



AIR WATER PLANT & ENGINEERING INC.

LNG equipment & facilities



AIR WATER PLANT & ENGINEERING INC.

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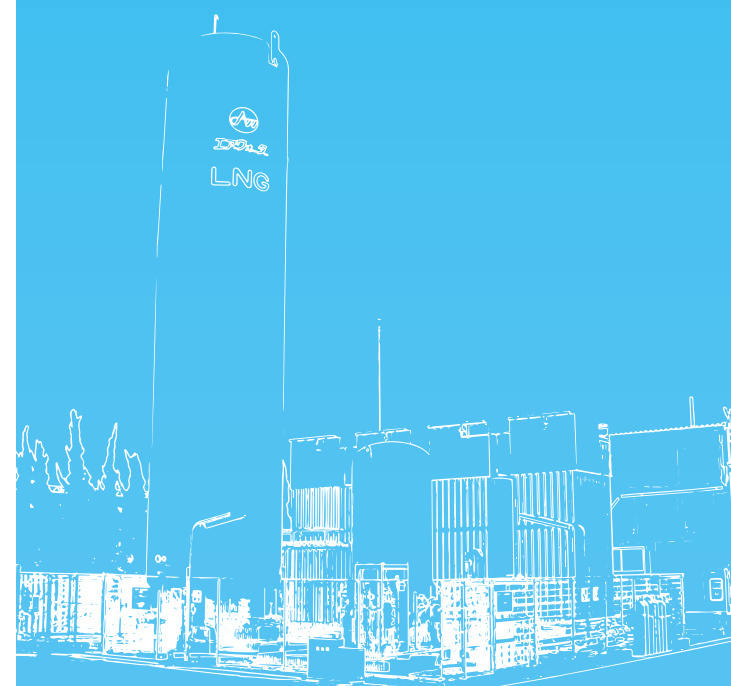
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For AIR WATER PLANT & ENGINEERING INC., "Be creative" is the origin of "creativity."

The stand-alone, complete on-site gas supply for blast furnaces for steel works is just one of the unique AIR WATER models for the gas industry in Japan.

AIR WATER is a comprehensive engineering company covering design, construction, safety, and quality control. The AW brand offers large-scale cryogenic air separation unit.

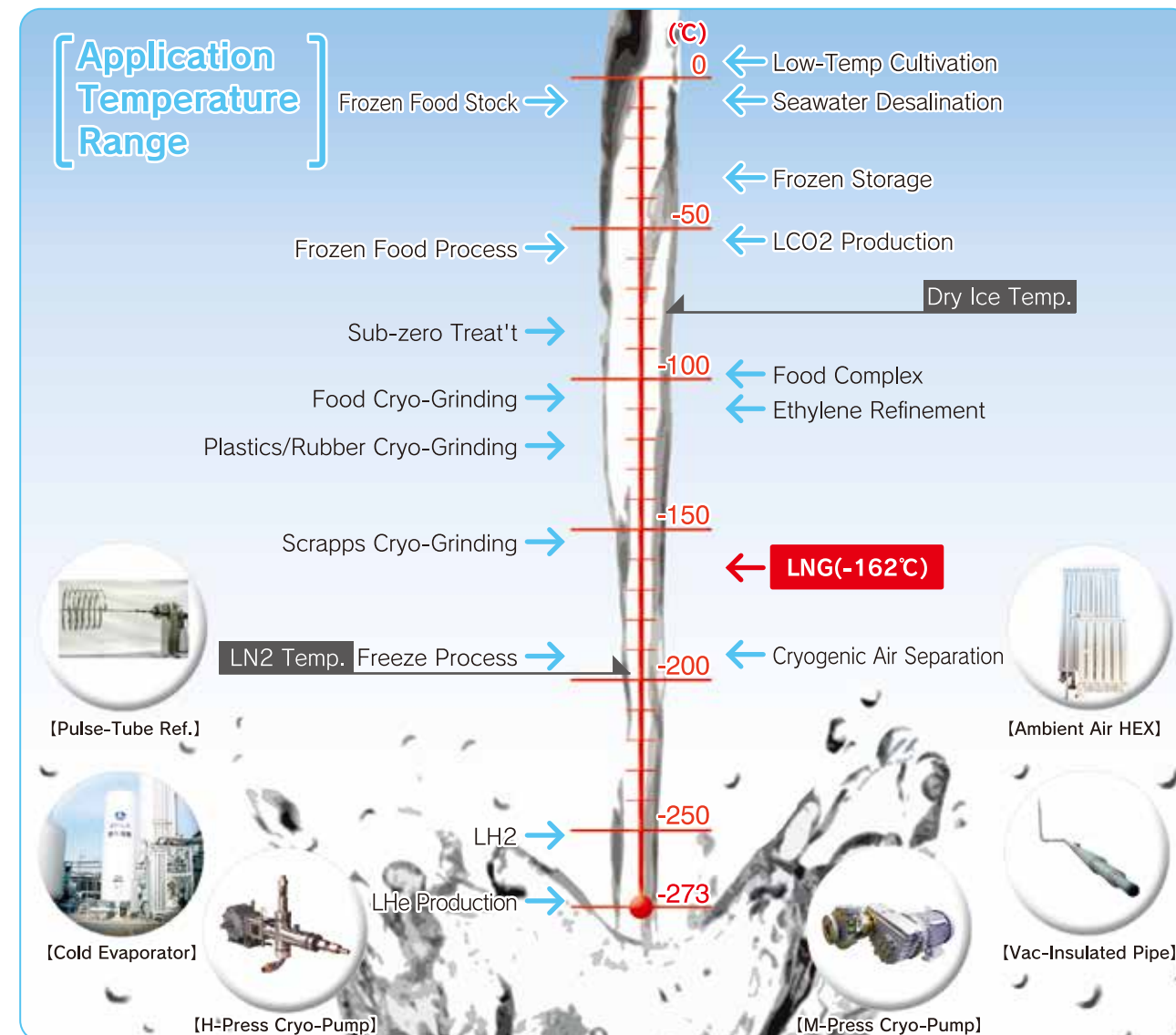
Keywords for our further progress are "Original technology" and "Excellent cost performance."

AIR WATER responds to the customers' needs of when, where and how and supplies the most suitable system from the view of the customers'.

We meet the full scope of a customer's requirements, ranging from a gas cylinder to a plant with several thousand cubic meters per hour of gas output. AIR WATER is eager to provide customers with our unique technologies.

»» Cryogenic Technology

[Industrial Gas Solution: Variation by Gas-handling Technology, and Various application bridged for Future.]



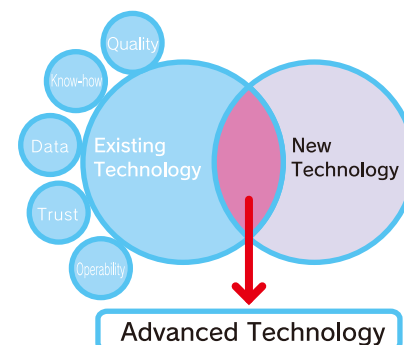
Advanced Cryogenic Technology for R&D in LNG Era

Seriousness in Environmental, less crude oil reliance, save energy trend call for LNG conversion, and more focused on.

Great Blessings of Nature is fed on to....

A global resources cyclical company, Air Water Plant & Engineering Inc. aims developing higher purity, lower cryogenic temperature and/or higher vacuum pressure, and provides various gases like Oxygen, Nitrogen, Argon and/or others based on them and supply systems for various industries like semiconductor, chemical, steel, medical, space, food processing, etc .

We, Air Water Plant & Engineering Inc. proceeds to further improvement in the cryogenic technology.



»» LNG Characteristics

LNG(Liquefied Natural Gas)

- Natural Gas is a fossil fuel consisting of methane mainly with small impurities and resorved deeply inside
- Heat Value: 54.6MJ/kg, Gas Density: 0.83kg/Nm³, Liquid Density: 0.46kg/L approximately
- Boiling Point: approx. -162 °C, normally liquefied at well by 1/500 in volume, and imported for use upon
- One of most clean energy in fossil fuels generating less CO₂, and provides a high energy conversion for environmentally-friendly.
- Stable supply with less price fluctuation based on the wide-spreaded production sites in the world.

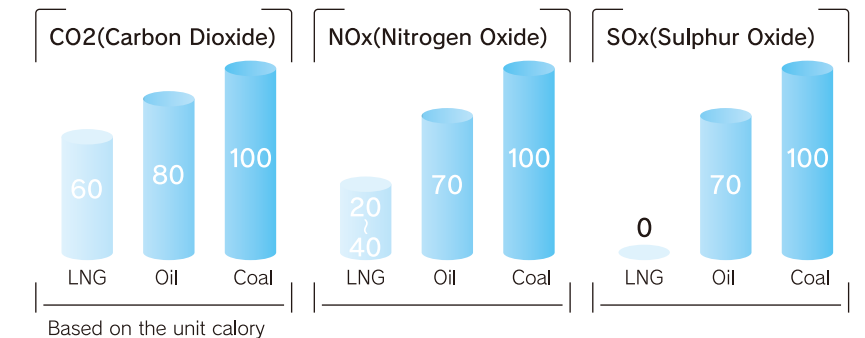
CLEAN ENERGY

Natural Gas contains little sulphur contents, and thus generates less SO_x and soot when combustioned. Furthermore, less NO_x and CO₂ generation is confirmed than Oil or Coal per the unit calory basis. Therefore, NG is enviromentally friendly fuel to the earth.

Heat Value Comparison

LNG	54.6MJ/kg
LPG	50.8MJ/kg
Kerosene	36.7MJ/ ℓ
Heavy Oil	39.1MJ/ ℓ
Coal	29MJ/kg

LNG Pollusion Effect



SAFETY

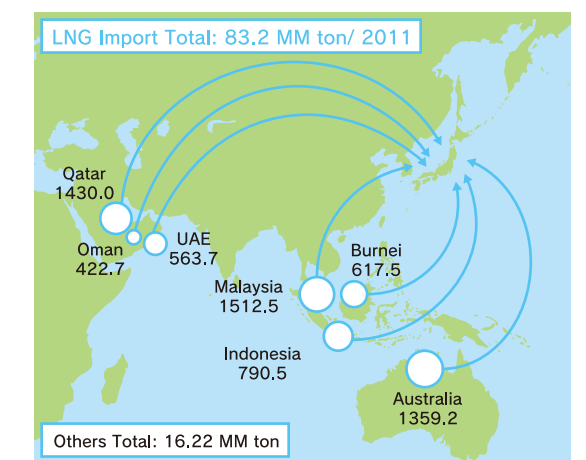
Natural Gas is comasible fuel consisting of methane mainly. The density to air is 0.67, and diffused into the atmosphere with less narrower combustion range smoothly. Thus, an explosion condition is seldom created, and considered as one of safe energies

Town Gas	HHV (MJ/Nm ³)	Specific weight (Air = 1)	Combustion Range (vs Air)	Main Component
12A - 13A (NG)	45.6	0.67	5 ~ 15%	Methane
4A ~ 7C	20.1	0.5 ~ 1.2	5 ~ 20%	H ₂ , CH ₄ , C ₃ H ₈ ,

STABILITY

Natural Gas is developped and produced globally. Japan imports the liquefied NG to maximize logistics. Possible reserves of NG has been confirmed larger than Crude oil, and the expanded long term supply is viable.

In Japan, there are some small scale NG production sites, and Tomakomai-Yufutsu site is one of largest reserve domestically.



Source: Natural Gas 2012, Unit: MM ton/yr

>>> Natural Gas Supply Chain

We can meet any requirements, and supply various styles of energy to the customers.

1. Satellite Station Supply

LNG Satellite Station consists of LNG Storage tank and vaporizer, and locates at the isolated areas and/or non pipeline-covered users as a secondary base. And further, Satellite Station can expand the service areas where used to be no access to the town gas. LNG is hauled in to Satellite Stations by LNG Tank-Lorry and/or TankContainer.

- NG is conditioned equivalent to 13A or 12A grade for supply.
- Satellite Station is constructed and owned by Air Water Inc. at the site to be provided by the customer, resulted in free from the initial investment.



LNG Satellite Station



14 tons Moncoque Lorry



LNG Delivery & Filling Works



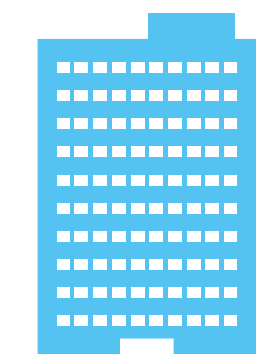
Application Examples



Co-generation



LNG Fuel Truck
(approx. 1000 trucks in USA)



Boiler Fuel

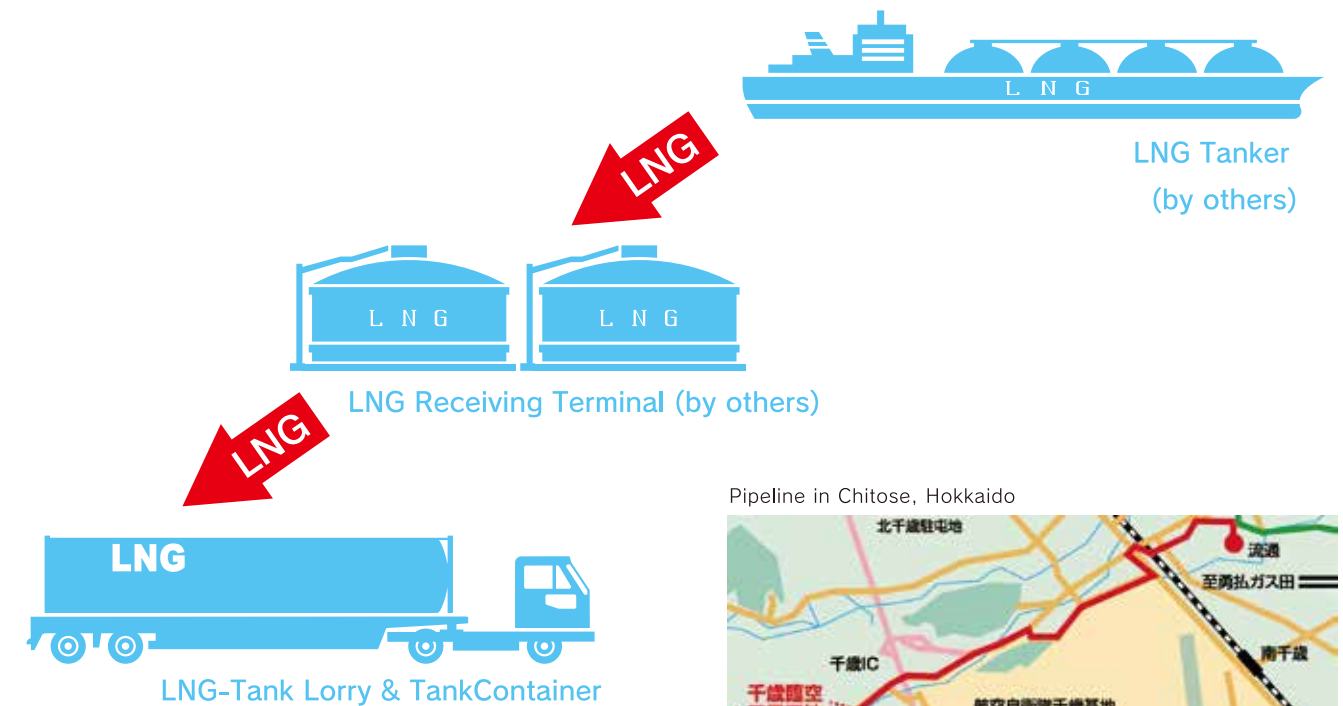


Chitose LNG Supply Station

2. Pipeline Supply

Air Water has constructed its own pipeline, 10 km plus, from Chitose branch point of Yufutsu NG Main Pipeline, to Chitose LNG Supply Station, so as to provide NG for the customers in the Chitose Airport Industrial Park.

Air Water is the first licensed company to conduct NG distribution business other than Gas companies under the deregulation of the Gas Business Law.



Pipeline in Chitose, Hokkaido



LNG Governor



Chitose LNG Supply Station

Chitose Station receives NG at 6.9MPaG pressure, and conditions it to 2.0MPaG for supply. Also, it is controlling and monitoring operation for a stable supply, in addition to pipeline maintenance.

》》 Satellite Station Flow Diagram

[Energy Conservative and Compact Design achieved]

① LNG Transportors



Trailer-type Tank-Lorry and TankContainer provide for large volume transportation.

See P11-12

② LNG Tank (Vacuum insulated)



Vacuum jacketed Single Tank and/or Composite type with Multi-inner tanks are available.

See P13-14

④ LNG Vaporizer

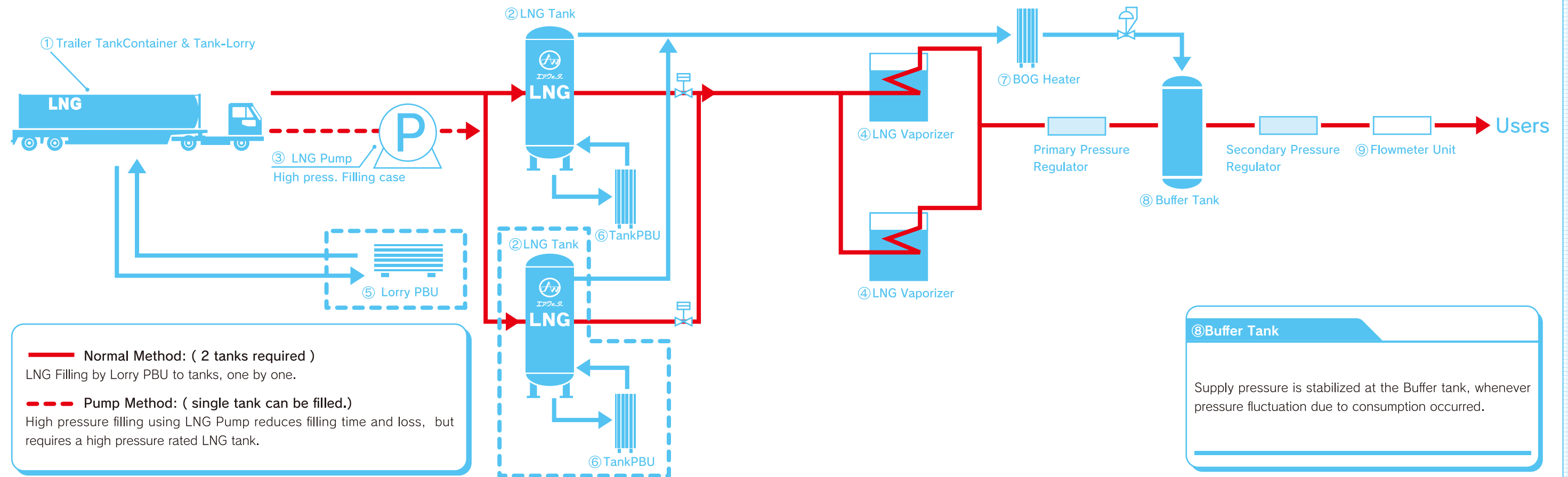


Two types, Ambient air HEX, and Fired or Steam injection Hot Water Bath.

See P15-16

⑦ Boil Off Gas Heater

BOG from LNG Tank and/or Tank Lorry is heated before sending back to the usage line.



⑤ Lorry Pressure Build-up Unit

Lorry PBU pressurizes the transported low pressure LNG in Lorry.

③ LNG Pump



Centrifugal(LNG)

LNG Pump pressurizes LNG for high pressure transfer.

See P14

⑥ Tank Pressure Build-up Unit

PBU pressurizes LNG Tank internal pressure for delivery.

⑨ Flowmeter Unit

Correct flow measuring is achieved by the unit for customers.

>>> LCNG/LNG Station Flow Diagram Natural Gas Fuel Conversion

① LNG Transportors



Trailer-type Tank-Lorry and TankContainer provide for large volume transportation.

See P11-12

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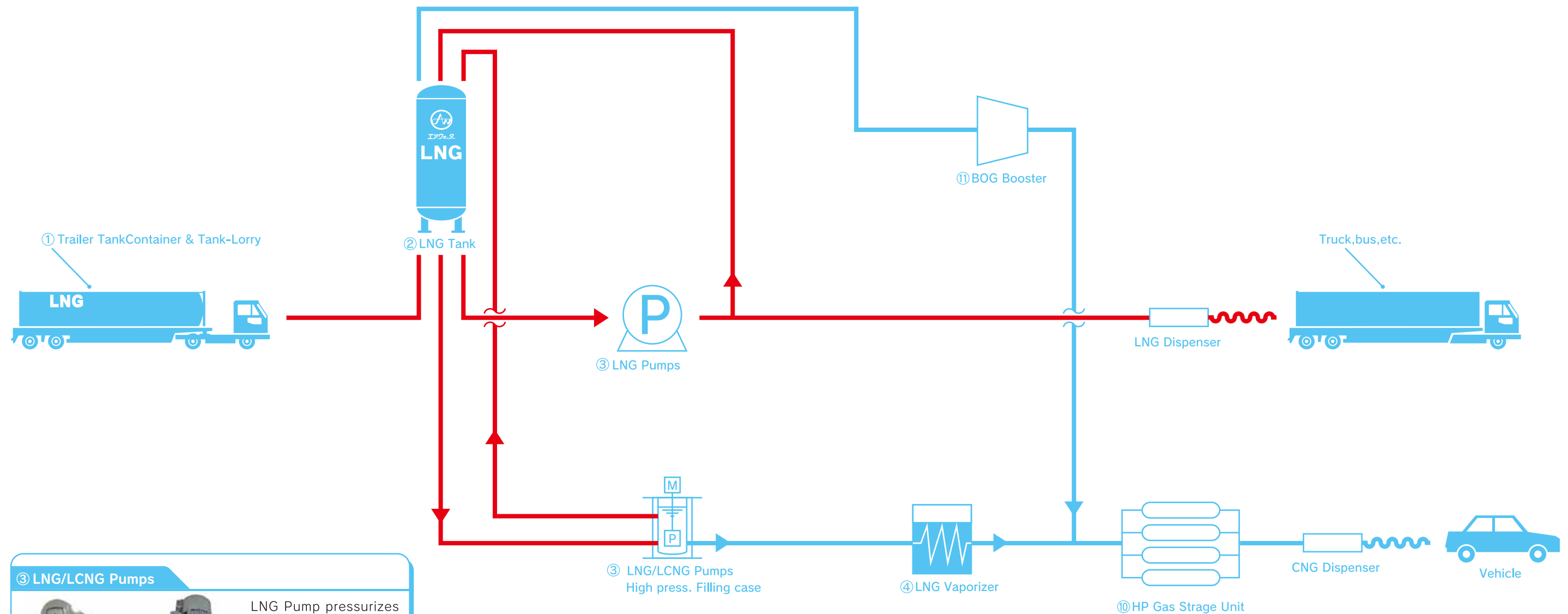
See P13-14

⑩ HP Gas Storage Unit

In order to fill NG quickly into vehicle, NG is stored under high pressure.

⑪ BOG Booster

BOG from LNG Tank is compressed by Booster, and utilized as a fuel for Natural Gas Vehicle (NGV), resulting in reduction of air pollution.



③ LNG/LCNG Pumps



Reciprocate(LCNG)



Centrifugal(LNG)

LNG Pump pressurizes LNG for pressure transfer. Two types, Reciprocate and Centrifugal are available.

See P14

»» LNG Satellite Units and Specifications

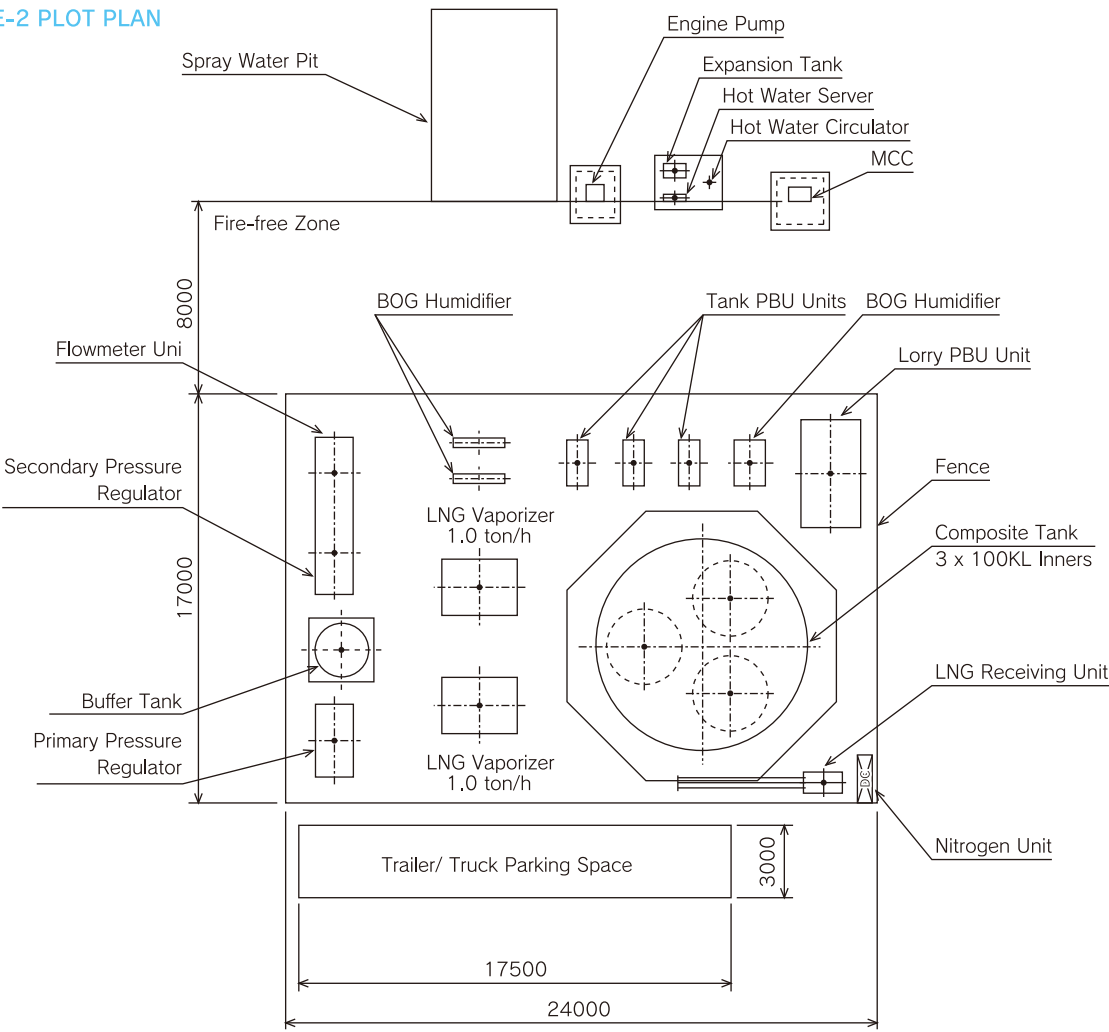
equipment specification table

Air Water Plant & Engineering Inc.(AWP) proposes a suitable LNG Satellite Station for the customer needs based on the accumulated engineering.
For examples, CASE-1~5 are shown below.
AWP can provide a customer specific design for further evaluation upon request.

Typical Satellite Specifications

		CASE1	CASE2	CASE3	CASE4	CASE5
Design Code/ Law		High Pressure Gas Safety Law				
Annual LNG Usage	ton/ yr	8000	6000	4000	2000	1000
LNG Tank	Cap.	kL ea.	125	100	70	40
	Quant.	-	4 (Composite)	3 (Composite)	1	1
LNG Vaporizer	Type	-	Steam Bath	Steam Bath	Steam Bath	Ambient Air Draft
	Cap.	ton/h	1.2	1.0	0.5	0.3
	Quant.	-	2	2	2	2
	Steam Use, ton/h	ton/h	0.7 @ 0.7MPa	0.5 @ 0.7MPa	0.25 @ 0.7MPa	-
Discharge Pressure	MPa	0.2 ~ 0.15				
Managed Stock	Days	5.0	5.4	3.8	3.8	4.3
Space Requirement	m × m	24×17	24×17	18×22	16×16	15×15

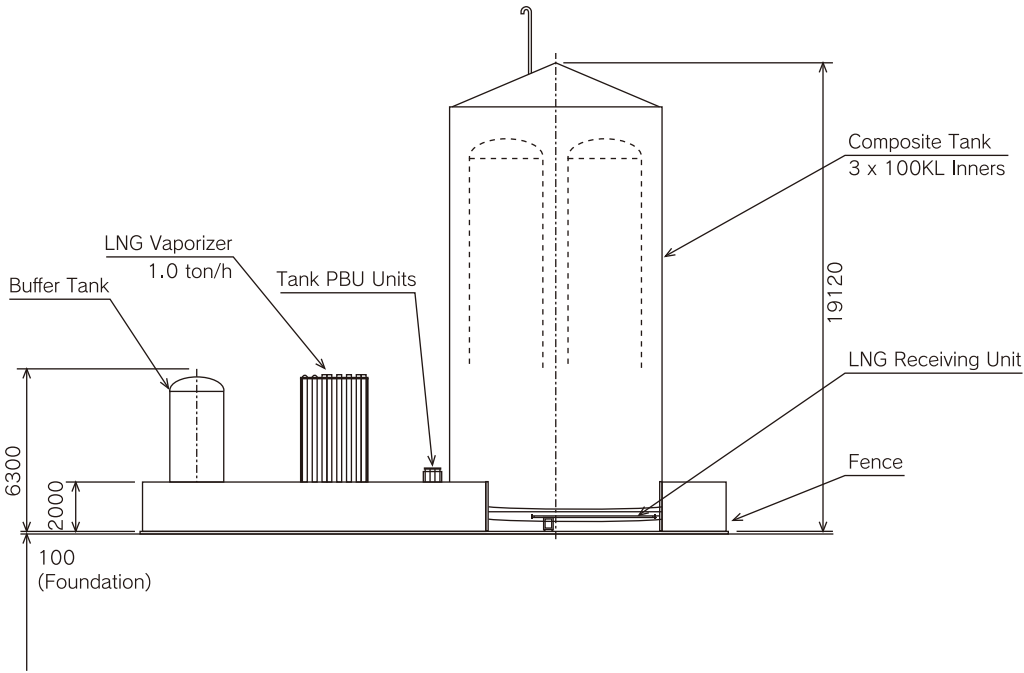
CASE-2 PLOT PLAN



LNG Refilling



LNG Satellite Overview



LNG Tank-Lorry

For LNG bulk transportation, a trailer-type Tank-Lorry has been developed, which has the Monocoque body consisting of Tank and Chassis frame as a combined one body, allowing more load (14 ton and new 15.7 ton) than standard tank lorries.

Specification

	Load (ton)	Max. Filling (MPa)	Total (ton)
Monocoque	15.7	0.6	30.79
	14	0.6	27.25
Standard Lorry	8	0.6	23.79
	6	0.6	19.75



Strong points of Tank-Lorry / TankContainer

1. Monocoque Design

- * Largest load of 15.7 tons LNG is now available, in addition to popular 14 tons, even if PBU vaporizer is mounted(as an option).
- * Tip-over angle = 40 degrees achieved due to the lower gravity center resulted from Monocoque tank design.
- * Conventional one-differential tractor can be used (14 ton load), contributing to fuel efficiency and lower tractor cost (Load distribution at coupler < 10 ton).

2. Superior Composite Insulation Tanks

- * Commercially proven Experiences:

For Railway use (30 ft type)	77 units
For Inland freight (Standard, 40 ft, Monocoque)	224 units
Total (as of March 2011)	301 units
- * Superior to Super-Insulation
 - 1) Lower vaccum pressure than SI, expecting less and easier maintenance.
 - 2) Stable product quality
 - 3) Less pressure rise in Inner tank, even if vaccum-break when trafic accident.



- * Superior to Perlite Vaccum Insulation:
 - 1) Lower insulation materials weight: approx. 1/4
 - 2) No additional filling work (i.e. vibration, etc.)

3. Total Length of Monocoque type trailer= 16.34m,

High Way regulation limit in Japan is 16,5 m or shorter.

4. 14ton Semi-trailer Model

Pressure Buildup Vaporizer mounted



Shortened unloading time

Experiences



Total 224 (76 x 14ton) trailers delivered

Turning Radius



Same TR as conventional 12ton class achieved

LNG TankContainer

The first container dedicated for LNG bulk transportation in the industries, which meets ISO Code, and allows flexible freight plannings with Railway, Ocean and/or Inland transportation. Standard 40ft, 30ft and 20ft models are available. Complete trailer can be provided including Chassis upon request.

Standard Specification

feet-type	Load (ton)	Max. Filling (MPa)	Total (ton)
40-Ocean	12.5	0.6	23.2
40-Land	13.5	0.6	23.5
30-Land/Rail	10.9	0.75	20
20-Land	5.66	0.93	12.63



Semi-Frame 40 ft LNG TankContainer

Semi-Frame Type & Full-Frame Type

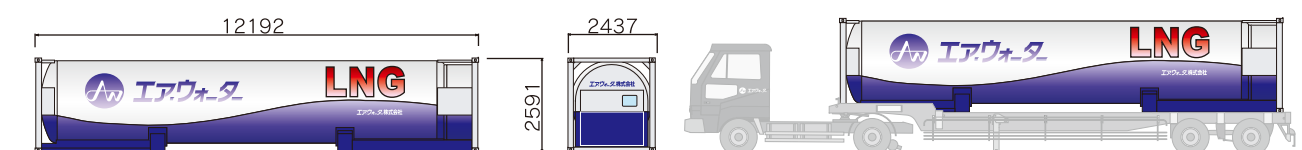
LNG TankContainer is honoured as the 3rd artisanal prize - Production & Process entry, by METI.

- With ISO 40ft dimensions, LNG TankContainer (semi-frame and Inland freight use) achieves 13.5 ton load. To realize stable turning and safety drive, a dedicated reclining trailer is designed to provide a lower gravity like standard lorry. Also, ISO 40ft dimensions for Ocean use LNG TankContainer is available.
- With ISO 30ft dimensions, LNG TankContainer (full-frame and Railway use) achieves 10.9 ton load. This is designed per JR Cargo Standards, and provides for a furtherer transportation using railway cargo.

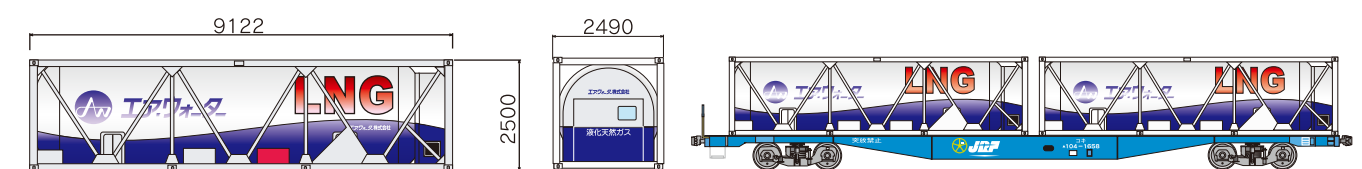


Full-Frame 30 ft LNG TankContainer for Railway

40ft LNG TankContainer (Semi-frame) for Inland



30ft LNG TankContainer (Full-frame) for Railway



>>> LNG Tanks

- * Inner and Outer tanks, dual tank construction with vacuum insulation.
- * LNG is held cryogenically and stably, and discharged at a constant pressure via PBU vaporizer

Use for LNG Storage



Standard Specifications

Capacity (KL)	Design Pressure (Mpa)
30	0.6 ~ 0.9+0.1013
40	
50	
70	
100	
150	
200	

* Pre-check for carry-in route required for the size above 70 KL

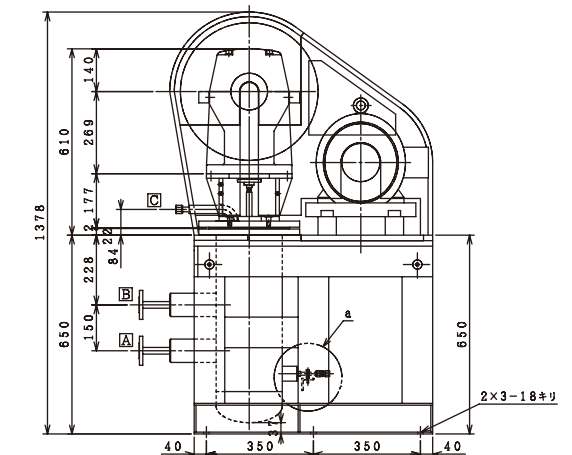
>>> Reciprocating Pump (VP-100L)

Energy saving model with a quick-start function internally developed. Vacuum[^]jacketed liquid chamber is adopted for the reduced vapor loss in addition to less space requirement. Also, V-belt drive provides various discharged pressures for wide users. The pump is manufactured domestically, which responds to prompt maintenance requirements. The pump is HPGSL approved in advance, resulting in easy and quick installation at site.

Use for CNG filling to vehicle and/or cylinder

Standard Specifications

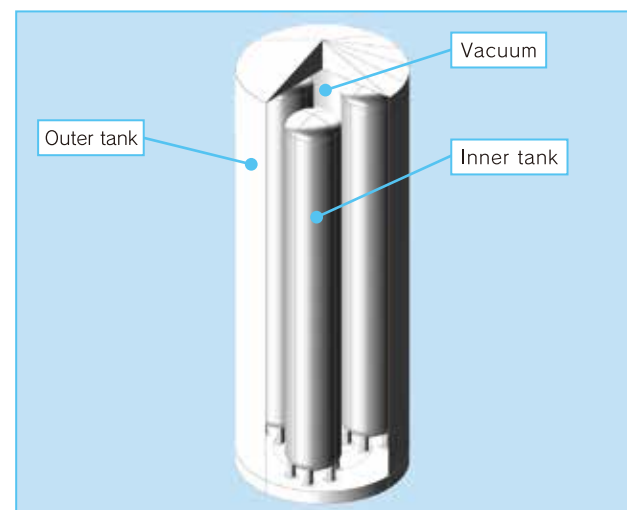
Disch'd P. (Mpa)	Flowrate (L/hr)	Motor Cap. (kW)
0 ~ 30	300 ~ 700	3.5 ~ 15



>>> Composite Tank

- * Multi-inner tanks are included in a common outer tank with vacuum space between inner and outer.
- * The composite tank requires less space than multiple tanks installation. Also, each inner tank can be set at different pressure levels

Use for LNG Storage



Standard Specifications

Capacity (KL)	Design Pressure (Mpa)
300 ~ 800	0.6 ~ 0.9+0.1013

* See page 15 for detailed dimensions.



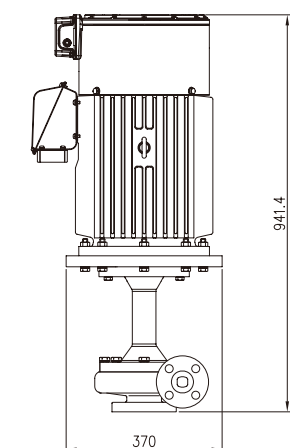
>>> Vertical Centrifugal Pump (VCP series)

The new pump is comprised of two major components, "Seal-less" volute and Inverter motor, and tied together with a common shaft within a closed casing, which allows the Inverter motor in the ambient atmosphere, while the volute is kept under cryogenic temperature. This concept provides a longer life without seal replacement and a quick start for the users.

Use for filling from/to CE, lorry, and/or transfer

Standard Specifications

Dis. head (m)	Flowrate (L/hr)	Motor Cap. (kW)
10 ~ 250	2000 ~ 20000	7.5 , 15 , 30



»» Fire Tube Water-bath Vaporizer

Features

Gas burner is incorporated into vaporizer unit to save space, and an efficient heat transfer to water bath is achieved. The bath capacity is designed large so that the controlled low temperature can deliver the stable vaporized gas.

Specification

Capacity (ton/hr)	Heat value (kW)	D.P. (MPa)	Design Temp (°C)	
			Vapor	Bath
3.5	1465	1.1	-163~+40	0 ~ 100
6	2490	1.1	-163~+40	0 ~ 100

* See page 17 for detailed dimensions.



»» Ambient Air Vaporizer(Natural draft/Fan-Assisted)

Features

High thermal efficiency aluminum fin-tube vaporizers.
Two types, Natural air draft and Fan-assisted types, both vaporize LNG efficiently for user consumption.
Especially, Fan-assisted type provides a powerful performance, when the available space is limited.
Ice forms safely at bottom of vaporizer, and easily removed for a large capacity of vaporization..



Natural Air Draft type



Fan-Assisted type

Specification

Natural Air Draft type

Capacity (ton/h)	Design Pressure(MPaG)	Design Temperature (°C)
~ 1.0	Per specification	-196 ~ 40

Fan-Assisted type

Capacity (ton/h)	Design Pressure(MPaG)	Design Temperature (°C)
3.5	2.0	-163 ~ 40
7.2	2.0	-163 ~ 40

* See page 17 for detailed dimensions.

»» Steam Injection/ Hot Water Vaporizers

Features

Either steam or hot water, whichever available, is used as heat source without any additional equipment.
The unit is flexible, and thus, any capacity can be designed for a stable vaporized gas supply.

Specification

* Steam Injection Vaporizer

Capacity (ton/hr)	
1.3 ~ 4	
Design P. (MPa)	
1.1	
Design Temp (°C)	
Vapor	Bath
-163 ~ +40	0 ~ 100

* Both types can be designed tailor-made per request.

* See page 17 for detailed dimensions.



»» Vacuum Insulated Piping

Features

This piping has been own-developed based on the years of cryogenic engineering experiences, and provides a compact, light weight and high-efficient insulation, and energy saving.
Vacuum conditions are made at shop in addition to the precise fabrication, which should eliminate the final adjustments at site, resulting in cost saving.

Application

LNG supply line, etc.

Specification

Outer /Inner Pipe Materials
SUS304・SUS316・SUS316L
Working Pressure (Normal)
1.0 ~ 7.0MPa
Order-made per specification

* For higher pressure than above, "Outer tube bellows" be applied.



»» Tank / Vaporizer Tables

■ LNG Tank Table (Design Pressure @ 0.7MPa)

Capacity (KL)	Diameter x Height, m	Empty W't (ton)	Oper. W't (ton)	Foundation (W x D, m)
30	φ 2.93×8.07	16.0	28.8	5.0×5.0
40	φ 3.03×9.32	20.8	37.9	5.0×5.0
50	φ 3.23×10.04	23.8	45.1	5.0×5.0
70	φ 3.43×11.77	31.6	61.4	6.0×6.0
100	φ 3.43×16.12	43.0	85.6	6.0×6.0
150	φ 3.43×23.22	64.0	127.9	7.0×7.0
200	φ 3.83×24.0	77.6	162.8	8.0×8.0
300(Composite)	φ 8.7×19.2	185.0	312.8	13.0×13.0
500(Composite)	φ 9.7×20.8	254.0	467.0	14.0×14.0

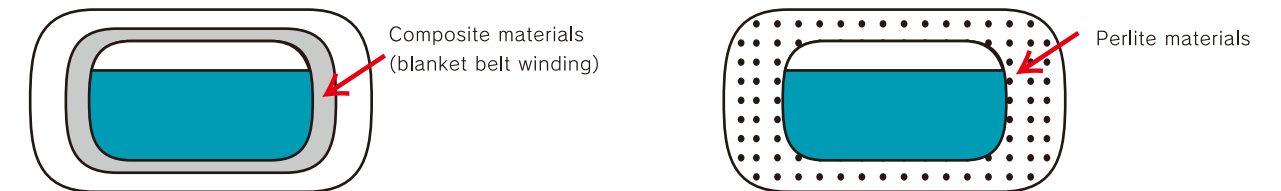
■ LNG Vaporiser Table (Natural Draft, Fan-Assited, Steam Injection, Fire-Tube)

		Capacity (ton/h)	Width x Depth x Height, m	Empty W't (ton)	Oper. W't (ton)
Ambient	ND	0.2	1.15×1.15×5.41	0.6	-
		0.3	1.75×1.15×5.41	0.8	-
		0.5	2.15×1.55×5.41	1.3	-
		1.0	2.75×2.35×5.41	2.4	-
	FA	3.5	1.87×2.3×9.15	7.3	-
Water Bath	SI	0.5	2.0×2.0×2.7	2.4	7.7
		1.0	2.0×2.0×3.0	3.0	8.9
		2.5	2.0×2.0×3.3	4.9	10.8
		4.0	2.2×2.2×3.3	6.3	14.2
	FT	3.5	8.4×2.1×2.4	6.6	20.1
		6.0	10.8×2.8×3.3	18.1	53.4

Note) Foundation depth is subject to Soil data & detaied engineering.

»» Vacuum Insulation System

Composite Vaccum Insulation



Composite Vacuum Strong Points:

* Superior to "Super-Insulation (SI)"

- 1) Lower vacuum pressure than SI, expecting less and easier maintenance.
- 2) Reliable product quality
- 3) Less pressure rise in Inner tank, even if vacuum-break when traffic accident.

* Superior to Perlite Vacuum Insulation

- 1) Lower insulation materials weight: approx. 1/4
- 2) No additional filling work (i.e. settling due to vibration, etc.)

»» Remote Monitoring System

LNG Lorry / Remote Monitoring

Using Devices

- Measuring Unit with wireless LAN.
- Cell-Phone

Device	Function
Measuring Unit	Real time Tank Level & Pressure indications within Local Area
Measuring Unit + Cell	①Real time Tank Level & Pressure readings within Local Area
	②Tank Level & Pressure readings via e-mails of Cell Phone or PC at a regular interval
	③Annunciation e-mail with the conditions to PC or Cell Phone
	④Tank Level & Pressure readings via Internet- connected PC/Cell Phone at a regular interval

Option) Addition of Mailing Analysis Software enables managing total monitoring system efficiently.

