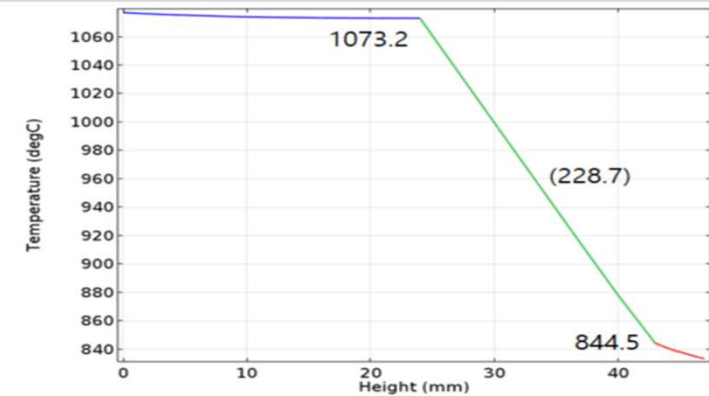
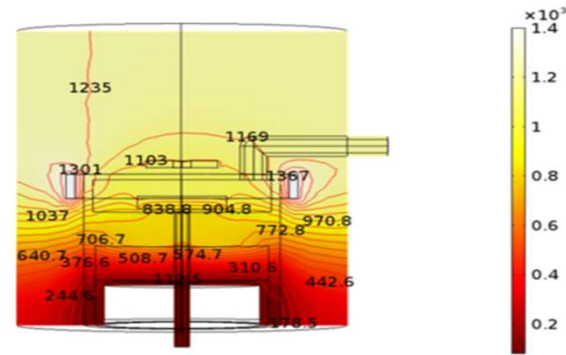


[CVI Simulation _ TG _ Control of Top Heater]

ThermVac

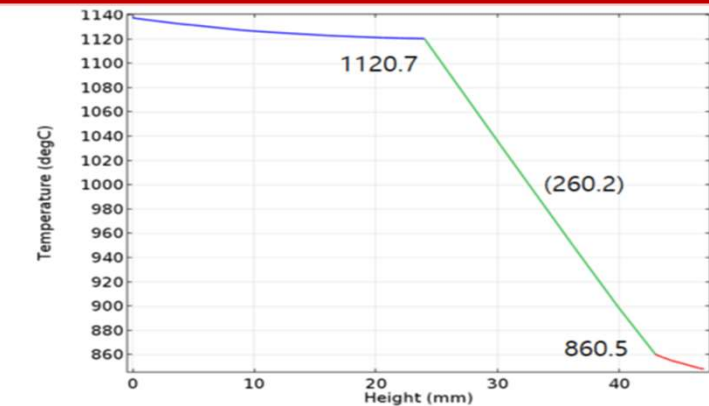
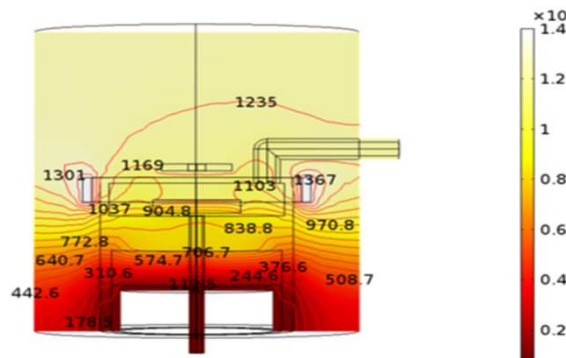
Top heater 1100°C

Side heater 1400°C
Bottom felt T 50mm
Cooling jacket 30°C



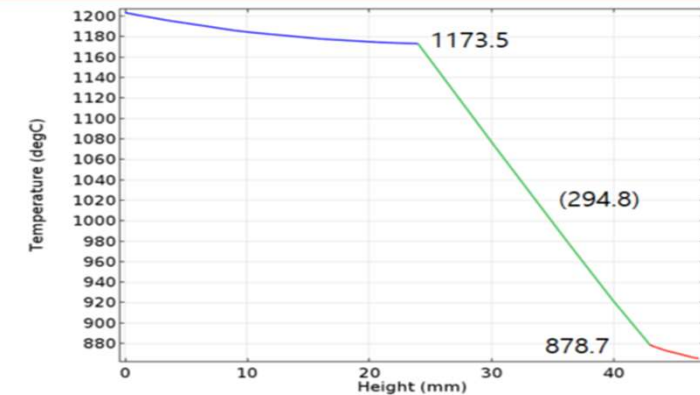
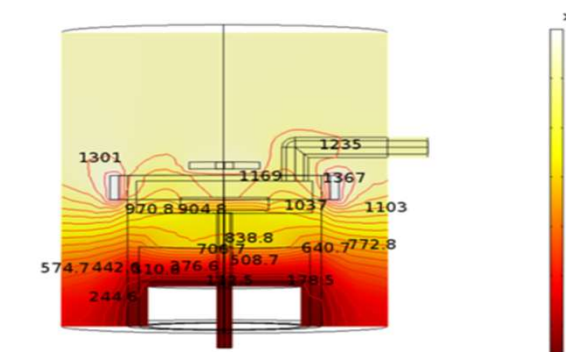
Top heater 1200°C

Side heater 1400°C
Bottom felt T 50mm
Cooling jacket 30°C



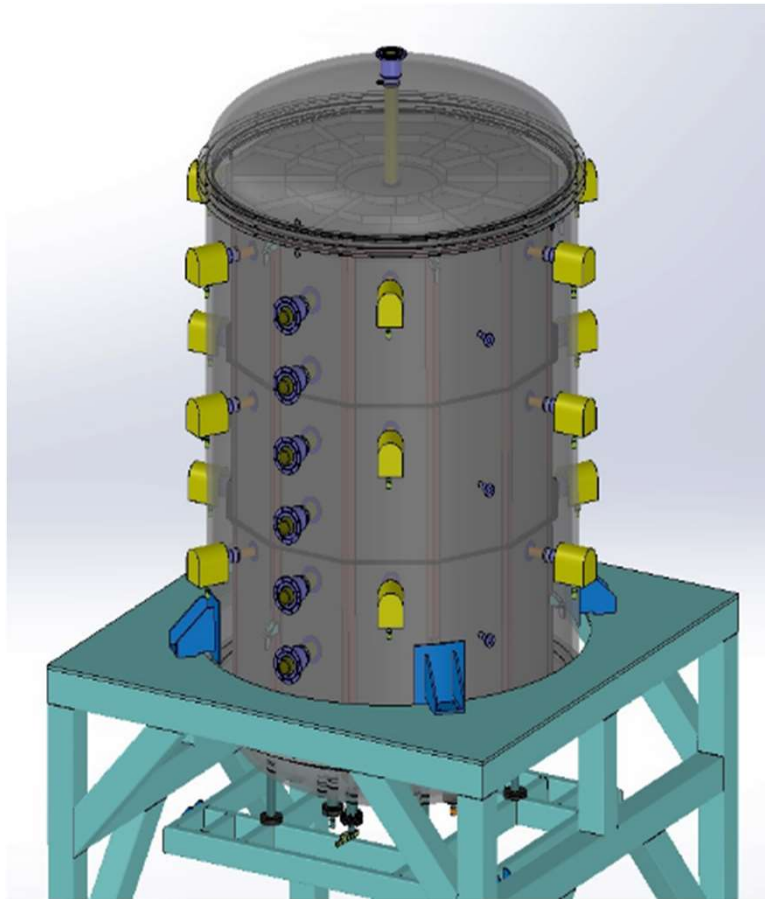
Top heater 1300°C

Side heater 1400°C
Bottom felt T 50mm
Cooling jacket 30°C





[Details _ ISO Vacuum Chamber]



Boundary Conditions

STEP1

- ▶ Max Temp. of inner surface : 250°C
- ▶ Internal pressure : Vacuum
- ▶ External pressure : Atmospheric
- ▶ Water pressure of cooling jacket : 3Kgf/cm²

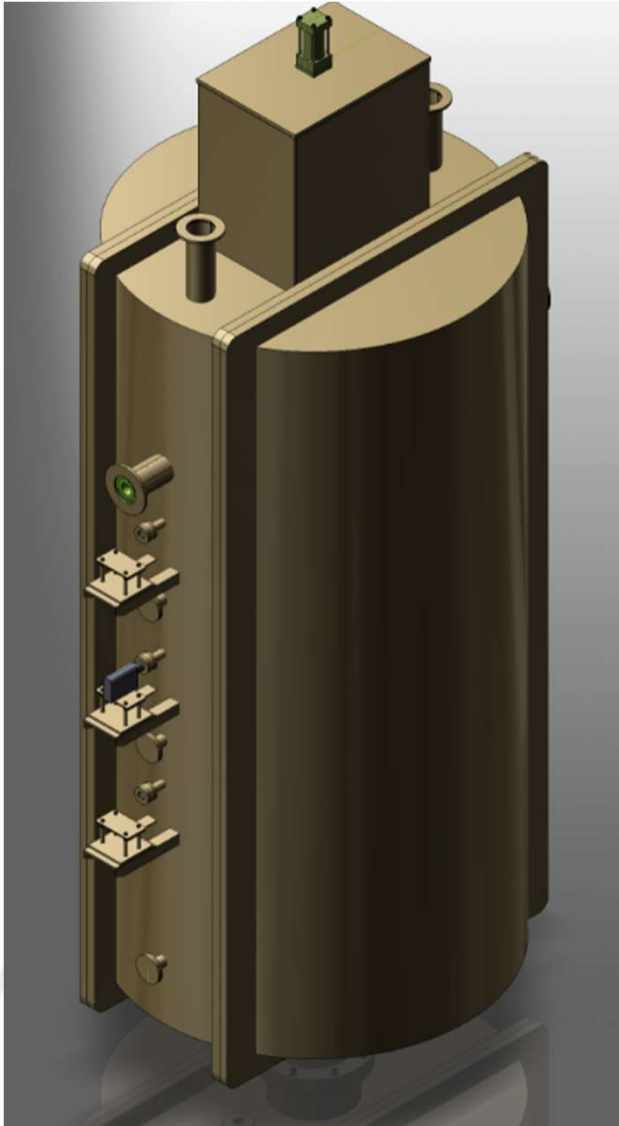
Fabrication

STEP2

- ▶ Type : Bottom loading vertical cylinder
- ▶ Double wall water cooled jacket
- ▶ Materials : STS316L(inner wall)
STS304(outer wall • flange)
- ▶ Inside surface : Buffing #300



[Details _ TG Vacuum Chamber]



Boundary Conditions

STEP1

- ▶ Max Temp. of inner surface : 550°C
- ▶ Internal pressure : Vacuum
- ▶ External pressure : Atmospheric
- ▶ Water pressure of cooling jacket : 3Kgf/cm²

Fabrication

STEP2

- ▶ Type : Front loading clam shell cylinder
- ▶ Double wall water cooled jacket
- ▶ Materials : STS310S(inner wall)
STS304(outer wall • flange)
- ▶ Inside surface : Buffing #300



[Details _ ISO Hot Zone]

Insulation



- ▶ Graphite rigid felt layers
- ▶ Thickness : 40 ~ 50T mm
- ▶ Inside treatment of foil coating

Heaters

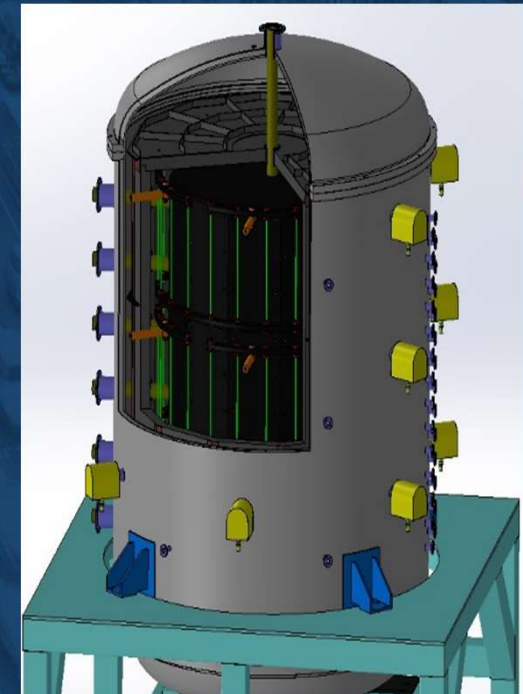


- ▶ Materials : Graphite CIP block
- ▶ 2 ~ 4 zone control
- ▶ Side : Connector & rod assembly
- ▶ Bottom : Disc plate

Muffle



- ▶ Materials : Graphite CIP plate
- ▶ Polygonal cylinder assembly
- ▶ Fixed by carbon composite screw
- ▶ Inside wall : Graphite foil lining



Hot Zone



[Details _ TG Hot Zone]

Reflector



- ▶ Materials : STS316L Sheet
- ▶ Sheet thickness : 2T

Heaters

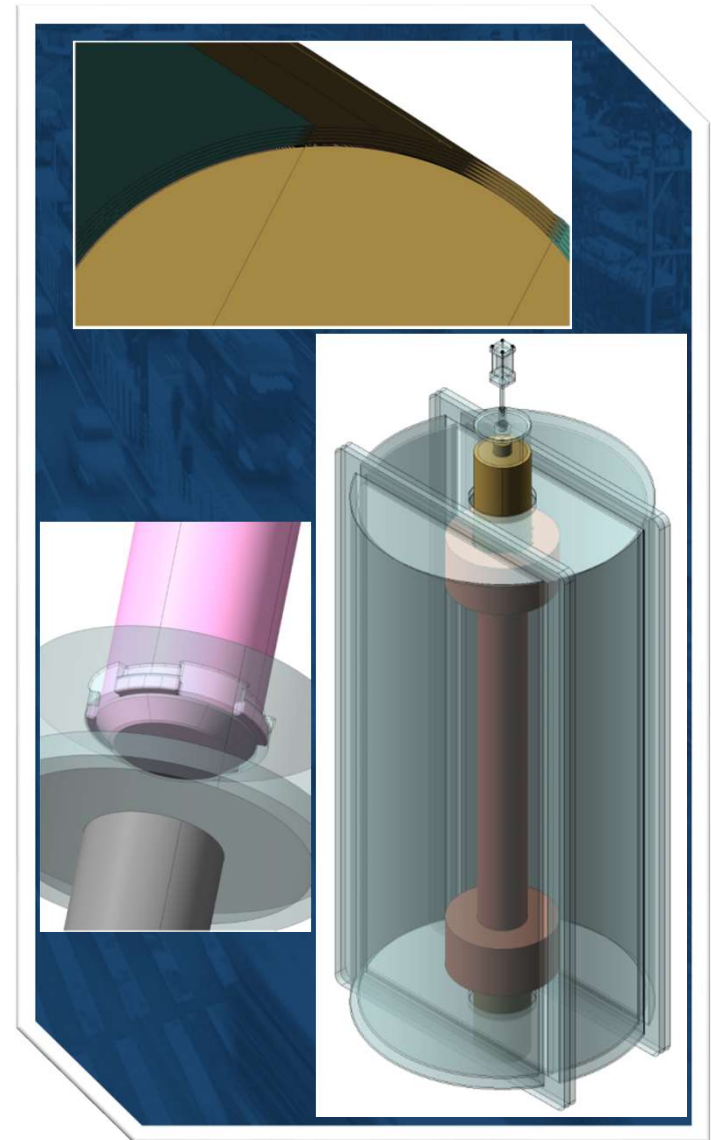


- ▶ Materials : Graphite CIP Rod or Pipe
- ▶ Heating circuit : Single circuit

Electrode

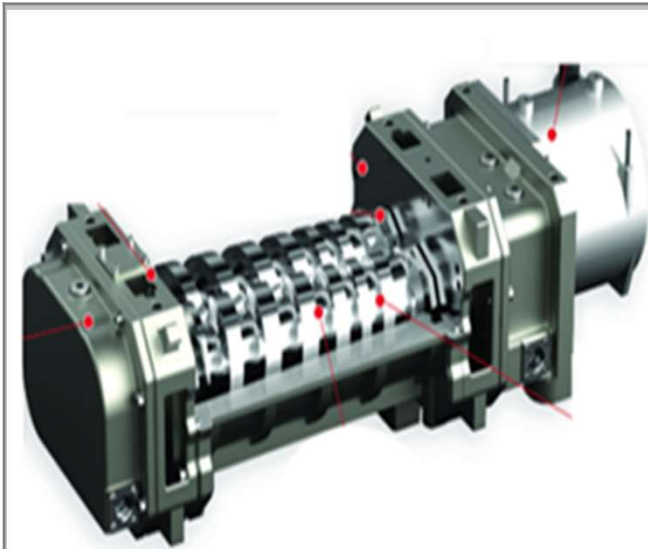


- ▶ Materials : Copper, Graphite
- ▶ Idling contact type
- ▶ Hemispherical rod, seat, spacer





[Details _ Evacuation System]



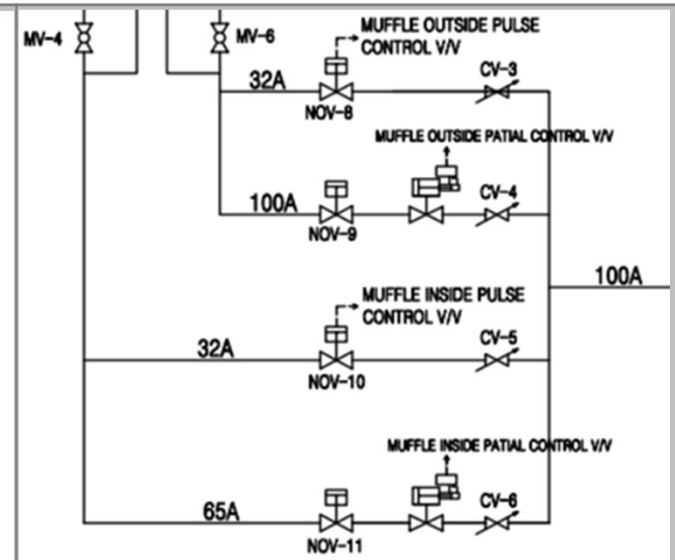
Vacuum Pumps

- ▶ Roots type mechanical Booster pump
- ▶ Screw type dry pump
- ▶ Maker : Edwards or Busch or Ulvac



Vacuum Gauges

- ▶ Type : Diaphragm Manometer
- ▶ Maker : MKS or Inficon
- ▶ Muffle inside & outside, pumping line

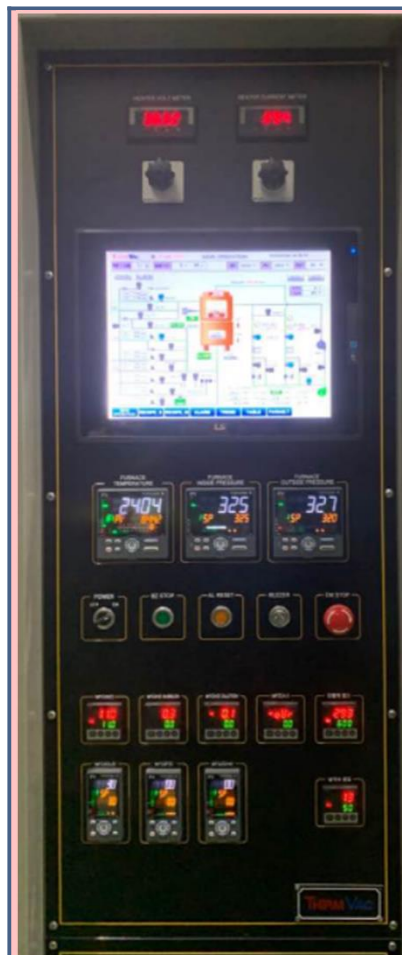


Suction Line Control(CVD)

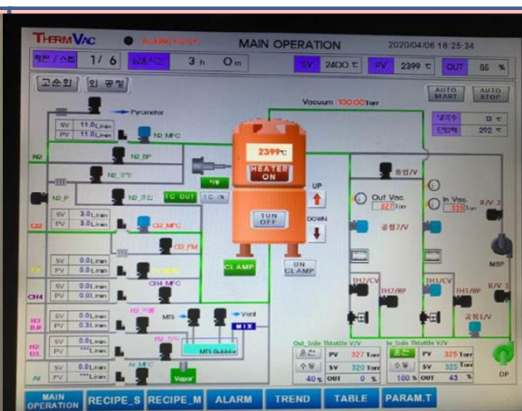
- ▶ Slow pumping vs. normal pumping
- ▶ Pumping of muffle inside vs. outside
- ▶ Atmospheric vs. partial pressure



[Details _ Control Panel]



Control panel of
Test Furnace



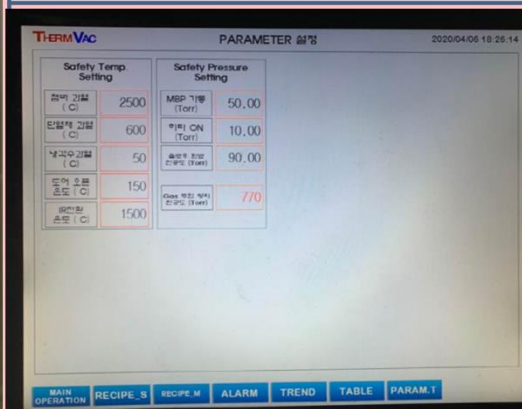
Main screen



Trend screen



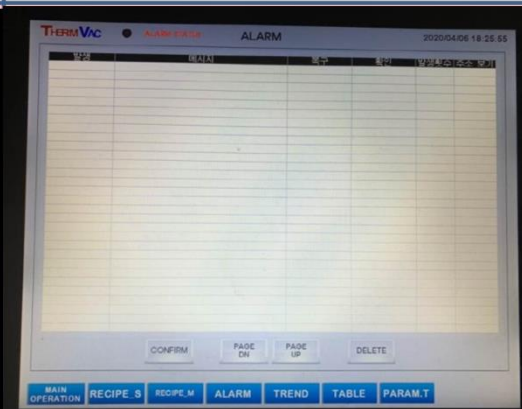
Recipe monitor



Parameter setting



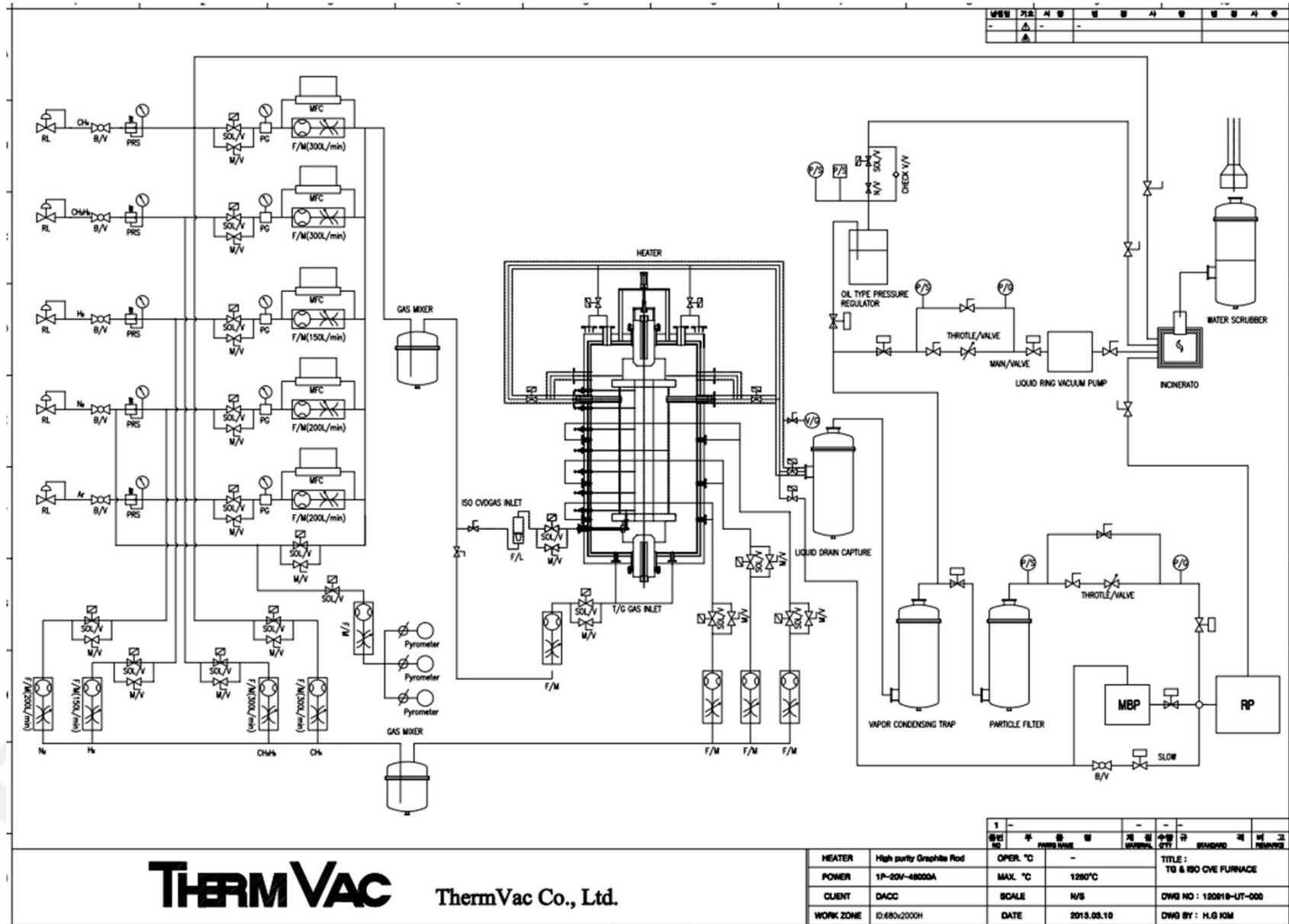
Data Logging



Alarm history



[Flow Sheet of ISO/TG Combined Model]



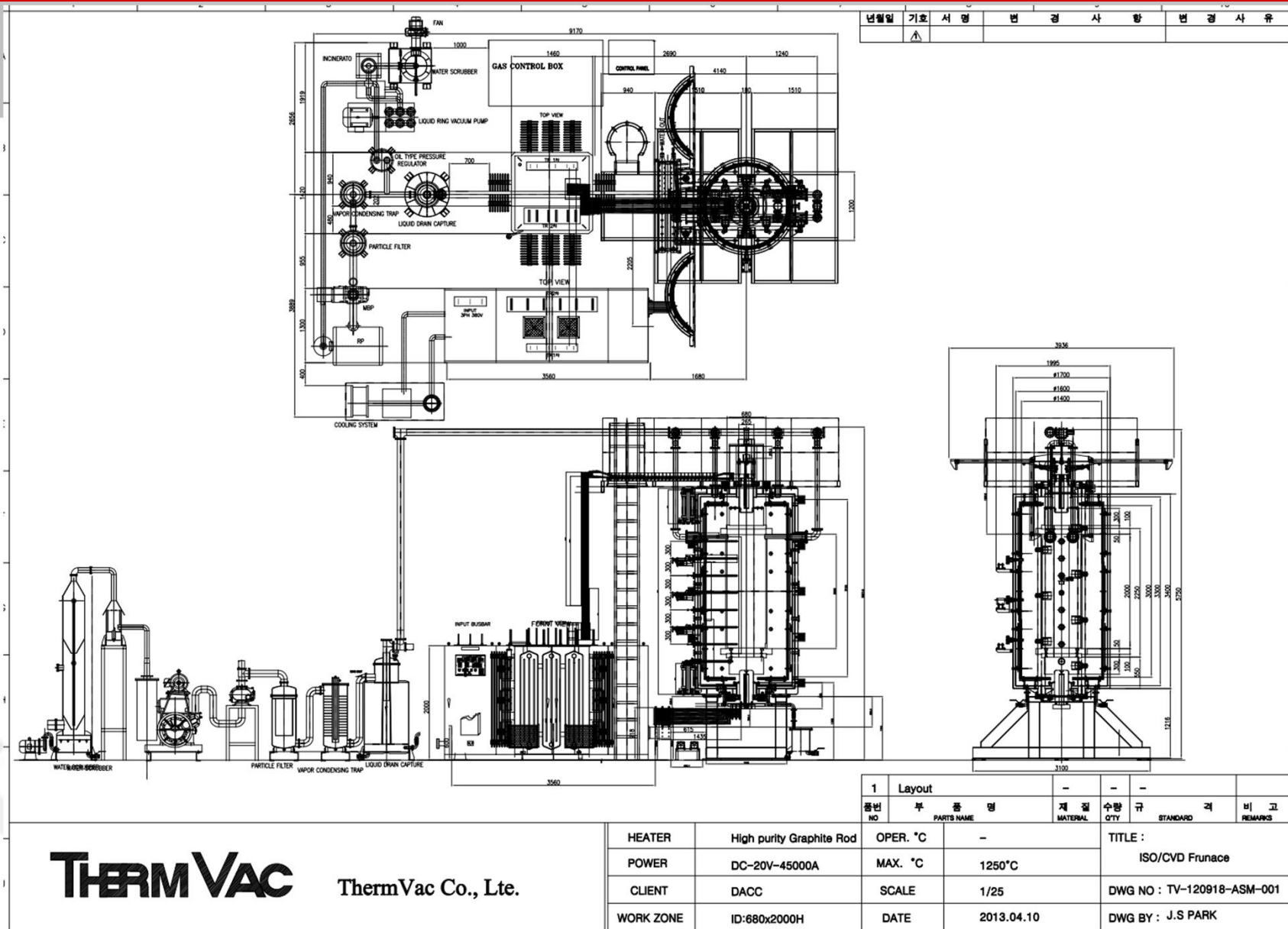
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[Layout of ISO/TG Combined Model]



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