CL—2006E

SHINKO SMR

INTANK REMOVABLE PUMPS

SHINKO IND. LTD.
Hiroshima Japan

SMR SUBMERGED LIQUEFIED GAS PUMPS

Shinko-Nishishiba "SMR" removable intank pumps are used as discharge or transfer pumps, and are installed at the bottom of LNG/LPG/DME storage stations such as underground receiving tanks, storage tanks, and PC tanks.
When this 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 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 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.

- The hydrodynamic thrust of the impeller is well balanced. Furthermore, a balance sleeve is provided at the upper end of the shaft to alleviate the weight of the rotating element loaded onto the thrust ball bearings.

- 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.

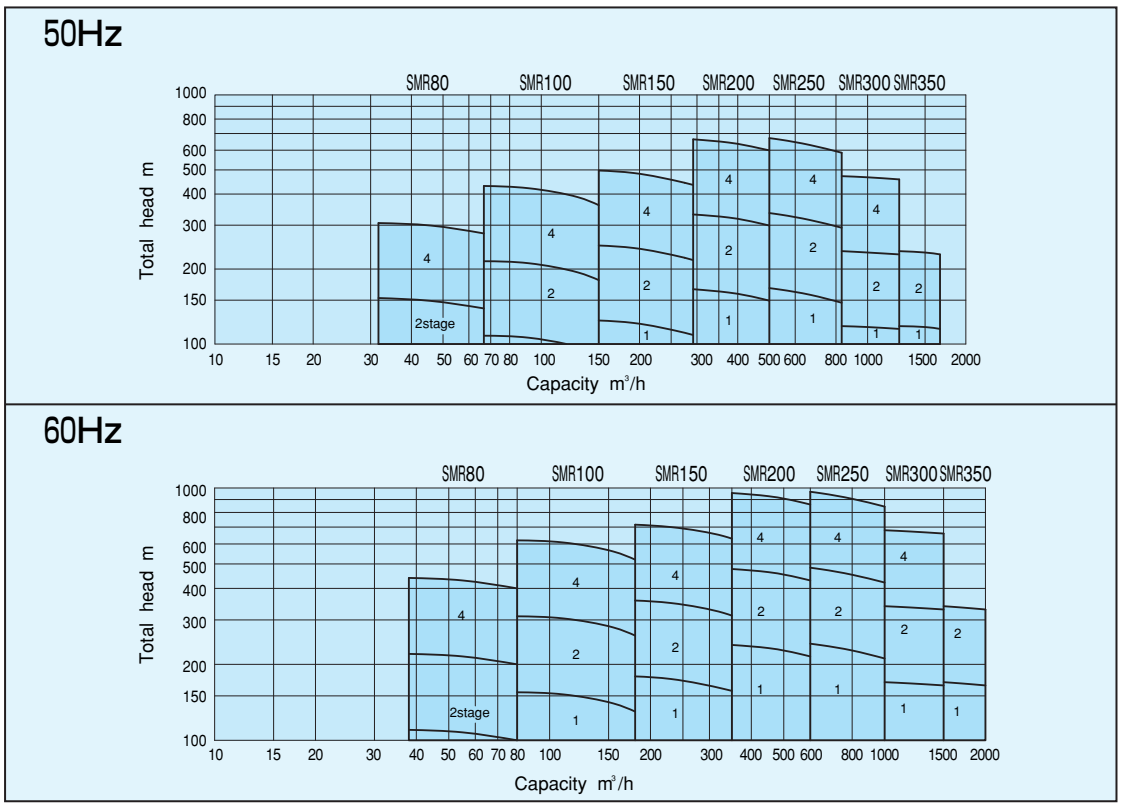
GENERAL CHARACTERISTICS

The vertical removal SMR models are submerged liquefied gas pumps having 1～4 stages, and the following standard 7 models are available:

	Item \ Model	SMR 80	SMR 100	SMR 150	SMR 200	SMR 250	SMR 300	SMR 350
Pump	Type	Removable type multi-stage centrifugal pump						
	Max. capacity (m³/h)	80	180	350	600	1000	1500	2000
	Tatal head (m)	100～900						
	Liquid temperature (℃)	40～－196						
	Discharge bore (mm)	80	100	150	200	250	300	350
Motor	Type	Submerged type 3-phase squirrel-cage induction motor						
	Synchronous speed (min^{-1})	3000, 3600					1500, 1800	
	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						

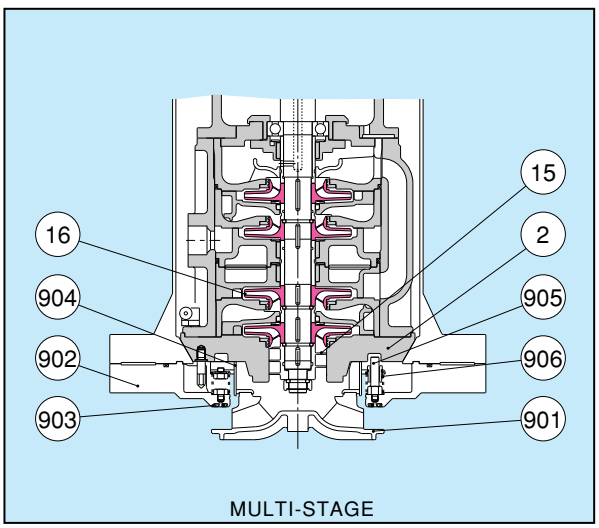
PERFORMANCE CHART

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

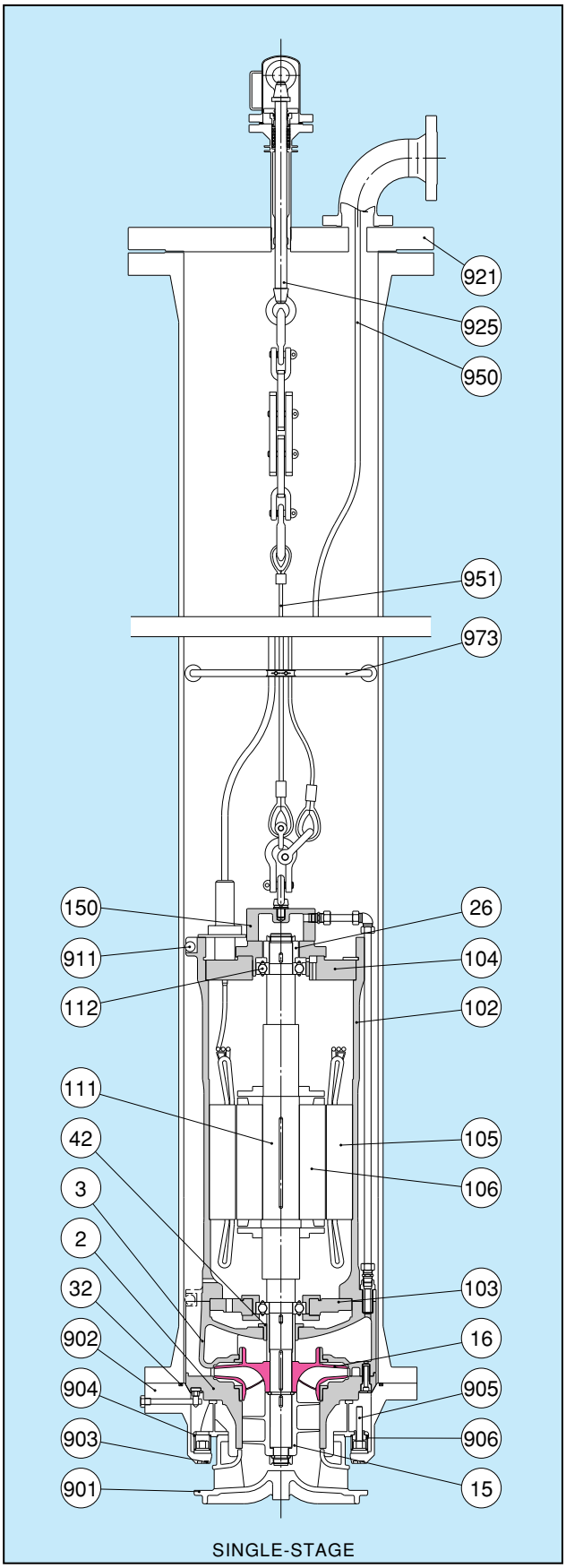


DESIGN & MATERIALS

PART NO.	NAME OF PART	MATERIAL		
		NAME	JIS	ASTM EQUIVAL
2	SUCTION COVER	STAINLESS STEEL	SUS304	A276-75 304
3	VOLUTE	AL ALLOY CASTING	AC4C-T6	SG70A
15	INDUCER	AL ALLOY	A2017BE	2017
16	IMPELLER	AL ALLOY CASTING	AC4C-T6	SG70A
26	BALANCE SLEEVE	LEAD BRONZE	CAC604	B584-74 938
32	GASKET	TFE	—	—
42	BUSH	LEAD BRONZE	CAC604	B584-74 938
102	MOTOR FRAME	AL ALLOY CASTING	AC4C-T6	SG70A
103	FRAME COVER	AL ALLOY	A6061FH	6061
104	FRAME COVER	〃	〃	〃
105	STATOR CORE	SILICON STEEL	—	—
106	ROTOR CORE	〃	—	—
111	SHAFT	9% NICKEL STEEL	—	—
112	BALL BEARING	STAINLESS STEEL	SUS440C	A276-75 440C
150	COVER	〃	SUS304	A276-75 304
901	FOOT VALVE BODY	AL ALLOY CASTING	AC4C-T6	SG70A
902	FOOT VALVE CASE	STAINLESS STEEL	SUS304	A276-75 304
903	FOOT VALVE SEAL	TFE	—	—
904	DISK HANGER	STAINLESS STEEL	SUS304	A276-75 304
905	GUIDE BOLT	〃	〃	〃
906	SPRING	〃	〃	〃
911	GUIDE ROLLER	TFE	—	—
921	COLUMN COVER	STAINLESS STEEL	SUS304	A276-75 304
925	SUPPORT ROD	〃	〃	〃
950	POWER CABLE	COPPER	—	—
951	SUPPORT WIRE ROPE	STAINLESS STEEL	SUS304	A276-75 304
973	ROLLER ARM	〃	〃	〃



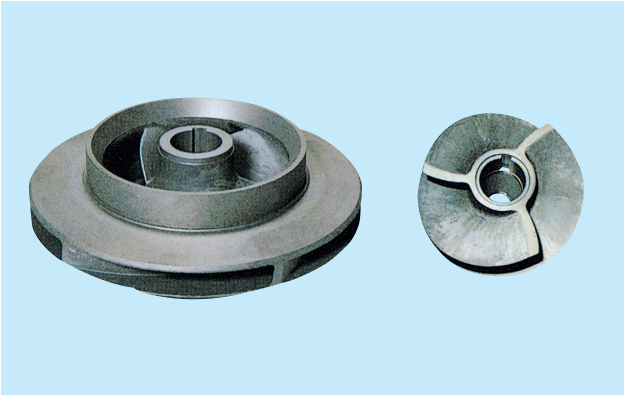
MULTI-STAGE



SINGLE-STAGE

●Impeller & Inducer

The impeller is the single suction type having three dimensional vanes, and is designed to stabilize its characteristic curve. The inlet of the impeller is provided with an inducer with spiral blades in order to minimize the NPSH value of the pump, leaving as little residual liquid as possible in the tank.



●Ball Bearings

In order to support the rotating element, 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. The inner and outer races of the bearing and the balls are made of stainless steel, while the cage is made of Teflon which has a self-lubrication ability.

●Shaft

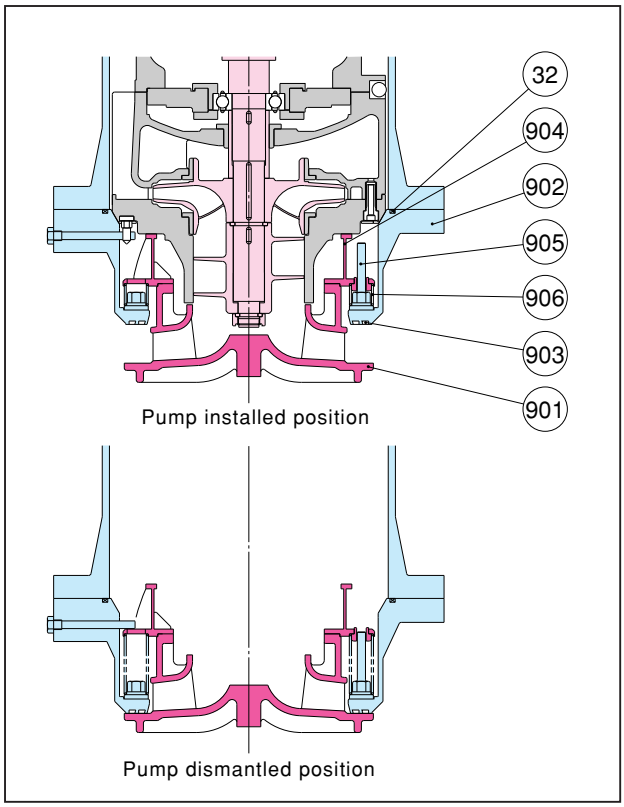
The common shaft of the pump and motor is durable with a diameter wide enough to prevent distortion of the shaft in the course of machining, overhauling, and assembling.

●Foot Valve with Multi Springs

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.

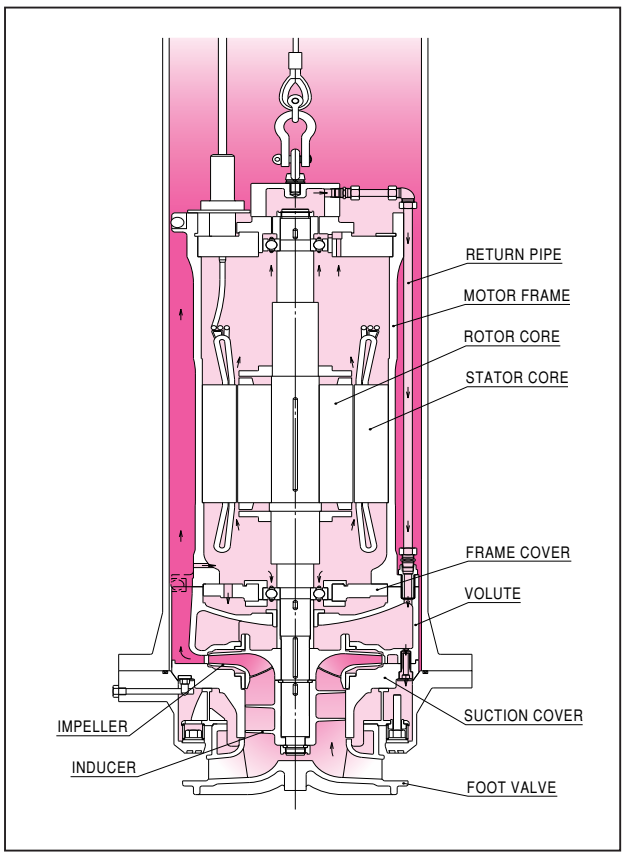
In the case of a periodic inspection or an unexpected accident, maintenance can be done by hoisting up the pump from the column.

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.



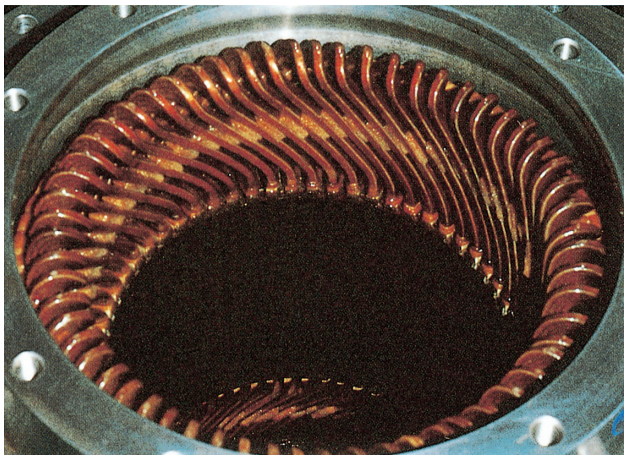
●Bearing Lubrication & Motor Cooling

A forced self-lubrication system is utilized and a small amount of discharge flow is led inside the motor to lubricate the ball bearings and cool the motor.



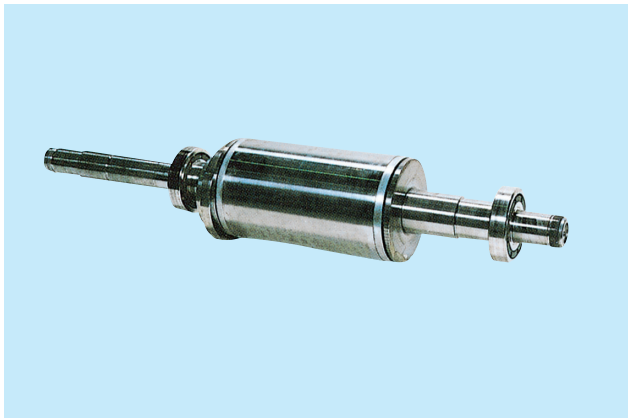
●Stator Coil

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.



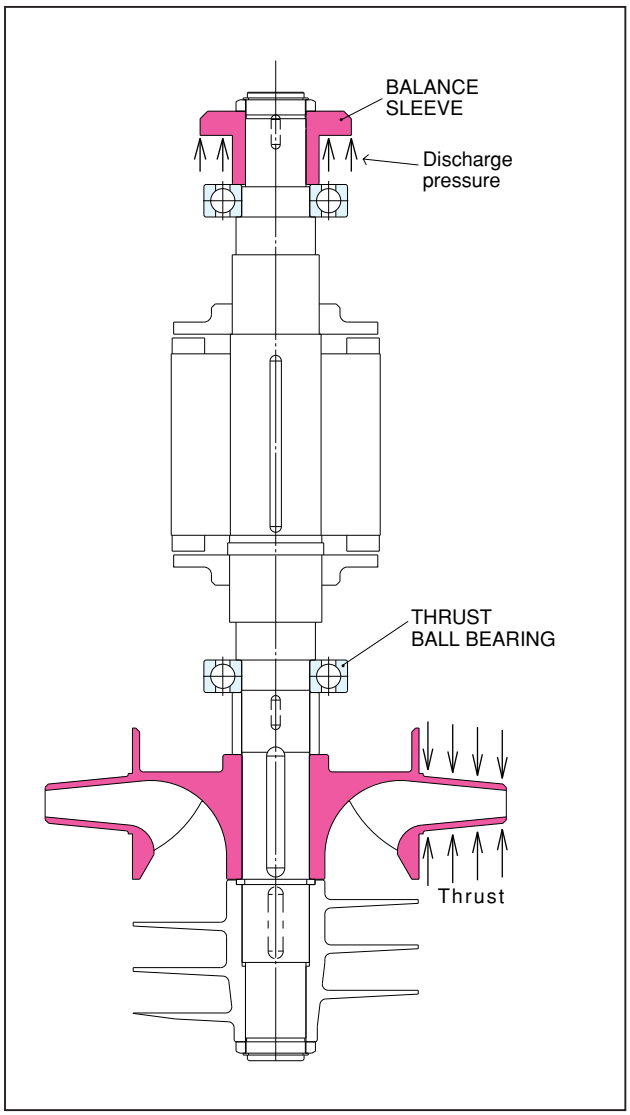
●Rotor

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.



●Balancing Mechanism

The hydrodynamic thrust of the impeller is well balanced. Furthermore, a balance sleeve is provided at the upper end of the shaft to generate upward thrust using the discharge pressure acting on the lower face of the balance sleeve.
In this way, the weight of the rotating element on the thrust ball bearings is reduced.



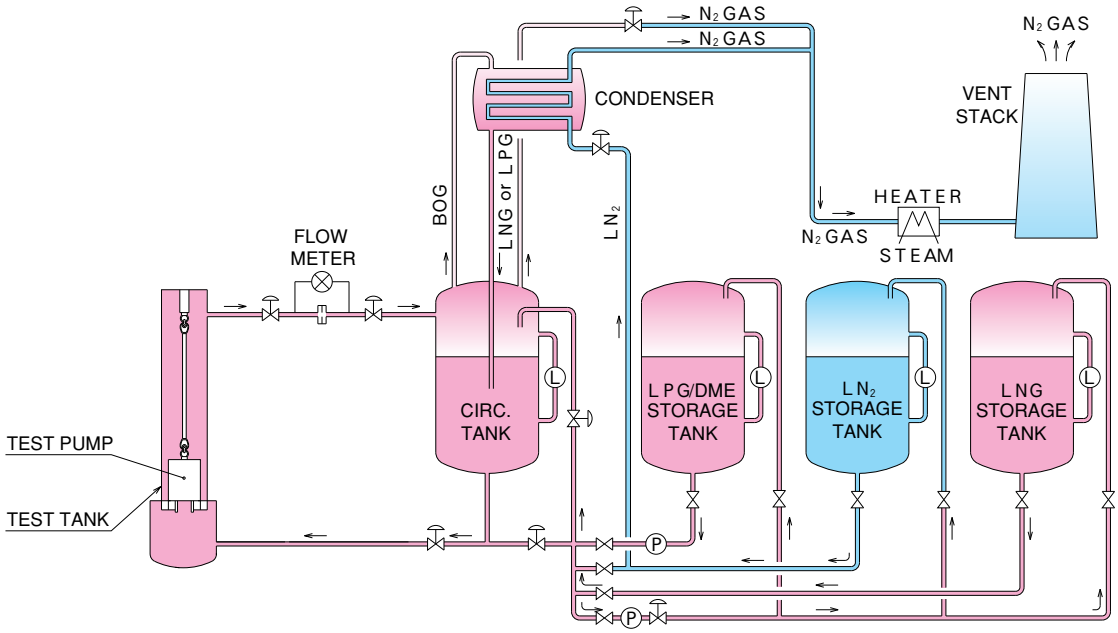
PERFORMANCE TESTS

●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 a one point performance test at the rated flow for the remaining pumps.



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Printed in Japan 2017.11.50. N.H.