CL-2002K

SHINKO SMB

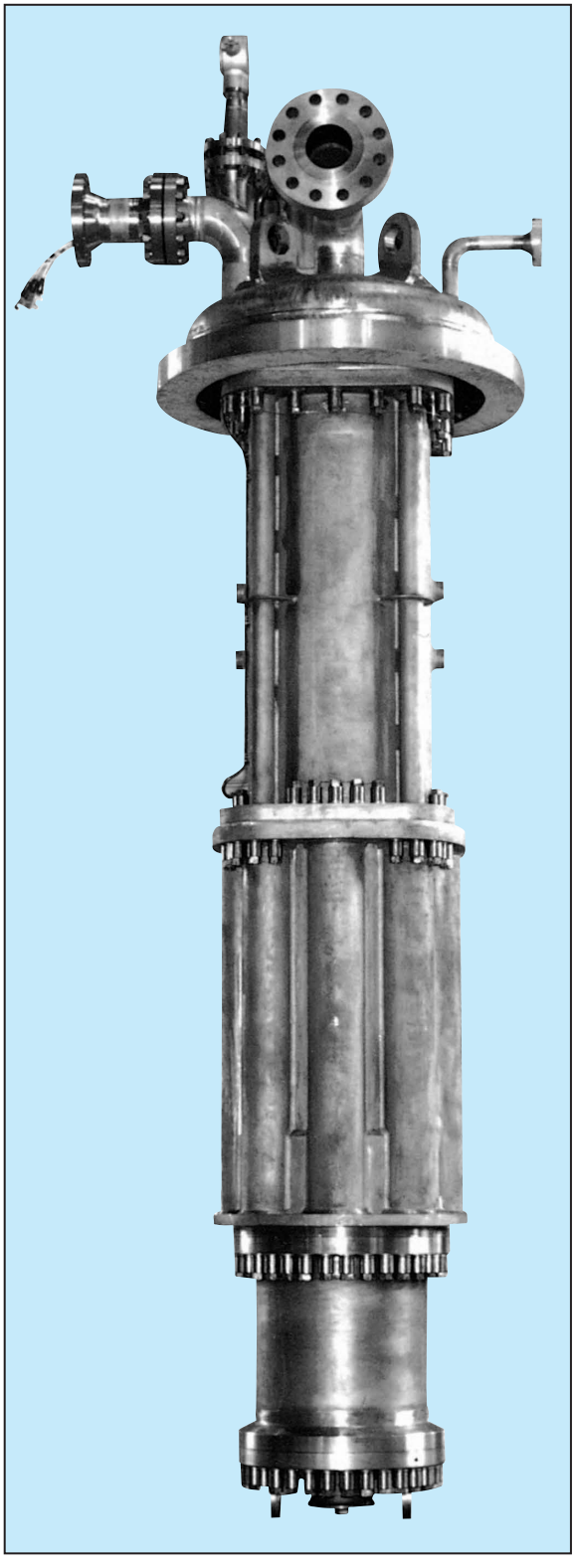
SUBMERGED LIQUEFIED GAS PUMPS

MULTI-STAGE
HYDRAULICALLY SELF BALANCED

SHINKO IND. LTD.
Hiroshima Japan

SMB SUBMERGED LIQUEFIED GAS PUMPS

Shinko-Nishishiba SMB type motor pumps have been developed as send-out pumps in LNG/LPG/DME storage stations, or as pressurizing and circulating pumps in LNG cryogenic power generation plants.
The pump is submerged in cryogenic liquefied gas within the barrel installed outside of the storage tank. The pump can be taken out of the barrel easily by closing the valve located between the barrel and tank, when it is necessary to check the pump for maintenance or inspection.



- The pump and motor are constructed as to form a single unit and be submerged in the pumping liquid. Thus, there is no fear of liquid or gas leakage because no sealing devices are required.
- The motor is operated in liquid, and is completely isolated from the atmosphere. Hence, there is no fear of an explosion.
- At the even numbered stages of the pump, the impellers are divided into 2 groups of equal numbers, and are arranged back to back with each other. Therefore, the hydrodynamic thrust is so balanced that the ball bearings are free from handling undue loads.
- The lower side of the first stage impeller is equipped with an inducer. The low NPSH feature of the inducer ensures safe operation even when the available NPSH is 0 meters.
- Ball bearings are lubricated via the pumped liquid, which is also used for cooling the motor.
- The stator coil is constructed with a form-wound type having a high insulation property and rigidity. Materials with a high insulation property, durability, and cryogenic resistance property are used for the motor insulation and varnish.

GENERAL CHARACTERISTICS

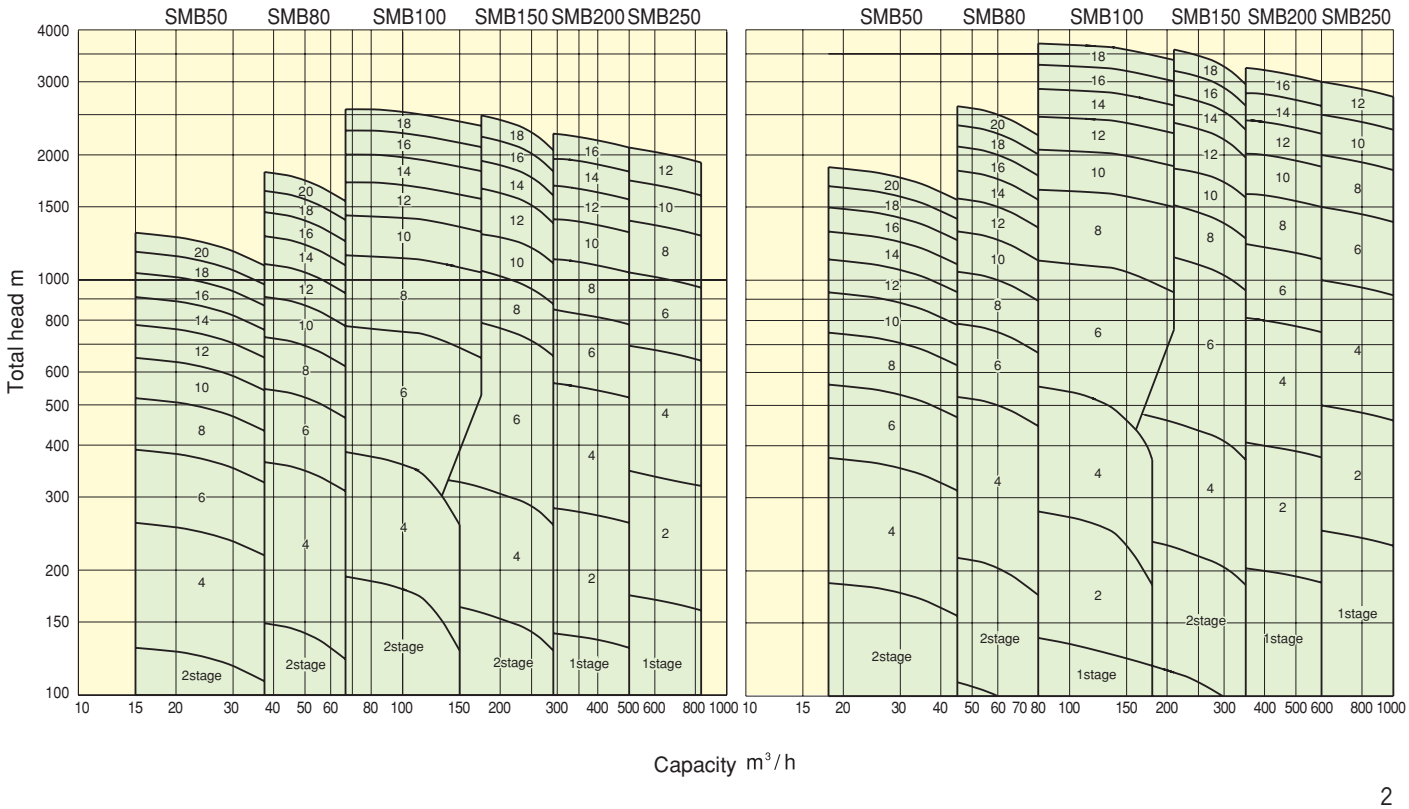
The following standard 6 models are available:

	Item \ Model	SMB 50	SMB 80	SMB 100	SMB 150	SMB 200	SMB 250
Pump	Type	Barrel type multi-stage centrifugal pump					
	Max. capacity (m^3/h)	45	80	210	350	600	1000
	Total head (m)	100～3500					
	Liquid temperature (℃)	40～－196					
	Suction bore (mm)	100	150	200	300	350	450
	Discharge bore (mm)	50	80	100	150	200	250
	Place of installation	Outdoor					
Motor	Type	Submerged type 3-phase squirrel-cage induction motor					
	Synchronous speed (min^{-1})	3000, 3600					
	Voltage (V)	400/440, 3000/3300, 6000/6600					
	Frequency (Hz)	50, 60					
	Coil	Form wound type					
	Insulation	Class F					
	Rating	Continuous					
	Starting method	Full voltage start					

PERFORMANCE CHART

Pump model and the number of impeller stages can be determined from the following charts based upon the total head, capacity, and Hz:

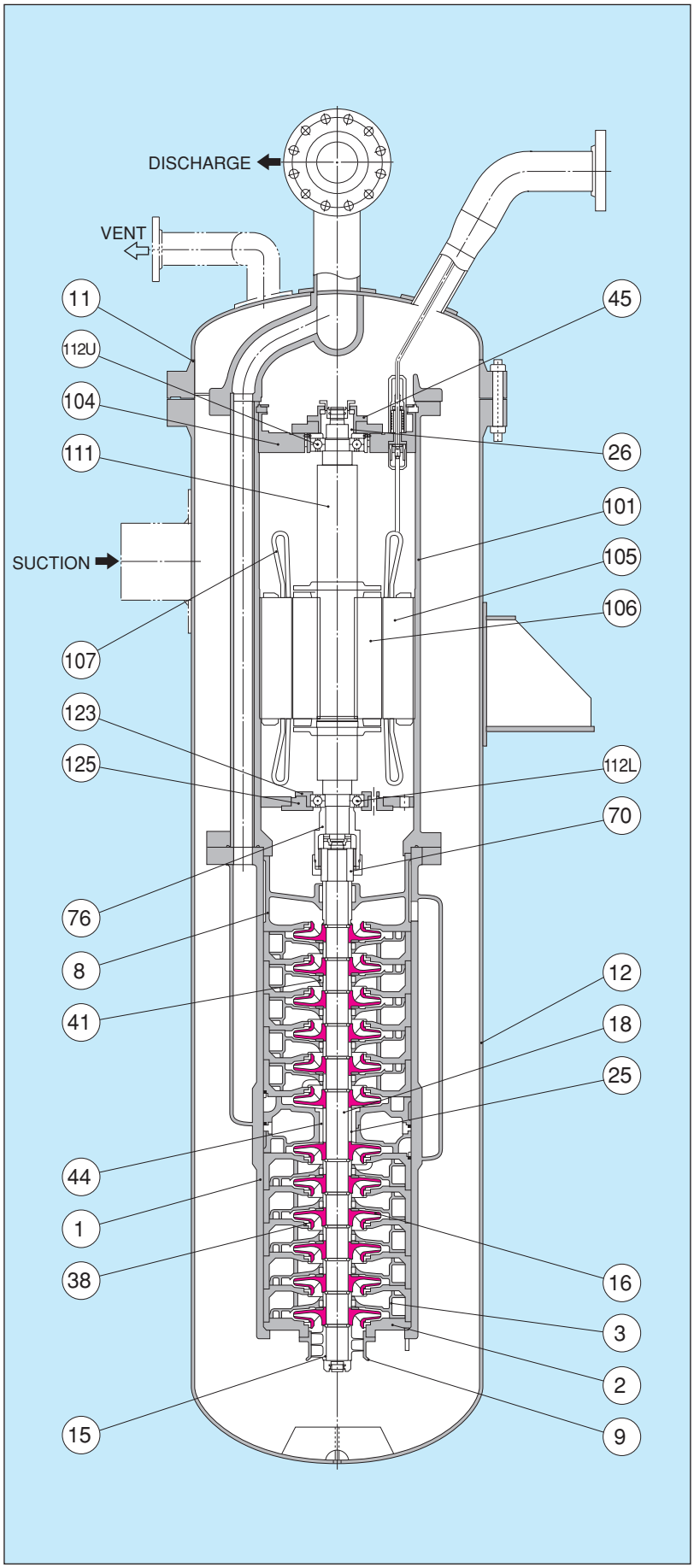
50Hz **60Hz**



DESIGN & MATERIALS

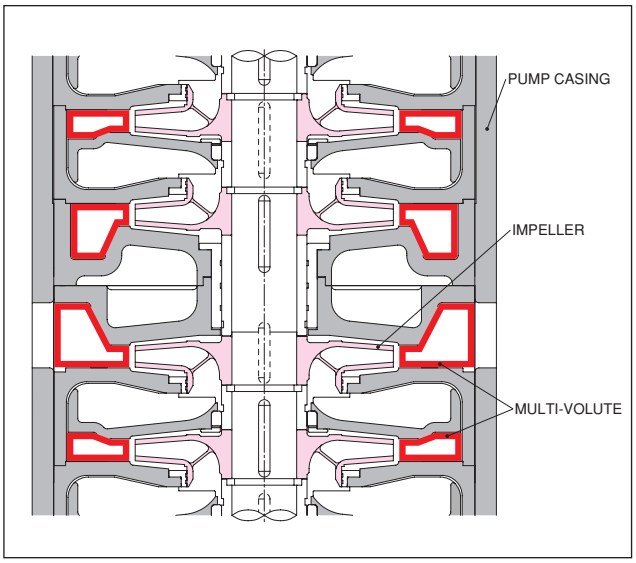
The pump casing and motor frame are combined with a flange joint as one unit, and are hanged from the barrel cover. The pump unit is submerged in liquid inside the barrel for use.
The weight of the rotating part of the pump and motor is supported by ball bearings which are located on the motor side.
The materials of the pressure sections such as pump casings, motor frames, and other parts are either aluminium alloy cast or stainless steel, depending on the application pressure. Other materials used are shown in the table below:

PART NO.	NAME OF PART	MATERIAL		
		NAME	JIS	ASTM EQUIVAL
1	PUMP CASING	Aℓ ALLOY CASTING or STAINLESS STEEL	AC4C-T6 or SUS304	SG70A or A276-75-304
2	SUCTION COVER	STAINLESS STEEL	SUS304	A276-75 304
3	VOLUTE	Aℓ ALLOY CASTING	AC4C-T6	SG70A
8	CASING COVER	〃	〃	〃
9	BELL MOUTH	LEAD BRONZE	CAC604	B584-74 938
11	BARREL COVER	STAINLESS STEEL	SUS304	A276-75 304
12	BARREL	〃	〃	〃
15	INDUCER	Aℓ ALLOY	A2017BE	2017
16	IMPELLER	Aℓ ALLOY CASTING	AC4C-T6	SG70A
18	PUMP SHAFT	STAINLESS STEEL	SUS304	A276-75 304
25	STAGE SLEEVE	〃	〃	〃
26	BALANCE SLEEVE	〃	〃	〃
38	MOUTH RING	LEAD BRONZE	CAC604	B584-74 938
41	SLEEVE BEARING	SPECIAL CARBON	—	—
44	STAGE BUSH	LEAD BRONZE	CAC604	B584-74 938
45	BALANCE BUSH	〃	〃	〃
70	COUPLING	STAINLESS STEEL	SUS630	A564 S17400
76	COUPLING	〃	SUS316	A276-75 316
101	MOTOR FRAME	Aℓ ALLOY CASTING or STAINLESS STEEL	AC4C-T6 or SUS304	SG70A A276-75, 304
104	FRAME COVER	〃	A5083P-O or SUS304	A276-75 304
105	STATOR CORE	SILICON STEEL	—	—
106	ROTOR CORE	〃	—	—
107	STATOR COIL	COPPER	—	—
111	MOTOR SHAFT	9% Ni-STEEL	—	—
112 L.U	BALL BEARING	STAINLESS STEEL	SUS440C	A276-75 440C
123	BEARING CASE	〃	SUS630	A564 S17400
125	BEARING COVER	〃	〃	〃



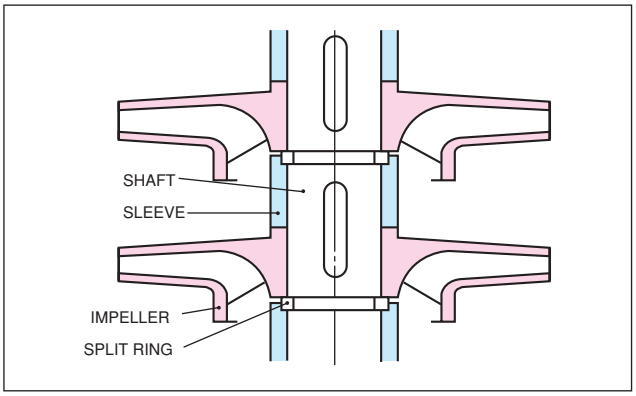
●Pump Casing

An even number of impellers are arranged symmetrically on the top and bottom portions of the shaft in the pump casing.
Since Shinko-original-multi volutes are used, instability caused by rotating stalls near the minimum flow zone does not occur.
Therefore, a quiet and stable operation is assured all through the operating process, resulting that a longer bearing life is attained.
Additionally, by adopting the multi-volute design, the radial thrust on the impellers is balanced at each stage, resulting that there is no danger of shaft bending.



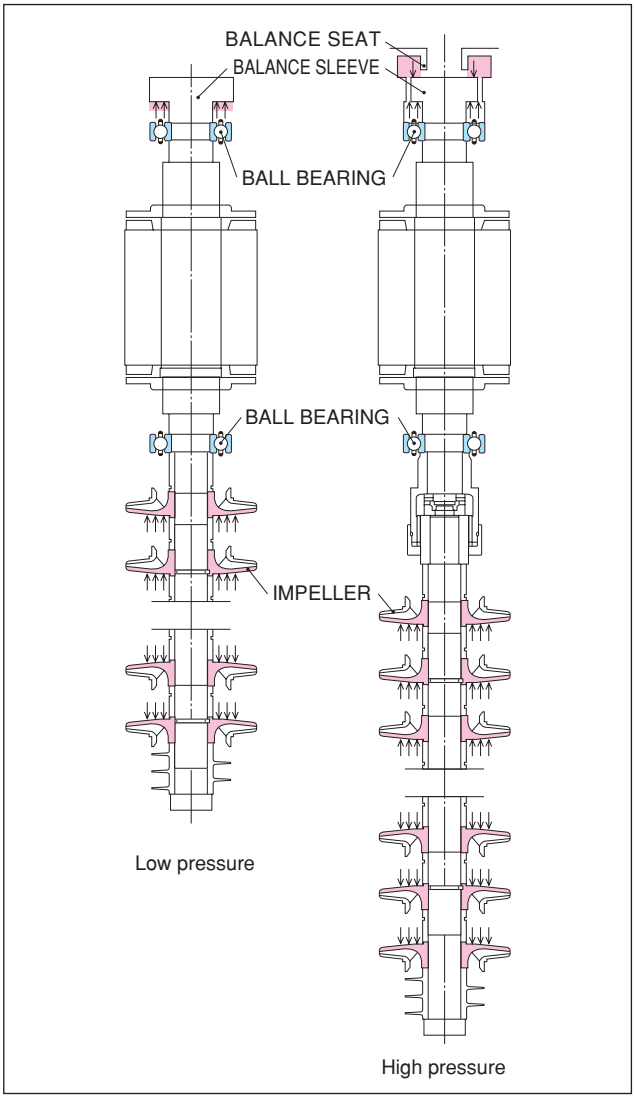
●Impeller & Inducer

The impellers are the single suction type with an even number of stages in order to keep the axial thrust in balance, being arranged symmetrically in equal numbers.
The inlet of the 1st stage impeller is fitted with an inducer with spiral blades in order to minimize the NPSH of the pump.
The impellers are placed in the shaft by means of sleeves and two-piece-ring keys. Accordingly, no work is required, when reassembling, in relation to dimension measurements, positioning adjustments, and so on.



●Balancing Mechanism

The hydraulic thrust of the impeller is completely balanced by the symmetrical arrangement of the impeller.
For low pressure pumps, a balance sleeve is fitted at the upper end of the shaft, and upward thrust is generated by the intermediate stage pressure acting on the lower face. Then, the weight of the rotating element on the lower ball bearings is reduced.
For high pressure pumps, an auto balance mechanism is utilized at the upper end of the shaft, so that no axial thrust acts on the ball bearings.

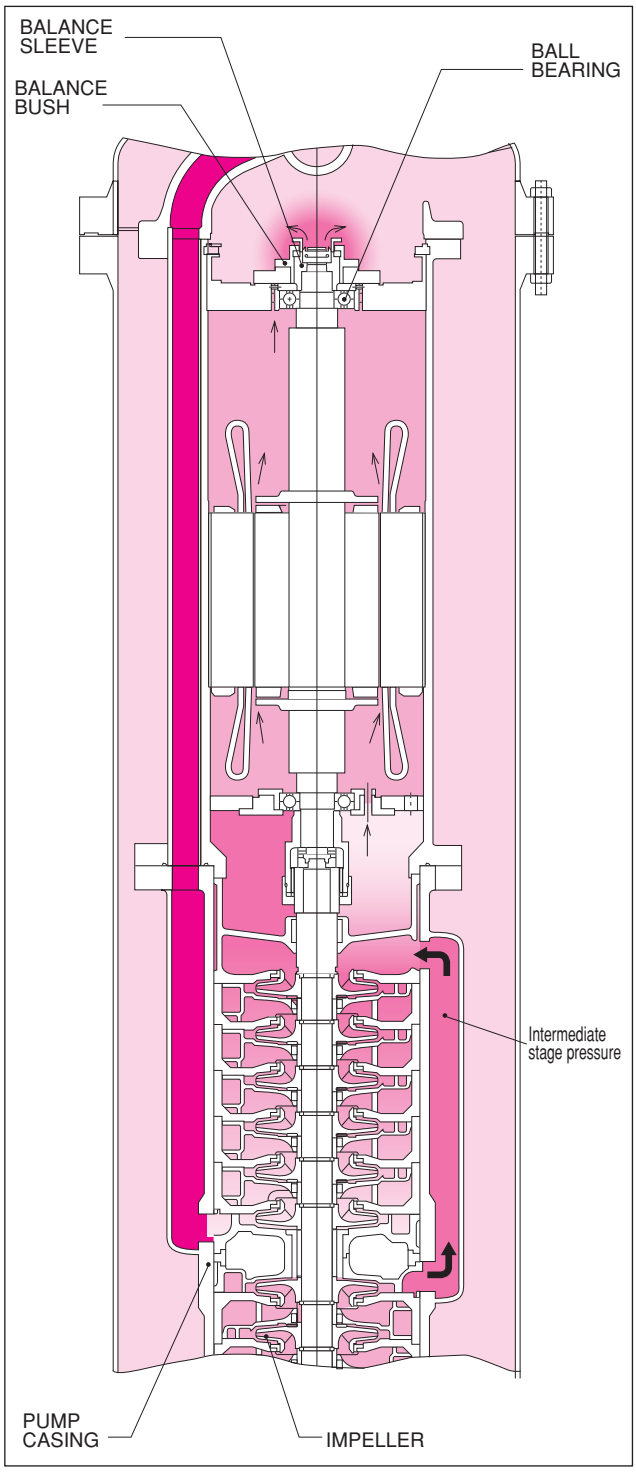


●Ball Bearings

Each set of single row deep-groove ball bearings (customized for submerged pumps handling extremely-low temperatures) is positioned at both the upper and lower side of the motor shaft. The inner and outer rings are made of stainless steel. The cage is constructed with teflon-system resin. Between the stages of the pump, sleeve bearings are utilized in order to support the impeller shaft, and the structure is designed to support accidental radial thrust as well.

●Cooling Ball Bearings & Motor

The ball bearings and motor are cooled off using a portion of the liquefied gas (pumping liquid) which has the intermediate pressure in the pump.
The cooling liquid lubricates and cools the lower ball bearing, the motor, and the upper ball bearing, and then is discharged inside the barrel.

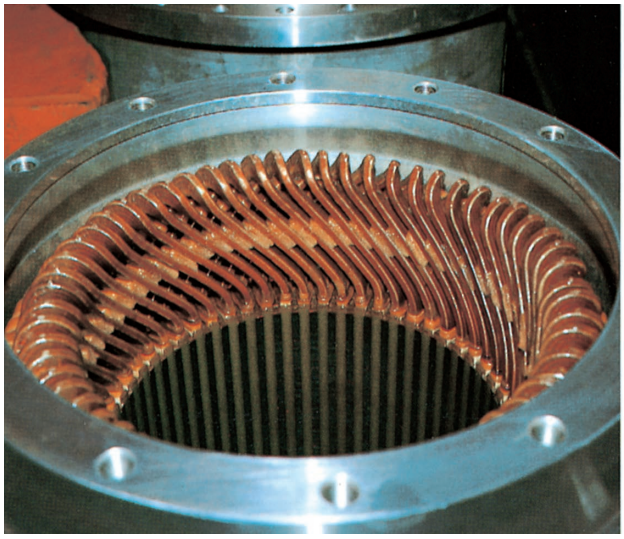


●Demagnetization of Ball Bearings

Consideration has been given to prevent the magnetization of the ball bearings, as magnetized bearings attract the iron powder in liquids causing the bearings to be damaged.

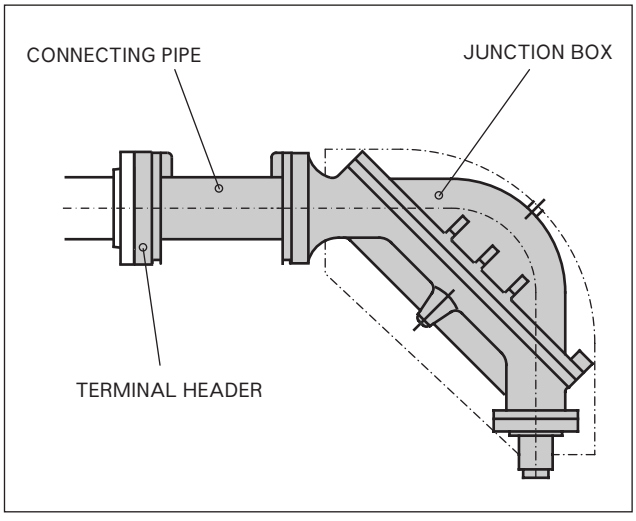
●Stator Coil

Consideration has been given to insulation, due to the fact that the coil is used in cryogenic liquid. For the stator, form-wound coil wires have been given a mechanically-and-electrically integrated design using special insulation materials.



●Connecting Pipe & Junction Box

The connecting pipe uses a tightly sealed terminal header made of electric insulation materials. Thereby, complete air-tightness is maintained so that the cryogenic temperature is not transmitted to the junction box.
The junction box is installed in a hazardous area. Therefore, it is designed to be pressure resistant and explosion-proof (Exd).



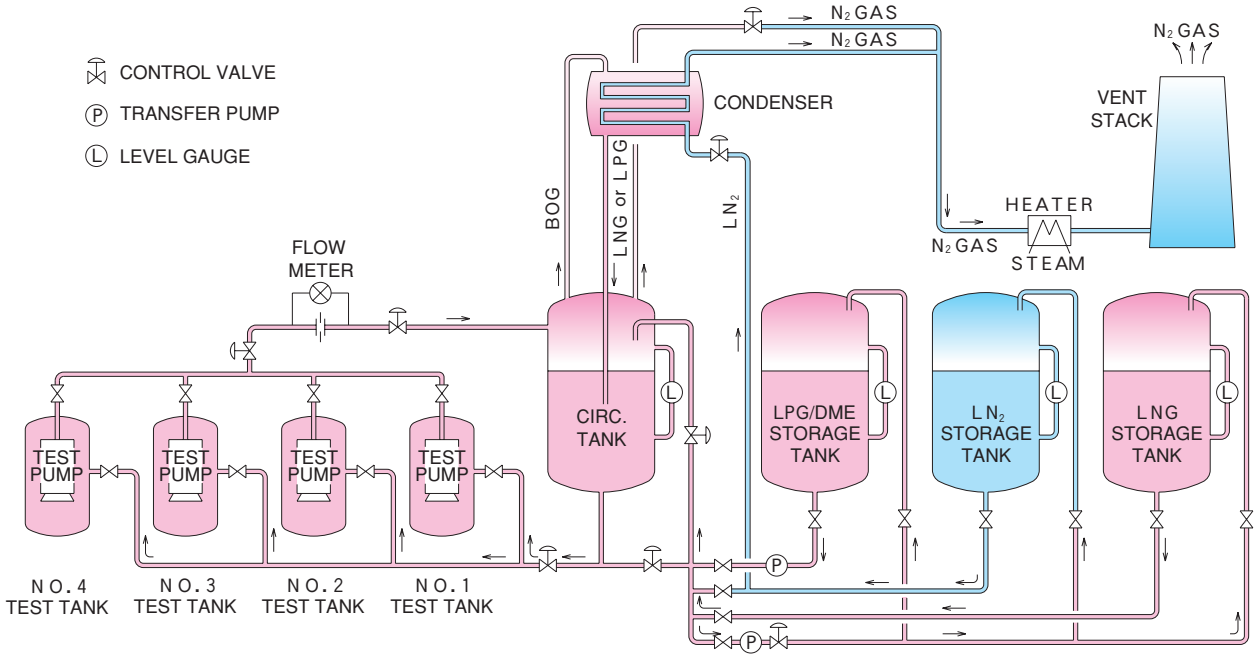
PERFORMANCE TESTS

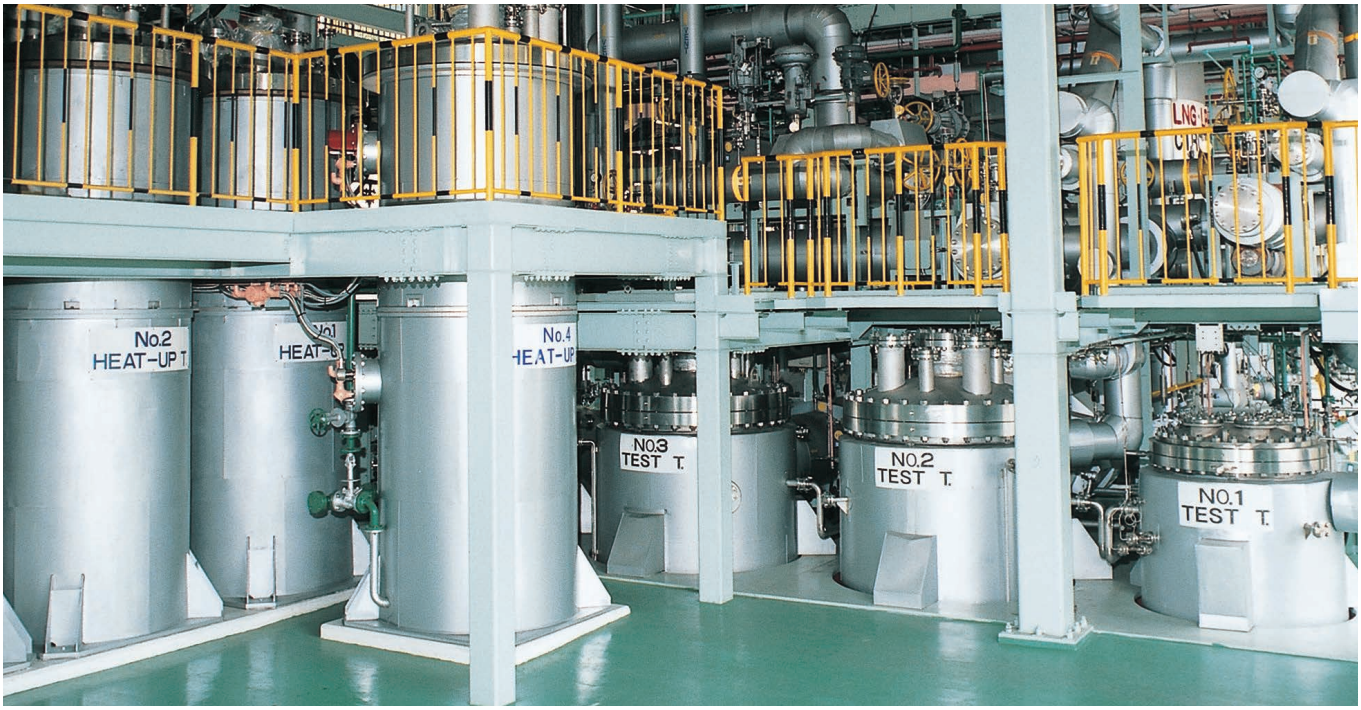
●Testing Facility

Max.capacity of test pump	: 2500㎥/h
Test liquid	: LNG, LPG, DME
Lowest liquid temperature	: −196℃
Design pressure	: 0.98MPa
Volume of LNG storage tank	: 50㎥
Volume of LN_2 storage tank	: 50㎥
Volume of LPG storage tank	: 26㎥
Volume of circulation tank	: 23.5㎥

●Testing Methods

A shop test is carried out using LPG for LPG/DME pumps and LNG for LNG pumps to measure the performance, and the NPSH level, and many other points. In the case that several pumps with the same specifications are supplied to a plant/ship, a full performance test is performed on only one pump, and an one point performance test at the rated flow for the remaining pumps.





Shinko-Nishishiba LNG/LPG submerged motor pumps are used in many storage stations. And, the cargo pumps for LNG/LPG tankers are also installed on a large number of ships.

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