

**VESSEL PARTICULARS (FORM C)**  
**LPG/C ECO INVICTUS**  
**(last updated 24/09/2014)**

Specifications of the vessel and the gas installation which are representations by the Owners.

**(A) VESSEL'S CHARACTERISTICS**

**PREAMBLE**

Name : **LPG/C ECO INVICTUS**  
Owner : **KAIZEN INDUSTRIES LTD**  
Flag : **MARSHALL ISLANDS**  
Build : **Sasaki Shipbuilding Co., Ltd., JAPAN**  
Date on Service : **30 Sep 2014**  
Class : **BV**  
IMO Number : **9711470**  
GRT International : **abt. 4,294 T** Suez : **TBC**  
Panama : **TBC**  
NRT International : **abt. 1,376 T** Suez : **TBC**  
Panama : **TBC**  
Is vessel build according to USCG regulations? : **Yes**  
Japanese regulation? : **N/A**  
Has vessel received USCG approval? : **N/A**

**HULL**

LOA : **99.98 M**  
LBP : **93.50 M**  
Breadth(Moulded) : **17.20 M**  
Depth (Moulded) : **7.80 M**  
Summer Draft : **6.10 M** Corresponding to Summer DWT = 4,920 T (TPC: 14.74 MTS)

Freeboard (summer) : 1.721 M  
Light Draft : 2.49 M  
Full load displacement : 7,722 T  
Light displacement : 2,790 T  
Parallel Length perpendiculars : **46.12 mtrs**  
Estimated draft with full cargo and full bunkers are as follows.

Product	Draft Fore' (m)	Draft Aft' (m)	Draft Mean (m)	Corresponding Deadweight (t)
<b>Propane (98%)</b>	<b>4.66 M</b>	<b>5.55 M</b>	<b>5.10 M</b>	<b>3,511 Mtons</b>
<b>N-Butane (98%)</b>	<b>5.12 M</b>	<b>5.70 M</b>	<b>5.41 M</b>	<b>3,949 Mtons</b>
<b>Butadiene (98%)</b>	<b>5.33 M</b>	<b>5.77 M</b>	<b>5.55 M</b>	<b>4,146 Mtons</b>
<b>VCM (92%)</b>	<b>5.35 M</b>	<b>6.78 M</b>	<b>6.06 M</b>	<b>4,932 Mtons</b>

**Propeller immersion : In Condition which Ballast Water properly arranged.**

**Immersion (TPC) in Salt water :**

**At draft 5.35 m correspond. : 13.27 tons per centimetre (Ballast Condition)**  
**At draft 5.55 m correspond. : 13.87 tons per centimetre (Propane load condition)**

**COMMUNICATION EQUIPMENT**

Call letter : **V7HC4**  
 Radio Station normally watched : **YES**  
 Radio MF/HF NBDP : **YES**  
 Radio MF/HFTEL/DSC : **YES**  
 VHF : **YES**  
 Satellite Communication **Inmarsat 'C'** : **453838898**  
**TELEPHONE NR** : **0870773213130**  
**FAX NR** : **0870783239873**  
**EMAIL** : **ecoinvictus@stealth.gr**

**MACHINERY**

**Main Engine x 1** . Type and make : **HANSHIN B&W, two cycle, single acting, cross head type diesel engine, 5L35MC**  
 . Max. Power / RPM : **2,750 KW / 178**  
 No of Cylinders : **6 Cylinder**  
 Cyl Bore x Stroke : **350mm X 1050mm**  
 . Grade of fuel used : **380 CST**

**Auxiliaries** Type and make : **YANMER CO., LTD. 6AYL-WET x 2 sets**  
 (Electrical) : **562.5 KVA (450 KW), AC445V, 60HZ, 3 phase, 722A**  
 (Mechanical) : **491 KW, 1800 min<sup>-1</sup>**  
 Grade of fuel used : **Marine Diesel Oil**  
 No off : **2**

**Emergency Gen** Maker : **MITSUI ZOSEN MACHINERY INC.**  
 Type : **6CTA8.3D(M)**  
 No off : **1**

**Bow Thruster** : **1**  
 Type : **TCB-55MN**  
 Maker : **KAMOME PROPELLER CO., LTD.**  
 Capacity : **316 KW**

**Boiler** Type : **VWH-800E, Natural circulating vertical water tube boiler**  
 Maker : **MIURA CO., LTD.**  
 Evaporation : **800 kg/h (actual evaporation:717 kg/h)**  
 Max Design Pressure : **0.7 Mpa**  
 No off : **1**  
 Grade of Fuel used : **Same as ME used heavy oil**

**Exhaust Economiser** Type : **KF-111F, Forced circulating type Multitudinous Tube**  
 Evaporation : **350 kg/h**  
 No off : **1**

**Air Compressors (Main)** Type / Capacity : **YANMER CO., LTD. SC12.5N**  
**65 M<sup>3</sup>/hFA X 2.94 Mpa**  
 No off : **2**

**Air Compressors (Emergency)** Type : **YANMER CO., LTD. SC12.5N**  
**7.7 M<sup>3</sup>/hFA X 2.94 Mpa**

No off : **1**  
**Fuel Oil Purifier** Type : **S815 (Maker : ALFA LAVAL)**  
 No off : **2**  
 Capacity : **1500 L/h at 380 CST/50 deg.C**

<b>Lub Oil Purifier</b>	Type	:	<b>P615 (Maker : ALFA LAVAL)</b>
	No off	:	<b>1</b>
	Capacity	:	<b>1500 L/h</b>
<b>Evaporator</b>	Type	:	<b>JWP-26-C 80 (Maker : ALFA LAVAL)</b>
	Capacity	:	<b>10 tons / day</b>
<b>Fresh Water Sterilizer</b>	Type	:	<b>USS-1k (Maker : UZUSHIO ELECTRIC)</b>
	Capacity	:	<b>1000 L/h</b>
<b>Fresh Water Mineraliser</b>	Type / Capacity	:	<b>NIL</b>
<b>Waste Oil Incinerator</b>	Type	:	
	Capacity	:	<b>300,000 kcal/h</b>
<b>Oily Water Separator</b>	Type	:	<b>USH-20 (Maker : TAIKO KIKAI IND.)</b>
	Capacity	:	<b>2 m<sup>3</sup>/h</b>
<b>Sewage Treatment plant</b>	Type	:	<b>SBT-25 (Maker : TAIKO KIKAI IND.)</b> <b>Rated number of persons = 25 Man / Day unit</b>
	Capacity	:	<b>Sewage BOD volume = 13.5 g/ Man-Day</b> <b>Sewage volume – 60 L / Man-Day</b>
<b>Calorifier unit</b>	Type	:	<b>HSF12-FG-S (Maker : HARISON SANGYO CO., LTD.)</b> <b>(Electric heater = 30 kW)</b>
	No off	:	<b>1</b>
<b>Steering Gear</b>	Type	:	<b>SP-W12-170-S (Maker : TOKIMEC INC.)</b>
	Duty Capacity	:	<b>167.6 kN.m</b>

### Speed

Upto Beaufort scale 4, Douglas sea state 3

**About:** 13.5 Knots @ CSR with 15% sea margin

### CONSUMPTION/ DAY

		<b>At Sea</b>	<b>In Port</b>
Main Engine	HFO	<b>About 11.2 Tons @ 90% Load (Loaded condition)</b>	<b>Nil</b>
		<b>About 10.7 Tons @ 90% Load (Ballast condition)</b>	
Auxiliary Engine	DO	<b>: 1.0 MT</b>	<b>- 1.2 MT ( With 2 GENS RUNNING)</b>

Permanent bunker capacity (100%)

HFO	:	<b>440.84 m3</b>
Diesel	:	<b>96.94 m3</b>
Fresh Water	:	<b>181.80 m3</b>

## (B) CARGO INSTALLATIONS

### 1. Transportable products and respective quantities, calculated in accordance with IMO – maximum filling formula. (Tonnes)

	100% (CBM)	98% (CBM)		
NO.1 CARGO TANK	2,507.892	2,457.734		
NO.2 CARGO TANK	2,508.079	2,457.917		
TOTAL	5,015.971	4,915.651		
	SPSV (bar g)	Ref. Temp. (deg. C.)	Density at (Ref. Temp.)	Corresponding Quantity (MT)
Propane	17.65	45.0	0.459	2,256
Propylene	17.65	45.0	0.470	2,310
B/P Mixture	*1	45.0	*1	*1
I-Butane	17.65	45.0	0.526	2,585
N-Butane	17.65	45.0	0.548	2,693
Butylene	17.65	45.0	0.565	2,777
Butadiene	17.65	45.0	0.588	2,890
V.C.M.	17.65	45.0	0.872	4,286
Isoprene	17.65	45.0	0.656	3,224
Pentanes	17.65	45.0	0.600	2,949
Pentene	17.65	45.0	0.611	2,820

Note (1): Specific gravity to be determined according to the mixing ratio.

### 2. Other transportable products N/A

	SPSV	Ref. Temp. (°C.)	Density at Ref. Temp.	Corresponding Quantity (MT)
	*	*	*	*
	*	*	*	*

\* Figures are varied in accordance with the mixing proportion of the components and are to be determined on the basis of the characteristics of main component having the highest vapour pressure in the mixing products.

### 3. TANKS

- 3.1 Design pressure (Vapour) – : 17.65 bar g (1.765 MPag)  
:  
3.2 Valve setting : 17.65 bar g  
3.3 Maximum vacuum obtainable : Atmospheric  
3.5 Maximum temperature acceptable : 45 °C  
3.6 Minimum temperature acceptable : -10 °C  
3.7 Hydrostatic Test Pressure : 26.48 bar g (2.648 MPag)

### 4. LOADING RATE (TONS/HOUR) – For Full Cargo Parcels

- Ex-atmospheric storage with gas : 1 tank : 450 m<sup>3</sup> / h for LPG  
Return : 2 tanks : 790 m<sup>3</sup> / h for LPG

Remarks:

\* Calculated based on 7 m/sec. in velocity head at 10" of liquid line. Except VCM, and 5.0 m/sec for VCM in the liquid piping.

\* If cargo temperature is less than -10 °C, shore heater to be used. If ship cargo heater used, max rate is **250 m<sup>3</sup>** per hour.

\* Loading by shore pump only, proper size gas return line to be connected

\* Subject to both ship and shore tanks being under favourable conditions

## 5. CARGO PUMPS

- 5.1 Type : **Vertical multistage centrifugal Deep well**  
Make : **WÄRTSILÄ SVANEHØJ A/S**  
How many : **1 Set / Each Tank**  
Maximum specific gravity : **0.965 VCM, 0.610 LPG**
- 5.2 Capacity (CMB/Hour) : **300m<sup>3</sup>/h (S.G.0.610), 250m<sup>3</sup>/h (S.G.0.965)**  
Two speed or variable speed : **FIXED SPEED @ 1785 rpm**  
Rated kW (each) : **130 KW**  
Working pressure maximum : **21.6 bar g**
- 5.3 Location : **on the Cargo Tank**  
Removable : **Not removable**
- 5.4 Booster pumps : **One**  
Type : **Horizontal, centrifugal**  
Maker : **WÄRTSILÄ SVANEHØJ A/S**
- 5.5 Capacity (CMB/Hour) : **300m<sup>3</sup>/h (S.G.0.610)**  
Working pressure : **21.6 bar g**
- 5.6 Location : **near manifold**
- 5.7 Time to discharge a full liquid cargo using all pumps against back pressure at pump  
1 bar : **about hours for LPG : 18 Hrs**  
5 bars : **about hours for LPG : 24 Hrs**  
Time will vary depending on shore tank condition
- 5.8 Nominal back pressure when working : **about 1 bar**  
In series corresponding head : **220 m**  
Maximum back pressure : **about 10 bar**  
Nominal pressure at rail (propane) : **about 13 bar at 20 degree C of cargo temperature**
- 5.9 What amount of cargo remains in tanks after completion pumping before stripping:  
- liquid : **about 1.5 m<sup>3</sup> per one tank**  
- vapour : **about 30 ton per one tank for LPG**

## 6. STRIPPING

- 6.1 Stripping system, if any : **Not equipped**
- 6.2 Time required to remove all traces of liquid cargo as stated in 5.9 for:  
- LPG : **about 3 hours**

## 7. CARGO COMPRESSORS

- 7.1 Type : **Vertical single stage double action fresh water cooled, oil less compressor**  
**LPGOS-97A**

Make : **Tanabe Pneumatic Machinery Co. Ltd.**  
How many : **2 set**  
Piston displacement : **460 m<sup>3</sup> / H**  
Rated Kw : **75 kw**  
Stroke : **177.8mm**  
Max discharge pressure : **20 bar g**  
Pressure differential(Suction pressure) : **7 bar at single action**  
No of Revolutions : **540 rpm**

7.2 Are compressors oil free : **Yes**

7.3 Can they reliquefy VCM without risk : **N/A**

7.4 State time to bring full cargo of butane to atmospheric pressure from : **N/A**

## 8. N2 SYSTEM

8.1 Does the vessel use N2 : **The vessel has N2 Generator**  
If so, state utilization and quantities : **Innerting & Gas freeing**

8.2 Can the vessel produce N2 gas? : **Yes**  
If so, state type and composition of gas produce: **PSA type N2 Generator**  
**250 Nm<sup>3</sup>/h @ 99.9%N2(Include Ar)**  
**370 Nm<sup>3</sup>/h @ 99.0%N2(Include Ar)**  
**475 Nm<sup>3</sup>/h @ 97.0%N2(Include Ar)**

Discharge pressure **0.5MPa**

8.3 Maximum production obtainable : **475 Nm<sup>3</sup>/h @ 97.0%N2(Include Ar)**  
**\*Performance design standard temperature ; 30° C**

~~NOTE:- Above quantities obtained at engine room temperature 45° C~~

8.4 State if there are storage facilities for inert gas onboard: **NO**  
- Size : **N/A**  
- Pressure : **N/A**

8.5 State if any shore supply of nitrogen may be required: : **N/A**  
- for what purpose : **N/A**  
- what quantities : **N/A**

## 9. GAS FREEING

9.1 State method used giving all details : **Blow off remaining cargo vapour in cargo tank by N2 and thereafter gas free by dry air.**  
9.2 State time required including stripping : **About 4-5days**

## 10. CHANGING GRADE

10.1 From completion discharge of cargo Propane, time required in hours and N2 in CBM required to reach a tank and gas installation atmosphere of less than 100 ppm of Propane in Vapour phase.  
**Time required: About 6-7 days (Base on 250m<sup>3</sup>/h of N2 capacity)**

10.2 Can this operation be carried out at sea? : **Yes**

10.3 Can the ship measure the number of ppm in vapour phase? : **Yes**

10.4 Has vessel deck tank for changing grade/cooling operations? : **No**

10.5 Deck tanks : **NIL**  
Capacity :  
Purpose :

**11. COOLING BEFORE LOADING** : **Not required**

**12. CARGO HEATER**

12.1 Type : **Horizontal Shell and Tube**  
12.2 Inside Diameter : **700 mm**  
12.3 Overall length : **6430 mm**  
12.4 Cargo flow rate : **250 m3/H**  
12.5 Min Inlet Temp : **-48 degrees C**  
12.6 Min Outlet Temp : **-10 degrees C**  
12.7 Required Sea water Capacity : **450 Tons/h**  
12.8 Design Pressure : **20 bar g (cargo side), 5 bar g (sea water side)**  
12.9 Hydrostatic Test Pressure : **30 bar g**  
12.10 Tightness Test Pressure : **20 bar g**

12.0 State discharging rate for propane to be brought from atmospheric pressure **NA**  
Loading rate for Propane – **42 ° C / – 10 0° C: about 250 M3/hr**

**13. CARGO VAPORIZER**

In case vapour gas is needed to feed compressors, can vessel produce its own if no shore available: No

**14. REFRIGERATING APPARATUS** **NA**

14.1 Is it independent of cargo? : **NA**  
Is so, state cooling agents : **NA**

14.2 What minimum temperature can be maintained : **NA**

14.3 What time required at sea to lower by 1°C the full cargo of : **NA**

**15. MEASURING APPARATUS**

What gauges on board?

Type : **Float type level gauge; Musasino M-LMZ**  
Location : **Near each cargo tank dome**

Type : **Float type level gauge; HENRI FTLG 807**  
Location : **On each cargo tank dome**

**16. SAMPLES**

16.1 State how tank atmosphere samples can be taken and where from? From Slip tube and from drain line  
: **Top**  
: **Middle**  
: **Bottom**  
Standard of fitting? : **JIS PT1/4 thread**

16.2 Same question for cargo : **Closed loop sampling**

16.3 Are sample bottles available on board? : **No**

**17. CARGO LINES**

- 17.1 Is ship fitted with a port and starboard cargo manifold? : **Yes**
- 17.2 Position of cargo manifold
- distance from bow : **56.18 M**
  - distance from Aft : **63.11 M**
  - height above deck : **1.10 M**
  - distance from ship's rail : **2.45 M**
  - underside keel to manifold : **9.95 M**
  - height above grating to center of manifold : **N/A**
- 17.3 Liquid line
- diameter : **200 mm (OD)**
  - flange-size : **8" inches ANSI 300 lbs**
  - type : **Rise face ( RF)**
- Gas line
- : **125 mm (OD)**
  - flange-size : **5 inches ANSI 300 lbs**
  - type : **Rise face (RF)**
- 17.4 What reducers on board? : **ANSI 300 lbs – 8"x10", 8"x6", 8"x5", 8"x4" 8"x3"**  
**ANSI 150 lbs – 8"x8", 8"x6"**  
**JIS 20K – 8"x8", 8"x6", 8"x4"**  
**For Vapor line (normal temp.) : ANSI 300 lbs – 5"x 4", 5"x3", 5"x2"**  
**ANSI 150 lbs – 5"x 5", 5"x3", 5"x2"**  
**JIS 20K – 5"x 5", 5"x4"**
- 17.5 Is ship fitted with stern discharge? **No**
- Liquid line - diameter : **N/A**
  - flange – size : **N/A**
  - type : **N/A**
- 18. HOSES**
- Are serviceable hoses available on board? : **None**
- 18.1 Two pieces, each : **N/A**
- Length : **N/A**
  - Diameter : **N/A**
  - Flange-size : **N/A**
  - Type : **N/A**
  - Bending radius : **N/A**
- 18.2 Minimum temperature acceptable : **N/A**
- Maximum pressure acceptable : **N/A**
- 18.3 For what products are hoses suitable? : **N/A**
- 19. DERRICKS**
- Hose cranes : **Electric – Hydraulic**
  - Where situated : **Cargo manifold**
  - Lifting capacity : **4.0Ton at max distance from ship's side : 1.5 meter**
  - Working radius : **360 degrees**
- 20. SPECIAL FACILITIES**
- 20.1 How many grades can be segregated? : **1 (one)**
- 20.2 How many cooled? : **N/A**
- 20.3 Can vessel sail with slack cargo tanks? : **Yes**