

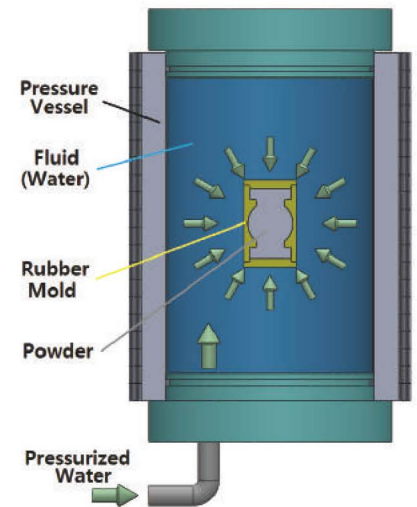
# Cold/Warm Isostatic Press (CIP/WIP)



- Cold/Warm Isostatic Press(CIP/WIP)
- Compacting powders using high (up to 600MPa) isostatic liquid pressure
- If liquid temperature is RT ► CIP VS elevated temperature ► WIP)
- WIP offers better binder activation & dense compaction
- ENERGYN developed an innovative 'High-speed WIP, in which temperature up & down is very fast.
- Uniform compaction and densification of ceramic/metal/polymer powder

## Applications

- Oxide ceramics;  $Al_2O_3$   $ZrO_2$
- Non-oxide ceramics; Nitride; AlN, BN, Si<sub>3</sub>N<sub>4</sub> Carbide; SiC, Metal Powder
- Lamination of ceramic and polymer multi-layers
- Electronics/Energy/Medical/Piezoelectric/Heaters/Auto/Aerospace
- Sputtering targets for semiconductor manufacturing
- Chip inductor/capacitor(MLCC, MLPC), hybrid chips
- Bearing balls, cutting tool inserts, wear resistance parts (valves, brakes etc)



Model No.	Work Zone(mm)	Max. P.	Max. T.	Auto cycle Time (typical)	M/C dimension	M/C weight(Kg)
ECIP-120/360	Ø120XH360	300MPa Or Special order up to 600MPa	RT or Special order: up to 150°C	<3min	1100 x 800 x 1620	1000
ECIP-200/600	Ø200XH600			<4min	1600 x 950 x 1800	1800
ECIP-200/900	Ø200XH900			<6min	1600 x 950 x 2400	2300
ECIP-300/31200	Ø200XH1200			<8min	1600 x 950 x 3000	TBD
ECIP-380/900	Ø380XH900		<10min	TBD	TBD	TBD
ECIP-800/1200	Ø800XH1200		80	<10min	TBD	TBD
ECIP-1400/2500	Ø1400XH2500		80	<10min	TBD	TBD

\* Other model can be made by customer specified temperature, pressure, cycle time, and work zone size

## Products



### Specifications

Work zone/Vol.	Diameter 1.5m x L3m
Pressure	700MPa
ECIP-200/900	Ø200XH900



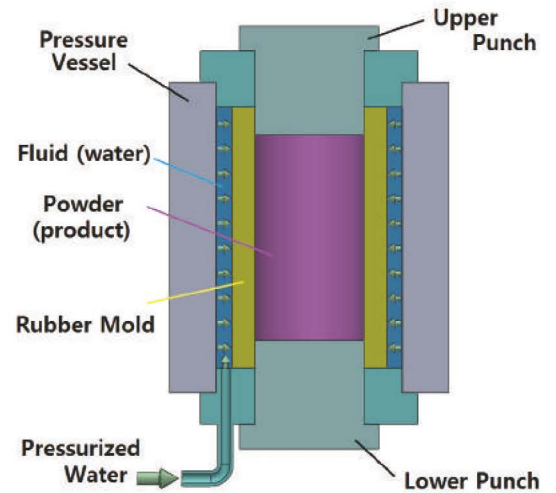
# Dry-bag CIP



- A variation of CIP for special applications & mass production
- Powder consolidation into cylindrical or polygonal shaped structures using shaped rubber mold and core
- Best for hollow and thin-section structure
- Very little or no post-machining needed

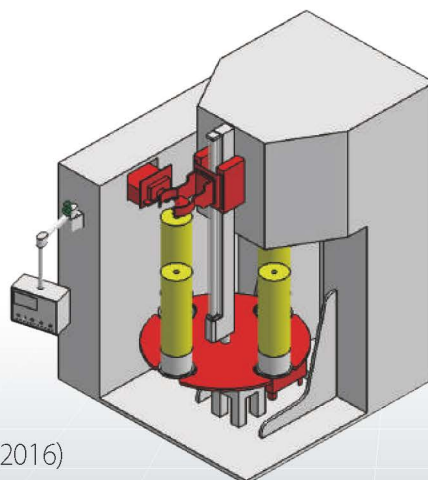
## Applications

- Electronics fine ceramics
- Insulation, piezo, feedthrough, crucibles, etc
- Ceramic heater (shaft) for semiconductor processing



Model No.	Work Zone(mm)	Max. P.	M/C dimension	M/C weight(Kg)
EDIP 1050	Ø100 x 500	200MPa Or Special order Up to 300MPa	1230 x 1760 x 2500	3000Kg
EDIP 1858	Ø180 x 580		1500 x 2100 x 2800	3200Kg
EDIP 2030	Ø200 x 300		1600 x 2100 x 2500	3100Kg
EDIP 2090	Ø200 x 900		1600 x 2100 x 4000	4500Kg
EDIP 20120	Ø200 x 1200		1600 x 2300 x 5000	6000Kg
EDIP 30420	Ø300 x 1200		2000 x 5100 x 5200	10500Kg

\* Work zones, pressures and any other customized requirements are available to modify accordingly.



Dry-bag CIP Installed  
in K-company(Japan) (2016)



# High Temperature & High Vacuum Furnace Sintering & Brazing

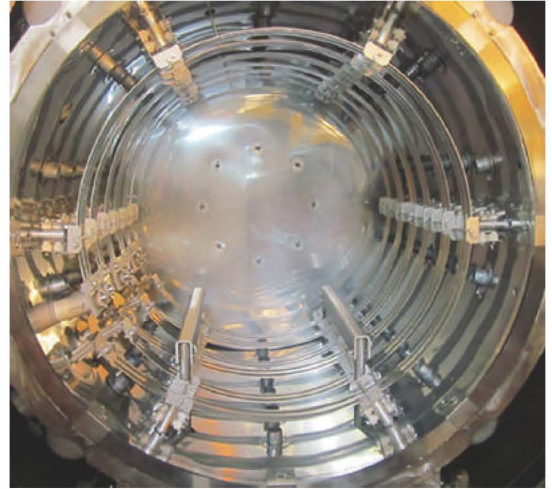


- High Temperature & High Vacuum Furnace; Sintering & Brazing
- Sintering and purification under high vacuum (~10E-7 torr)
- Gas Pressure Sintering (GPS) furnace (~200 bar)
- Horizontal or vertical types
- Various heating elements; Mo, graphite, C/C, kantal, etc
- Rapid cooling (quenching) option available

## Sintering & Brazing

### Applications

- General purpose for powder metal and fine ceramic industry
- Sintering of compacted powder by CIP or press
- Brazing, heat treatment, graphitization



Model No.	Work Zone(mm)	Charging Weight(Kg)	Max. T.	Vacuum	Heating Element	Loading Direction
ESB 50RP	300 x 250 x 500	50	1350°C or Special order: up to 2500°C	5 x 10E-5 or Special order: up to 1 x 1.00E-06	1100 x 800 x 1620	Front , Bottom or Top
ESB 100RP	400 x 350 x 800	100			1600 x 950 x 1800	
ESB 300RP	600 x 600 x 1000	300			1600 x 950 x 2400	
ESB 500RP	700 x 750 x 1200	500			1600 x 950 x 3000	
ESB 700RP	750 x 750 x 1200	700			TBD	
ESB 1000RP	850 x 850 x 1400	1000			TBD	

\* Work zones, pressures and any other customized requirements are available to modify accordingly.

SiC Sintering  
Furnace



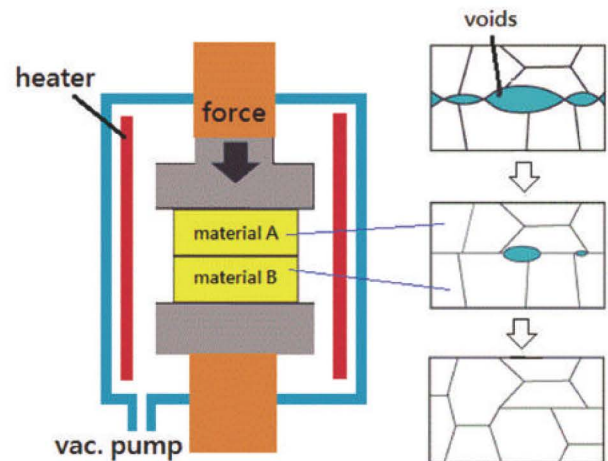
# Vacuum Hot Press



- Densification and sintering of metal or ceramic powder
- Diffusion bonding of similar & dissimilar materials

## Applications

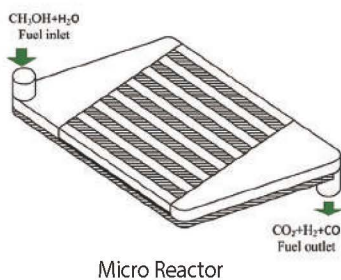
- Printed Circuit Heat Exchanger (PCHE) for LNG and H<sub>2</sub>
- Microchannel reactor cores for chemical processing
- Heat spreader imbedded plastic injection die/hot runner
- Semiconductor processing equipment (ESC, ceramic heaters)
- Complicated 3D structure; fuel mixing nozzles
- Functionally Graded Materials (FGMs)



Model No.	Work Zone(mm)	Max. P.	Max. T.	Vacuum(Torr)	M/C dimension	Weight(Ton)
EHP-200L	200 x 200 x 200	50 Ton	2200°C	5 X 10-5 torr or Special order: up to 7 X 10-5	TBD	2
EHP-200H	200 x 200 x 300	50 Ton	2200°C			3
EHP-300H	300 x 300 x 350	50 Ton	2200°C or Special order: up to 2500°C			7
EHP-500H	420 x 420 x 500	250 Ton				9
EHP-700H	700 x 700 x 700	300 Ton				13.5
EHP-1000H	1000 x 1000 x 1000	300 Ton				16

\* Work zones, pressures and any other customized requirements are available to modify accordingly.

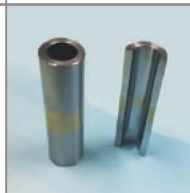
## Products



Micro Reactor



Electro Static Chuck



Various Diffusion Bonded Samples



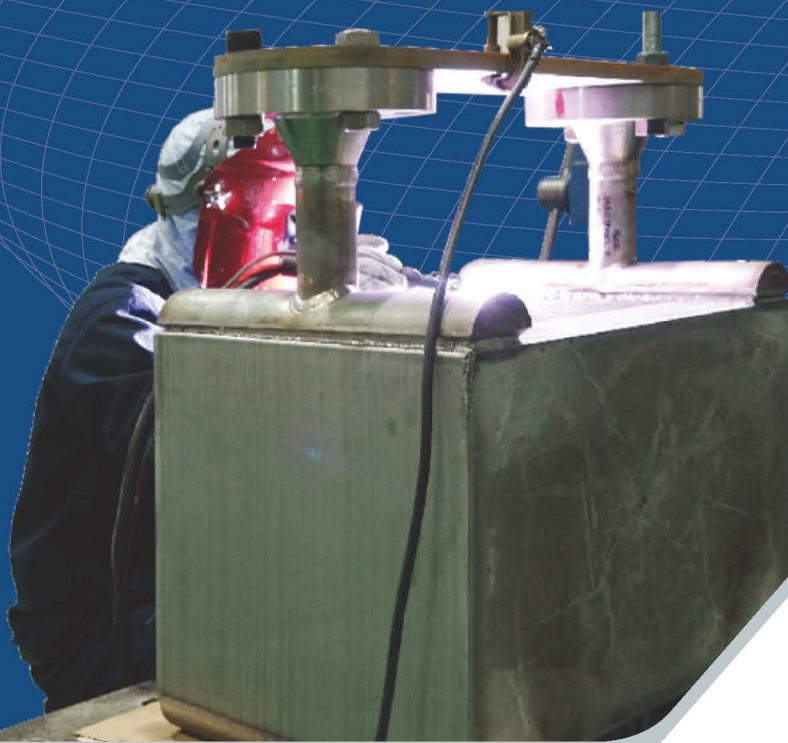
## 2,500ton press frame



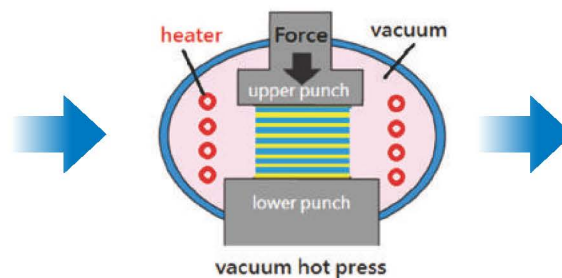
### Specifications

Work zone/Vol.	Max. 2m x 2m x 2m
Temp.	Max. 2,500°C
Force	1,000ton
Vacuum	10 <sup>-3</sup> ~10 <sup>-7</sup> torr
Heater: Mo, graphite, C/C, kantal	

# PCHE (Printed Circuit Heat Exchanger)



- PCHE (Printed Circuit Heat Exchanger)
- Large plate bonding area; 1,000mm x 1,000mm
- Extremely compact & highly efficient heat exchanger
- Service at high pressure up to 200MPa

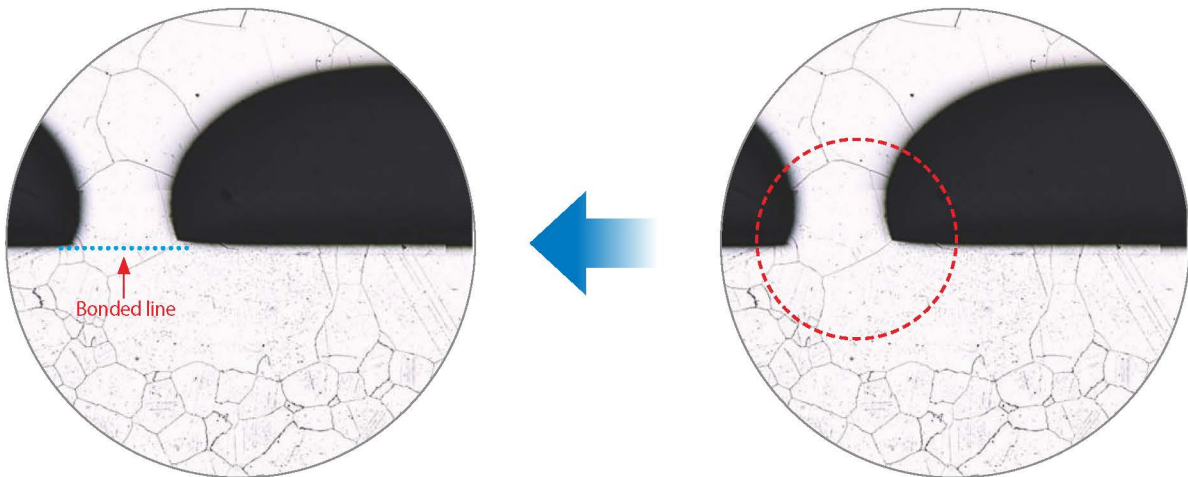


## ❖ Applications

- Big diesel engine Fuel Gas System (FGS)
- Best for Mini-LNG or Hydrogen plant
- Cryogenic gas liquefaction and Gasification
- Best for Offshore plants where installation space is critical

## ❖ Products

- PCHE with various size and material can be produced



LNG Industry



H2 Station



LNG Industry

## Company Overview

- **Location:** Hwa-seong City, S. Korea
- **Facility Area:** 7,000 sq. m  
70Km from Incheon International Airport,  
60Km from the downtown Seoul
- **No. of Employees:** 30
- **Specialty:** Extreme Process Equipment and  
Process Service Business
- **Homepage:** [www.energyn.com](http://www.energyn.com)
- **Email:** [sales@energyn.com](mailto:sales@energyn.com)



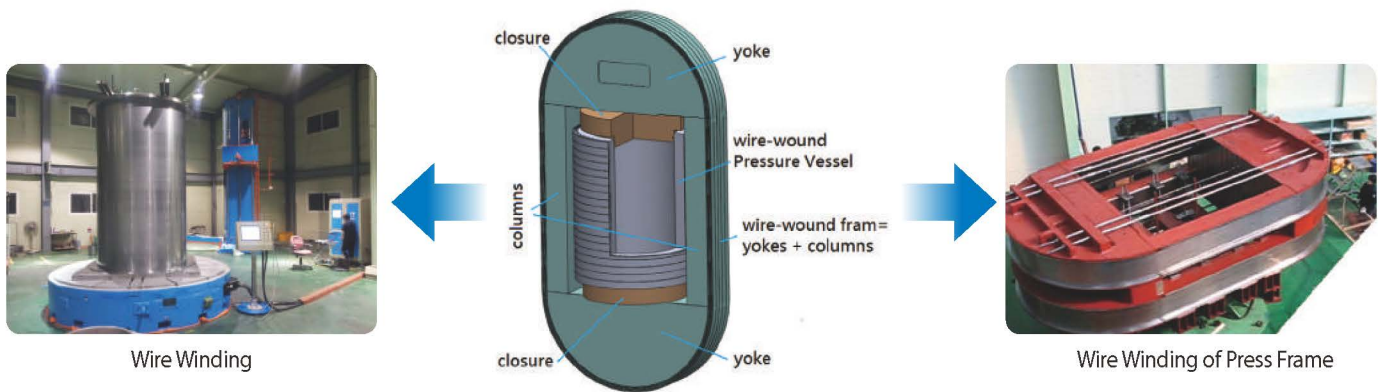
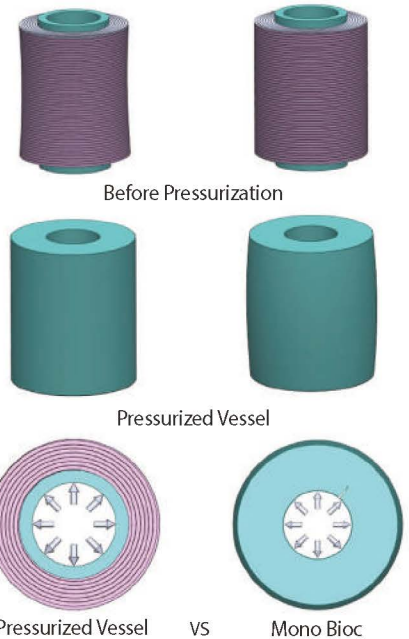
## Mission Statement: Extreme Process and Equipment Specialist

ENERGYN is the extreme process equipment manufacturing company. Our normal process temperature, pressure, vacuum capability is 3,000°C, 900MPa, and 10-10 torr respectively. The equipment product line-up is Hot Isostatic Press (HIP), Cold Isostatic Press (CIP), Vacuum Hot (Diffusion Bonding) Press, Gas Pressure Sintering Furnace (GPS), Vacuum Brazing Furnace. ENERGYN provides not only the extreme process equipment but also special process solutions using those equipment for various customers in semiconductor, LCD, automotive, food, electronics, medical, nuclear, aerospace, and military industries.

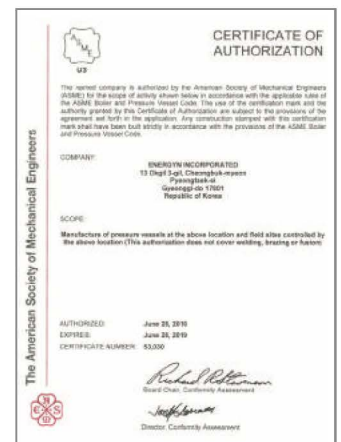
## Wire Winding of Pressure Vessel and Frame (ASME U, U3 Certified)

- Extremely high static and fatigue strength under cyclic load
- No stress-concentration points  
(see threaded type for comparison)
- Crack propagation eliminated
- Light Weight & Compact Structure

Wire-Wound VS mono Block



## ❖ Certification of ASME U & U3



# ENERGYN

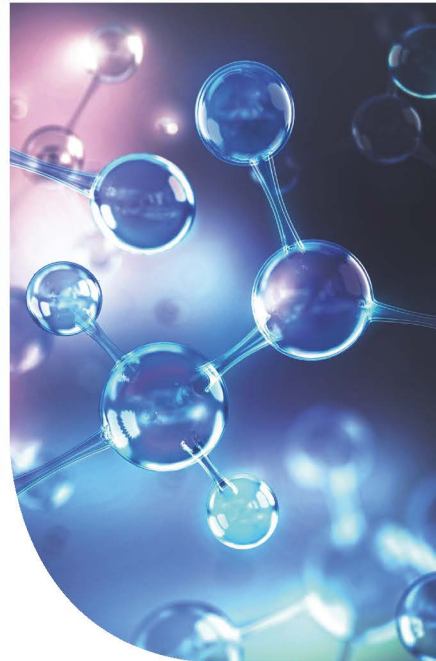
EXTREME TECHNOLOGY

## Core technology of Energyn

High Pressure Technology  
Diffusion Bonding Technology

[www.energyn.com](http://www.energyn.com)

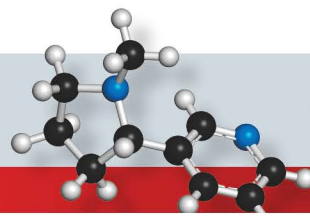
The Future of **H<sub>2</sub>**,  
The Future of **Energy**,  
The Future of **Energyn.**



## Company History

- 2020. 00** Jointly developed type 1 wire wound H<sub>2</sub> storage pressure vessel with KGS, RIST, and KITECH
- 2019. 05** Planned ASME U and U3 code renewal for the next 3 years
- 2019. 11** Exported WIP system up to 250°C with the rapid cooling option to the USA
- 2019. 05** HOT PRESS Delivery (EHP300-500HV)
- 2019. 03** Introduced the first Spark Plasma Sintering Furnace in domestic
- 2018. 12** Supplied WIP system up to 200MPa ID450
- 2018. 10** Completed development of PLASMA GUN Cathode / Anode
- 2018. 10** Received ASME / KGS joint certification 99MPa hydrogen station PCHE manufacture and shipment
- 2018. 08** Manufactured and supplied 600MPa cold isostatic / hydrostatic press
- 2018. 06** Produced and supplied Korea's first satellite-mounted aerospace SiC structure 1000 pi
- 2018. 04** Manufactured and delivered the world's largest 3600mm Length Hot Press
- 2017. 11** Installation of ID1600 Vacuum Heat Treatment Equipment
- 2017. 11** Exported High Vacuum Diffusion Bonding Equipment
- 2017. 06** Hydrogen Heat Treatment Furnace Installation
- 2017. 05** PCHE heat exchangers manufactured for sale, 1000Bar pressure
- 2017. 04** High Vacuum Brazing Equipment (Inner Diameter 800x1900H Vertical Type)
- 2017. 04** Delivered 3,000bar, Φ800 x 1,200 CIP
- 2017. 02** Moved to a new factory
- 2016. 06** ASME U&U3 Certified for High-Pressure Vessel
- 2016. 03** Delivered 1m X 1m Diffusion Bonding Vacuum Hot Press
- 2015. 12** Delivered medium-sized HIP
- 2015. 08** Exported Dry-type CIP delivered to overseas
- 2015. 06** Developed and delivered a rectangular H<sub>2</sub> furnace
- 2015. 03** Developed 'Chamber Integrated Vacuum Hot Press' (patent)
- 2014. 07** Installed 3,000°C diffusion bonding hot press and started bonding service
- 2014. 07** Developed HPP (High-Pressure Processing for Food)
- 2013. 12** High Throughput Warm Isostatic Press (WIP) developed
- 2013. 11** Developed Vacuum Chamber/Press Frame Integrated Hot Press (patent)
- 2013. 07** Developed Induction heated SiC CVI (Chemical Vapor Infiltration) equipment
- 2013. 06** Delivered HIP for Carbon Composite for defense application
- 2012. 12** Delivered 25,000 tons Hybrid CIP (patent)
- 2012. 03** Received ISO9001, ISO14001 Certification
- 2012. 01** Installed Big scale servo-controlled wire-winding machine
- 2011. 08** Delivered High Temp. Gas Pressure Sintering (GPS, 2000C, 10MPa) Furnace
- 2011. 06** Delivered Laboratory Hot Isostatic Press (HIP) to KITECH National Institute
- 2011. 04** New FRP technology (patented), PV Panel cooling technology(patented)
- 2011. 02** Established ENERGYN



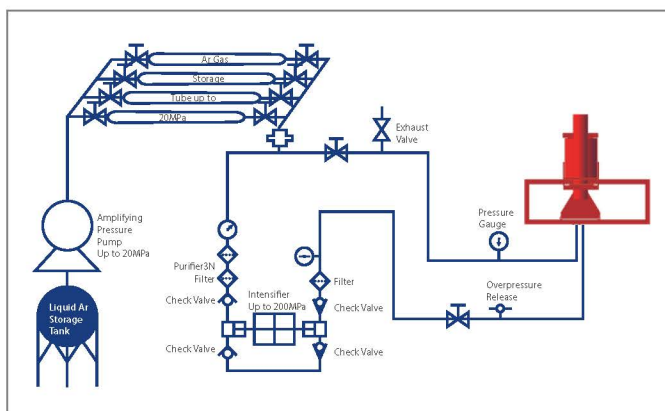


# High Pressure Technology

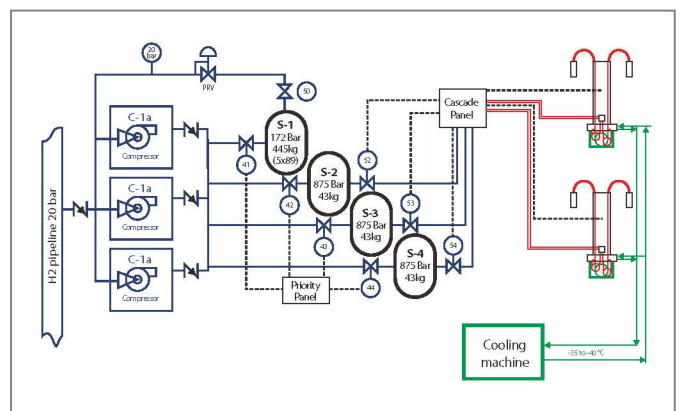
## High Pressure Technology of Energyn

Energyn is one of most leading manufacturers of high-pressure vessel designed, constructed, and qualified up to 700MPa by its own wire-wound technology through ASME. And this technology has a similar construction structure as H2 filling station with an even much lower operating pressure range of 120MPa. All the designs of compressions, storages, and valves for H2 industries that Energyn proposed are started from these experiences and fundamentals

### Design and construction high pressure vessel and frames



Schematic drawing of Energyn HIP



Schematic drawing of H2 filling station

### Energyn Hot Isostatic Press

- Working pressure : 200MPa
- Max. Pressure : 200MPa
- Pressure media : Inert gases

### HIP Applications

- Casting Densification
- Powder Metallurgy & MIM
- Additive Manufacturing & 3D Printing
- Cladding & Diffusion Bonding
- Intermetallics
- Composites & Ceramics

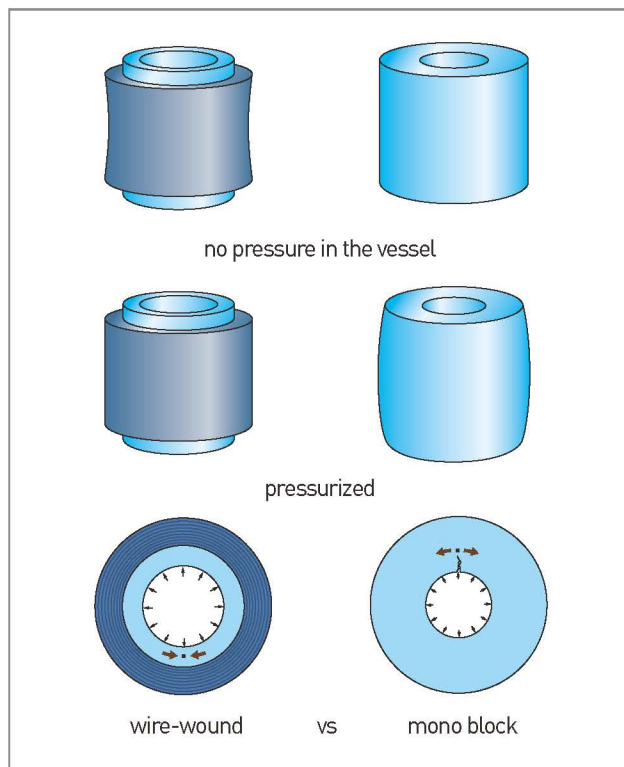


Energyn HIP system

# Core Technology of Energy

## Wire-Wound Technology

The wire wound technology is only one technology ASME permits for high-pressure vessel manufacturing technology over 68.9MPa. Energy has wire-wound technology and applying it for high-pressure vessel manufacturing processes in real. The LBB (Leak before burst) warrants a safe operating environment and the longest durability for the pressure vessel

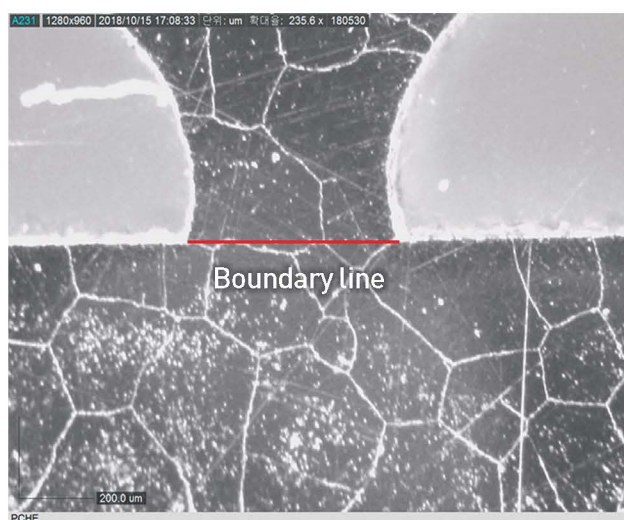


Wire wound vessel vs Mono block vessel

### Wire Wound technology

- Extremely high static and fatigue strength under cyclic pressure load
- No stress-concentration points (see threaded type for comparison)
- Crack propagation eliminated
- Light Weight & Compact Structure

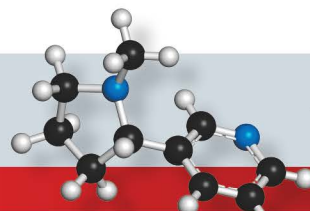
## Diffusion Bonding Technology



Microscope picture of diffusion bonded plates

### Diffusion Bonding Technology

- Bonding or Welding between similar or dissimilar solid materials
- Transient Liquid Phase (TLP) diffusion bonding without inserting an interlayer
- Targeting to achieve its material properties
- Closing interfacial voids with grain diffuse
- Bonding between surface-to-surface not linear area
- Optimized solution for high pressure and wide operating temperature application unit



# Printed Circuit Heat Exchanger for Pre-cooler of H2 station

By incorporating diffusion bonding with micro-channel technology, Energyn can manufacture a unit that is up to 85% smaller and lighter than traditional technologies such as shell and tube heat exchangers. This reduction in unit size can lead to significant savings in structural costs due to the elimination of excess pipework, frames, and associated equipment.



H2 station Pre-cooler PCHE joint qualified by ASME and KGS



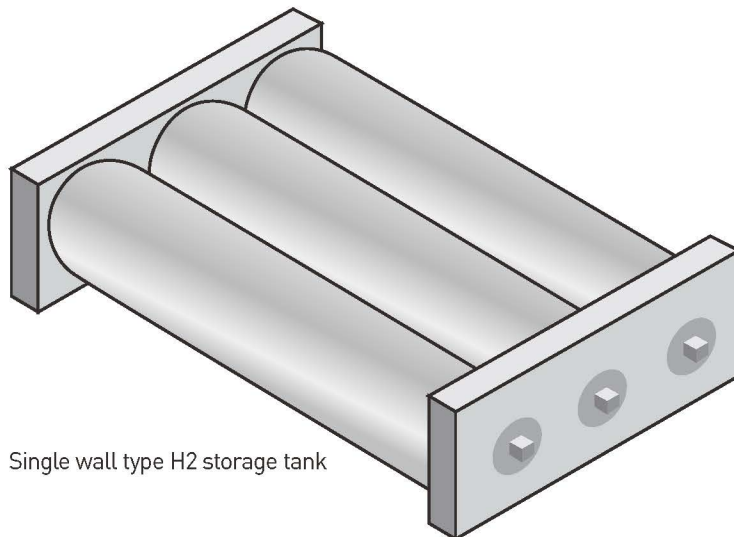
PCHE verification test in real operation environment of H2 filling station

## SPECIFICATION OF PRE\_COOLER HEAT EXCHANGER

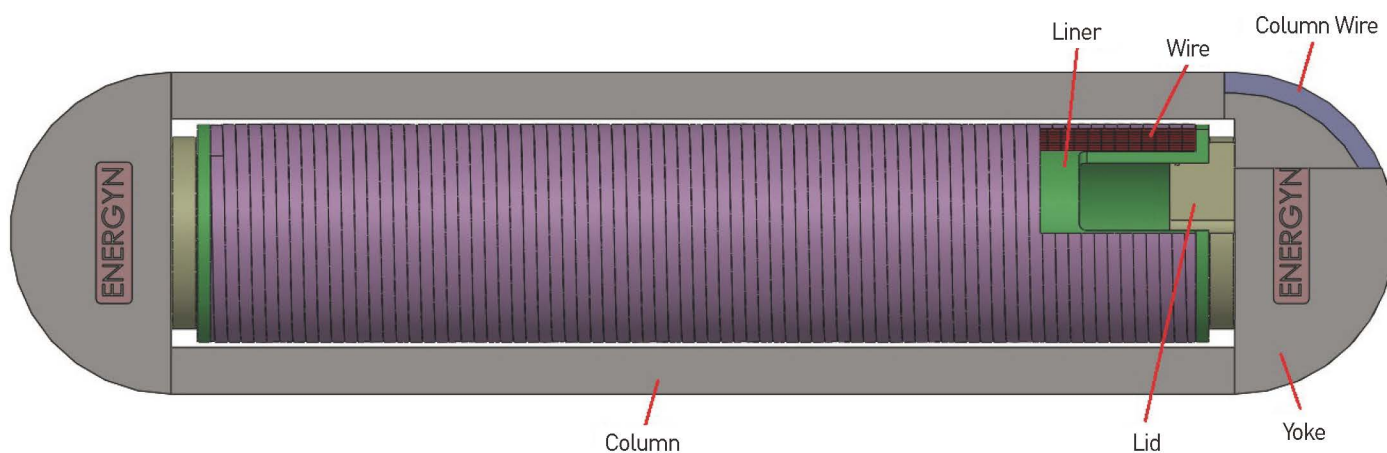
Specification								
Fluid		Unit	Stream 1			Stream 2		
			BRINE			H2		
			4,887			H2		
Flow Rate	Total	kg/hr						
	Vap. In/Out	kg/hr	0	/	0	76	/	76
Density	Liq. In/Out	kg/hr	4,887	/	4,887	0	/	0
	Vap. In/Out	kg/hr	-	/	-	38.350	/	47.014
Viscosity	Liq. In/Out	kg/hr	943.250	/	928.470	-	/	-
	Vap. In/Out	cP	-	/	-	0.011	/	0.011
Thermal Conductivity	Liq. In/Out	cP	7.932	/	5.244	-	/	-
	Vap. In/Out	W/m-C	-	/	-	0.268	/	0.257
Specific Heat	Liq. In/Out	W/m-C	0.125	/	0.123	-	/	-
	Vap. In/Out	kJ/kg-C	-	/	-	15.507	/	16.670
Operating Temperature	Liq. In/Out	kJ/kg-C	1.609	/	1.630	-	/	-
		°C	-45	/	-35.6	35.0	/	-40.0
Inlet pressure		bar g	3.5	/	875		/	
Allowable DP / Cal. DP		bar	1.00	/	0.32	1.00	/	0.21
Heat Load		kW	32					
Fouling Resistance		m2K/W	N/A	N/A				
Thermal Design Result								
LMTD / MTD		°C	21.9	11.4				
Required UA / Actual UA		W/C	1.46	2.98				
Geometry Information								
Design Pressure		bar g	FV	/	10	FV	/	1,000
Design Temperature		°C	-70/70			-70/70		
No. of Layer		-	72			36		
Plate I.D		-	P15			P15		
Heat Transfer Areas		m²	10.37			4.59		
ID		-	N1	/	N2	N3	/	N4
Rating		ASME	-	/	-	-	/	-
Dia.		inch	1-1/2"	/	1-1/2"	1-1/8"	/	1-1/8"
Type & Face		-	THREAD	/	THREAD	THREAD	/	THREAD
Header Type		-	N/A	/	N/A	N/A	/	N/A
Recommended Stainer Size		40 Mesh	Con	80 Mesh	/	Basket		

## Type 1 Wire-Wound H2 storage tank

One of the most difficult issues when decide the installation site of H2 filling station is opposition against explosion risks by neighborhood downtown. This is resulted in why almost H2 filling stations in the world were still being constructing in a far distance from the convenient living area. Type 1 wire wound H2 storage tank eliminates this anxiety through never exploded since it had been used as only one technology for high-pressure vessel application fields



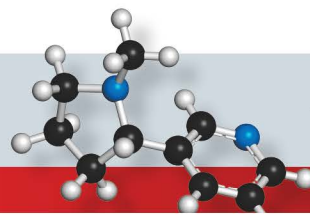
Single wall type H2 storage tank



Type 1 Wire-Wound H2 storage tank and frame.

### Specification of Type 1 Wire Wound H2 storage high pressure vessel

Description	Unit	Specification	Qualification
Design pressure	MPa	125	KGS AC111/ ASME Sec.VIII Div.3
Working Pressure	MPa	100	
Volume	m3	1	
Pressure test	cycles	100K	-
Wire-wound Certification	100Mpa & m3	1	ASME Sec.VIII Div.3
Wire Yield Strength	MPa	1,450	ASTM A931
Wire fatigue limit	MPa	705	ASTM E466



## Burst tester for Hydrogen components:

Hot isostatic press withstanding 200MPa is completed by high pressure safety valves, check valves and compression pumps. Energyn has enough experience to design and manufacture all of related products for last 20 years. All the materials are selected, designed and manufactured considering H<sub>2</sub> brittleness characteristics and qualified under ASME SEC VIII DIV.3.



1000MPa Pressure booster pump



Check valves up to 1000MPa



Check valves up to 1000MPa



The Future of **H<sub>2</sub>,**  
The Future of **Energy,**  
The Future of **Energyn.**

**ENERGYN**  
EXTREME TECHNOLOGY

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