



SM

SUBMERGED LIQUEFIED GAS PUMPS



LNG PUMPS

SMR

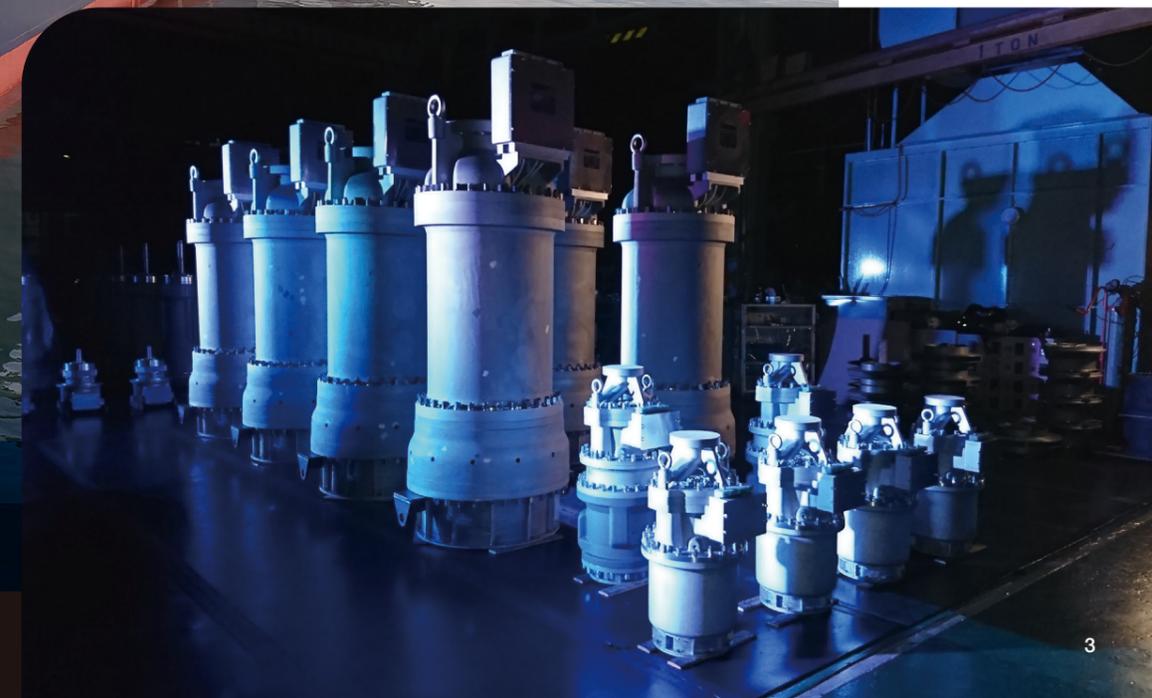
REMOVABLE INTANK PUMPS





No. 1 Pump in the World for LNG Carriers

In anticipation of the growing need for safe and clean energies, our company began developing cryogenic liquefied gas pump in the 1970's. In 1992, we supplied our first marine LNG pumps to a LNG carrier "Flora" constructed by Kawasaki Heavy Industries, Ltd. Since then, our global market share has increased and now reached over 90%. These LNG pumps have become one of our main products that supports our company, much like our cargo oil pumps. Our LNG pump specifications can adapt to the shale gas energy revolution and other new demands, allowing us to receive a high reputation from customers worldwide.



SM

SUBMERGED LIQUEFIED GAS PUMPS

Shinko "SM" submerged liquefied gas pumps have been developed as cargo pumps for LNG carriers based upon our rich experience in designing, manufacturing, and operating a large number of discharge pumps, pressurizing pumps, and circulating pumps used at LNG terminals or in LNG cryogenic power generating plants.

In order to operate submerged properly in cryogenic liquefied gas under harsh conditions, the pumps have been designed with the following various features:

GENERAL CHARACTERISTICS

- The pump and motor are so constructed as to form a single unit and be submerged in the pumping liquid. Thus, there is no fear of liquid and 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.
- Ball bearings are lubricated via the pumped liquid, which is also used for cooling the motor.
- An auto balance mechanism is located on the back of the impeller to balance the axial thrust in all operating ranges.
- An inducer with high suction performance is equipped underneath the impeller. So, full capacity operation is possible while unloading, leaving as little residual liquid as possible.
- 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.



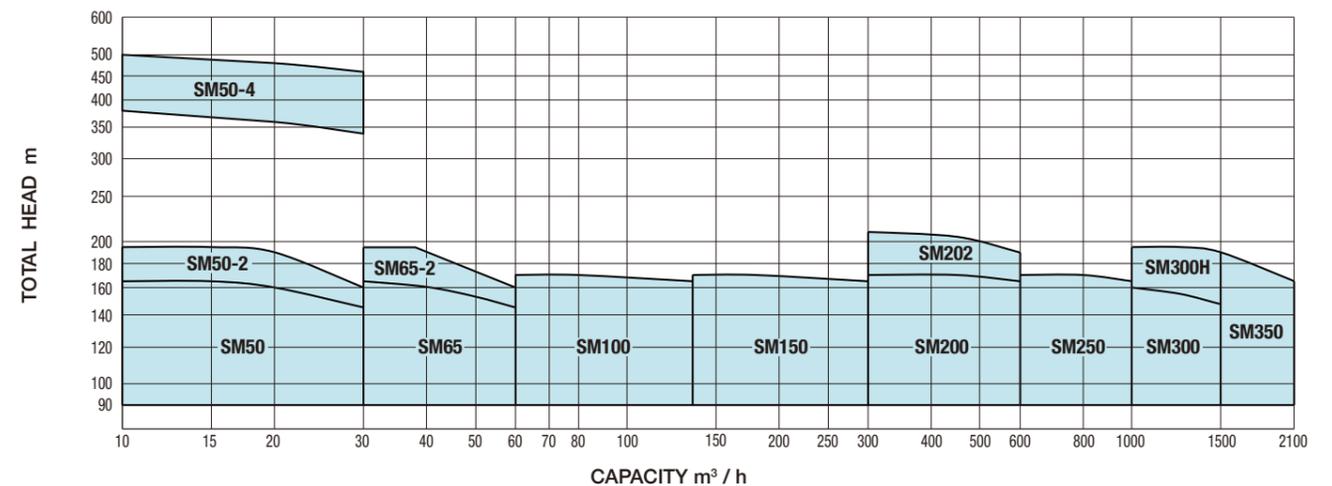
SPECIFICATION

The vertical SM models are submerged liquefied gas pumps having 1,2,4 stages, and the following standard 13 models are available:

Item \ Model	SM 50	SM 50-2	SM 50-4	SM 65	SM 65-2	SM 100	SM 150	SM 202	SM 200	SM 250	SM 300	SM 300H	SM 350
Max. capacity (m ³ /h)	30			60		135	300	600		1000	1500		2100
Max. total head (m)	165	195	500	165	195	170	170	210	170	170	160	195	190
Liquid temperature (°C)	-163												
Discharge bore (mm)	50			65		100	150	200		250	300		350
Synchronous speed (min ⁻¹)	3600									1800			
Voltage (V)	440						6600						
Frequency (Hz)	60												
Coil	Form wound type												
Insulation	Class F												
Rating	Continuous												
Starting method	Full / reduced voltage start available												

PERFORMANCE CHART

Pump model can be determined from the following charts based upon the total head, and capacity:



SMR REMOVABLE INTANK PUMPS

Shinko “SMR” removable intank pump is operated as an emergency cargo pump for an LNG carrier, it is usually kept in the deck store. In the event that an unexpected accident occurs to the cargo pumps, it can be used by being hoisted down inside the column in the cargo tank.

The pumps have been designed with the following various features.

GENERAL CHARACTERISTICS

- The pump and motor are so constructed as to form a single unit and be submerged in the pumping liquid. Thus, there is no fear of liquid and 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.

- Ball bearings are lubricated via the pumped liquid, which is also used for cooling the motor.

- An auto balance mechanism is located on the back of the impeller to balance the axial thrust in all operating ranges.

- An inducer with high suction performance is equipped underneath the impeller. So, full capacity operation is possible while unloading, leaving as little residual liquid as possible.

- 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.



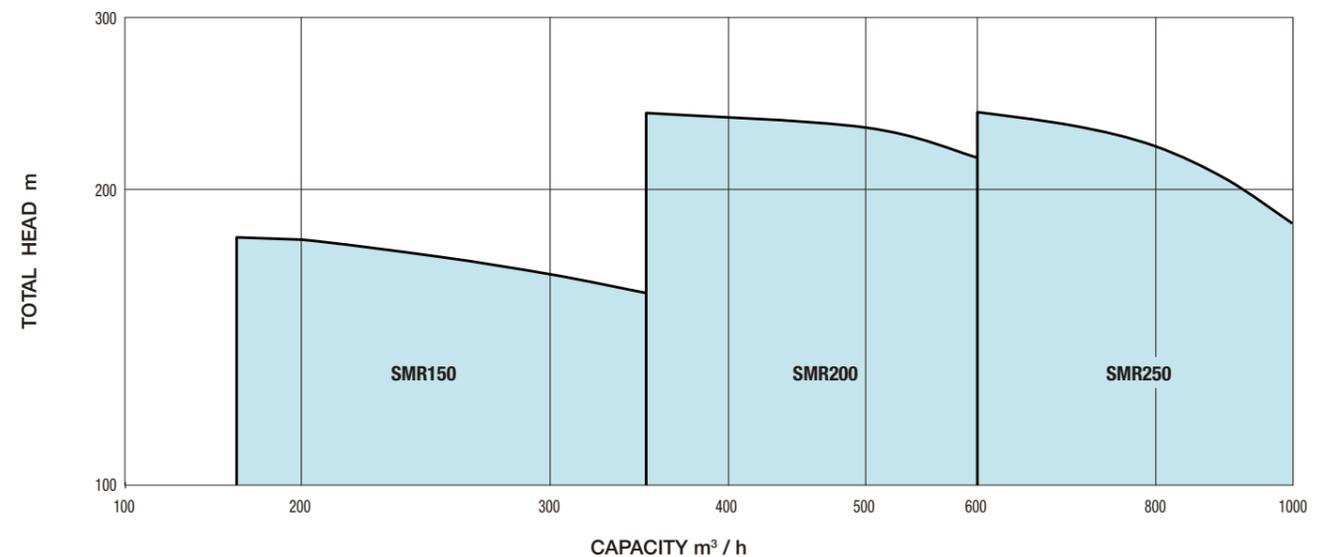
SPECIFICATION

The vertical removable SMR models are submerged liquefied gas pumps having 1 stage, and the following standard 3 models are available:

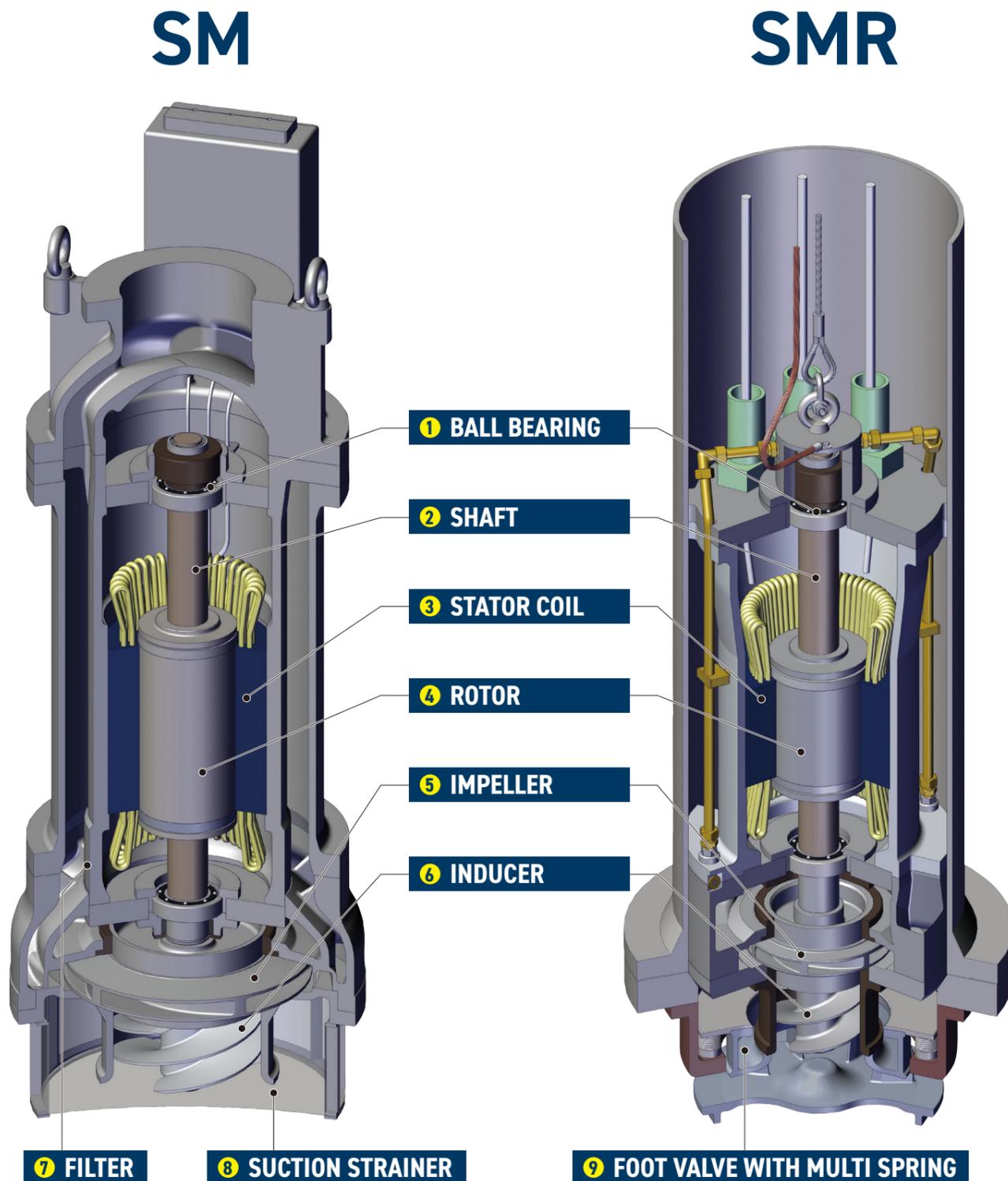
Item	Model	SMR 150	SMR 200	SMR 250
Type		Removable type 1 stage centrifugal pump		
Max. capacity	(m ³ /h)	350	600	1000
Max. total head	(m)	180	240	240
Liquid temperature	(°C)	-163		
Discharge bore	(mm)	150	200	250
Type		Submerged type 3-phase squirrel-cage induction motor		
Synchronous speed	(min ⁻¹)	3600		
Voltage	(V)	440, 6600		
Frequency	(Hz)	60		
Coil		Form wound type		
Insulation		Class F		
Rating		Continuous		
Starting method		Full / reduced voltage start available		

PERFORMANCE CHART

Pump model can be determined from the following charts based upon the total head, capacity:



DESIGN



1 BALL BEARING

In order to support the rotating element, each set of single row deep-groove ball bearings is positioned at the upper and lower side of the motor.

2 SHAFT

The common shaft of the pump and motor is durable with a diameter wide enough to prevent distortion of the shaft in the course of machining, overhauling and assembling.

3 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.

4 ROTOR

In order to minimize the vibration and to keep the bearings in good condition, the rotor is dynamically balanced with an impeller, an inducer, and other rotating elements.

5 IMPELLER

The impeller is the single suction type having three dimensional vanes, and is designed to stabilize its characteristic curve.

6 INDUCER

The inlet of the impeller is provided with an inducer with spiral blades in order to minimize the NPSH value.

7 FILTER

In order to extract the liquid for lubrication of ball bearing and cooling the motor, a self-cleaning filter has been installed at the bottom of the motor's inner frame.

8 SUCTION STRAINER

To prevent the inducer and impeller from being damaged by foreign matter sucked inside the pump, a suction strainer with a durable punching plate is positioned on the underside of the pump casing.

9 FOOT VALVE WITH MULTI SPRING

When the pump is installed in the column, the foot valve is opened by the weight of the pump (active position). In order to improve the suction performance, the pump is designed to allow smooth passage by eliminating obstacles around foot valve.

In the case of a periodic inspection or an unexpected accident, maintenance can be done by hoisting up the pump from the column.

In this case, the foot valve is closed by a spring force (inactive position), and is sealed by Teflon packing which is fitted onto the seat face.

TESTING FACILITY

In 1973, we launched a testing facility specialized for cryogenic liquefied gas pump that was the first of its kind to be built in Japan and certified by the Ministry of International Trade and Industry (the current Ministry of Economy, Trade and Industry). Like all of our other products, our cryogenic liquefied gas pump are all subject to factory testing, which secures high quality of the products.



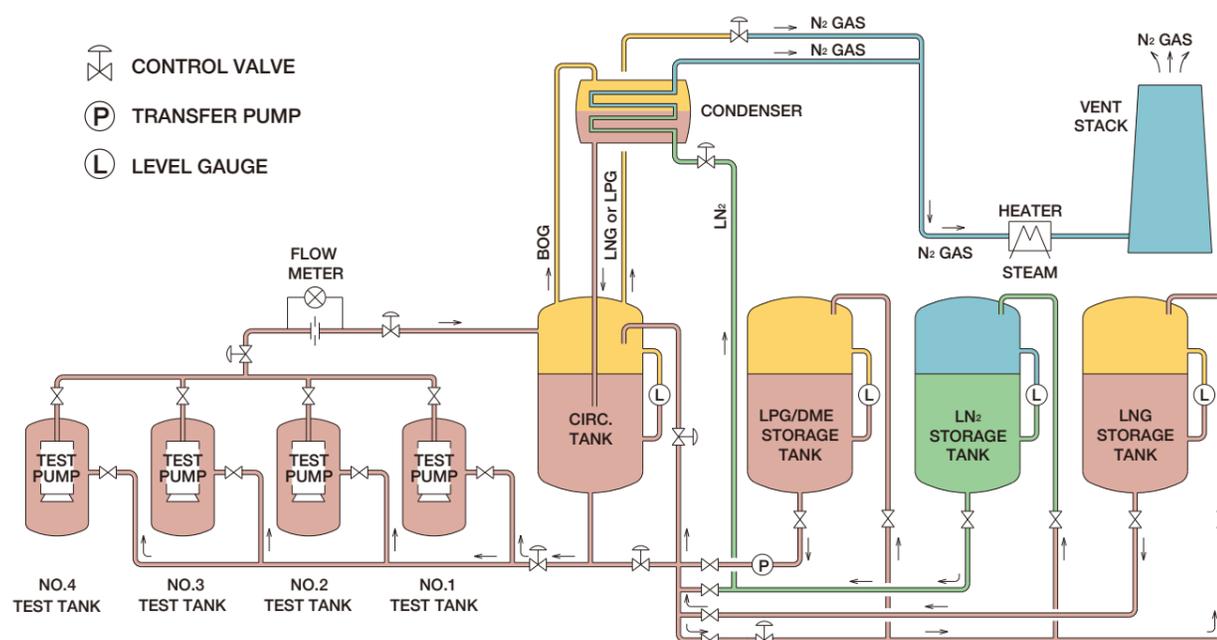
PERFORMANCE TESTS

■ Testing Facility

Max.capacity of test pump :2500m³/h
 Test liquid :LNG, LPG, DME
 Lowest liquid temperature :-196°C
 Design pressure :0.98MPa
 Volume of LNG storage tank :50m³
 Volume of LN₂ storage tank :50m³
 Volume of LPG storage tank :26m³
 Volume of circulation tank :23.5m³

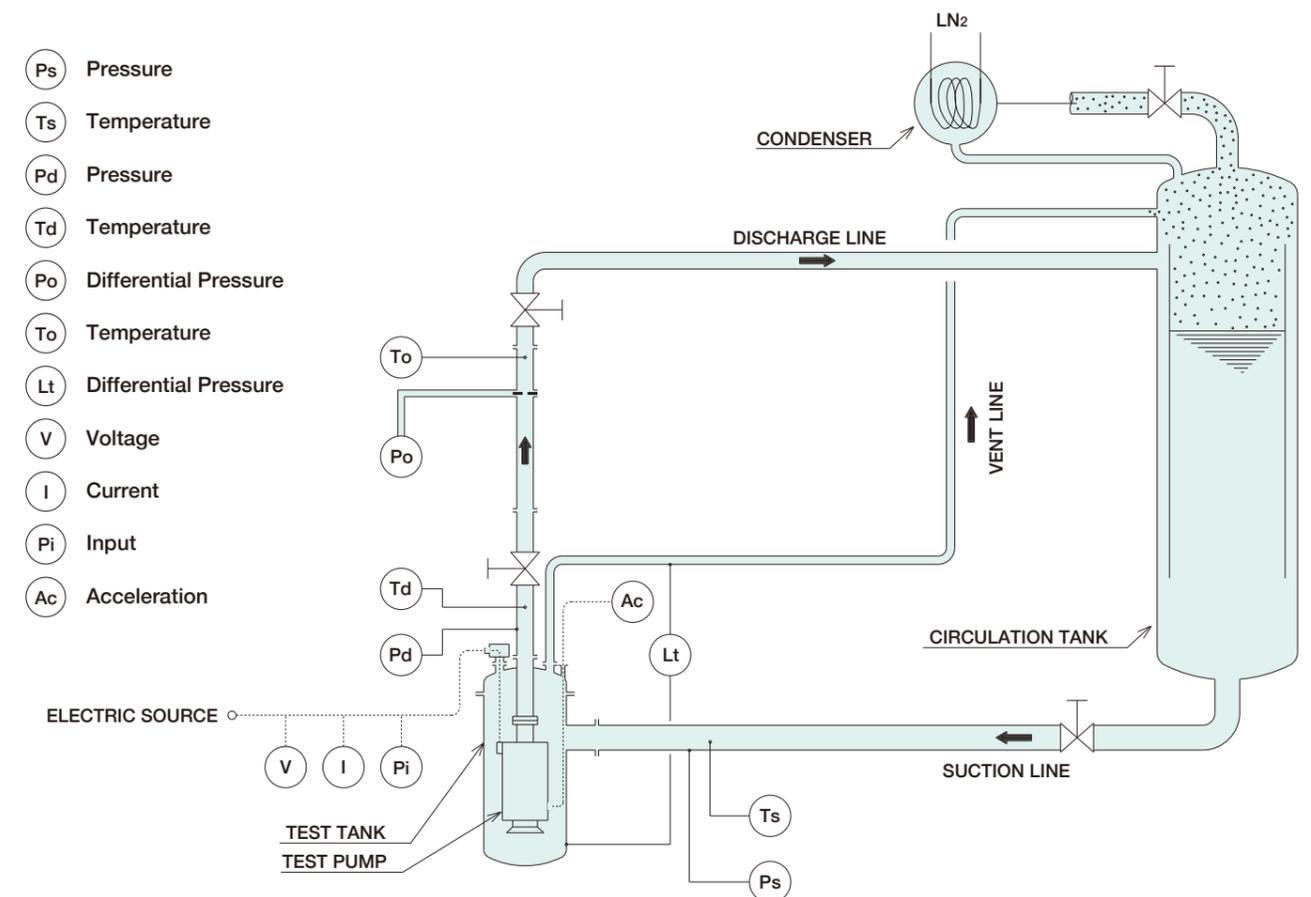
■ Testing Methods

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.



■ Testing procedures

1. Testing is conducted with specified liquid (LNG)
2. Measurement, record and calculation of performance are handled by computers and the test records are submitted immediately after the tests.
3. When there are more than two (2) pumps with the same specifications, full performance test is conducted for one pump and reduced performance test is conducted for the other pumps.
4. Four (4) pumps are tested a day and the overhaul inspection is conducted the following day in order to reduce the number of days necessary for testing.
5. Testing is conducted concerning the following items:
 - (1) **Performance test**
Performance test is performed at five (5) points (120%, the rated, 80%, 60% and minimum flow).
 - (2) **NPSH test**
NPSH test is performed at the rated flow.
 - (3) **PUMP DOWN test**
PUMP DOWN test is performed at the rated flow.
 - (4) **Vibration measurement**
Vibration is measured at each test point.





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