Practical training guidelines

Instructor training course for teaching basic of mechanical engineering to plant operator

Chapter 5 Basic of centrifugal pump

Mitsubishi Chemical Corporation
Kurosaki Plant
Administration Department HRD Section

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Basic of centrifugal pump practical training guidelines

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Practical training guidelines				
Lecture course name	Basic of centrifugal pump			
1．	Daily check of centrifugal pump			
1． 2	Check point of whole pump			
1． 2． 1	Visual check of pump (part･item･method)			
№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions

1. Working item

(1) Method of startup, continuous operation and shutdown of centrifugal pump

・ Understand the check item, check method and checkpoint at startup, continuous operation and shutdown of centrifugal pump.【P-4】

(2) Understand abnormal state of centrifugal pump.

・ Estimate the state of abnormality from grasping pump operation state and comparing with the operation state of other pump of the same type.【P-1, P-3, P-4, P-5】

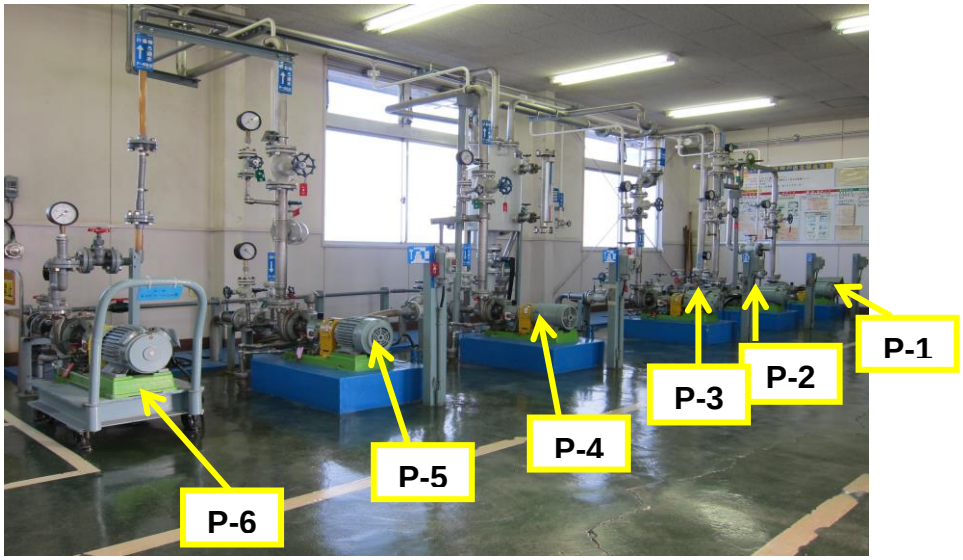
(3) Cavitation phenomena

・ Understand cavitation which is abnormal state.【Negative boiling practical training equipment P-6】

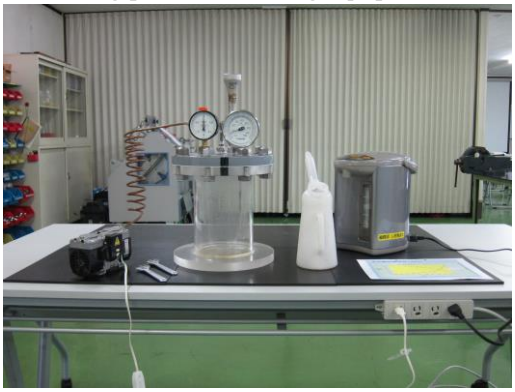
2. Outline of equipment

① MTC centrifugal pump practical training equipment P-1～P-6

(As for flow, refer to page 2)



② Negative boiling practical training equipment



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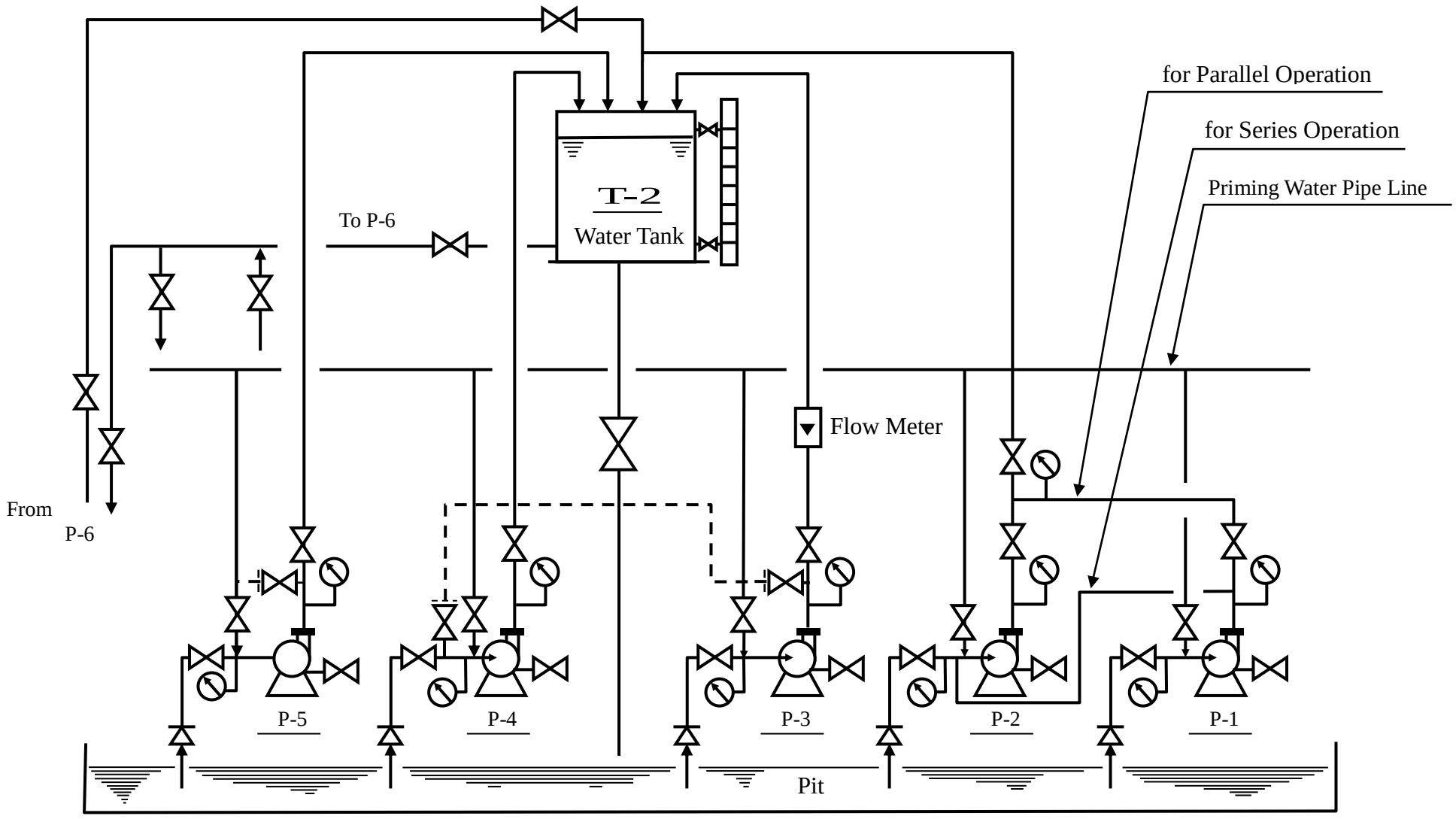
The Flow Sheet of Centrifugal Pump



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Practical training guidelines				
Lecture course name	Basic of centrifugal pump			
1．	Daily check of centrifugal pump			
1． 2	Check point of whole pump			
1． 2． 1	Visual check of pump (part･item･method) 【Practical training of startup, continuous operation and shutdown with P-4】			
№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
1	Preparation Prepare necessary equipment, parts, tools, measuring instrument and safety equipment.	・ Centrifugal pump ・ Auscultation rod ・ Portable vibration meter ・ Surface thermometer ・ Cramp meter ・ Monkey spanner ・ Key to unlock power source ・ Protective glasses ・ Protection gloves (work gloves)	P-1～P-5 (Permanent installation) 1 piece 1 set 1 set 1 set 1 set 150mm *2 sets or 200mm *2 sets For pump master power source for P-4. 1 set 1 set	
2	Confirm the lock of driving power source.		・ At-hand stand switch shall be off and be inserted with lock pin. ・ NFB in switch room shall be off and be locked.	・ Point and check off aloud.
3	Confirm the state of open and shut and set valves for P-4.		・ Pump suction valve; fully open Pump discharge valve; fully closed Suction pressure gauge master valve; fully open Discharge pressure gauge master valve; fully open Priming water inlet valve; fully closed Casing drain valve ; fully open	
4	Confirm bearing oil.		・ Confirm the amount of oil is appropriate or not, and the oil gauge is unstained or not.	
5	Confirm visually no abnormality of each part of pump.		・ Confirm no damage of each part nor bolt loosening of each bolt.	
6	Introduce priming water and fill the casing.	Monkey spanner	・ Slightly open the priming water introducing valve and confirm filtered water drainage from casing drain valve. ・ Once fully close the priming water introducing valve and close the casing drain valve. ・ Slightly open the priming water introducing valve again, and release air by loosening the plug valve of priming water funnel while introducing priming water into the casing. ・ Release air by loosening the casing air release plug. ・ Release air with hand turning of pump. ・ When water is spilled on the floor, wipe it off each time with a mop.	・ Wear protective glasses. ・ Pay attention to slip and fall.

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Practical training guidelines				
Lecture course name	Basic of centrifugal pump			
1．	Daily check of centrifugal pump			
1． 2	Check point of whole pump			
1． 2． 1	Visual check of pump (part･item･method) 【Practical training of startup, continuous operation and shutdown with P-4】			
№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
7	Confirm visually no abnormality of each part of pump.		・No leakage from casing. ・Appropriate leakage amount from gland packing.	
8	Confirm normal turning by hand turning.		・Hand turning shall be done in the direction of pump rotation. ・Confirm the smooth turning.	
9	Unlock the driving power source.	Key to unlock power source	・Unlock NFB in switch room and turn the lever OFF ⇒ON.	・Point and check off aloud.
10	Inching motion	Auscultation rod	・Remove the lock pin from OFF button of at-hand stand switch and push ON button. ・When pump stats to rotate, push OFF button. ・Confirm the direction of rotation, abnormal noise, smooth rotation and no sudden rotation stop after switch OFF. ・Perform inching motion 2～3 times.	・Wear protective glasses. ・Point and check off aloud.
11	Startup		・Push ON button of at-hand stand switch.	・Wear protective glasses. ・Point and check off aloud.
12	Confirm abnormality of pump.	Auscultation rod	・Confirm abnormal noise, abnormal vibration, leakage from each part and amount of leakage from gland packing etc. ・Confirm that discharge pressure rises up to 0.11MPa under fully closing state of discharge valve.	・Wear protective glasses. ・Put off protective gloves (work gloves) when touching pump by hand. (However, when inner liquid is other than normal temperature water, the designated safety equipment shall be worn for work.)
13	Delivery of water by operating discharge valve.		・Gradually open the discharge valve until the discharge pressure becomes about 0.08MPa. (Proceed 10～20 seconds after pump startup.)	・Wear protective glasses.
14	Check and observe the operating state of pump and abnormality of each part.	Auscultation rod Portable vibration meter Surface thermometer Cramp meter	・Continue operation, checking and observing leakage, noise, vibration, temperature, suction pressure, discharge pressure and electric current. ・When vibration is felt to be large by hand touching, measure the vibration by portable vibration gauge. ・When temperature is felt to be high, measure the temperature by surface thermometer.	・Wear protective glasses. The handling method of portable measuring instrument is explained as an option.

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
１．	Daily check of centrifugal pump
１．２	Check point of whole pump
１．２．１	Visual check of pump (part･item･method) 【Practical training of startup, continuous operation and shutdown with P-4】

№	Work procedure	Tool etc. to be used	Work points etc.	Safety precautions
15	Stop delivery of water by operating discharge valve.		・ Watching discharge pressure, gradually close discharge valve until fully close.	・ Wear protective glasses.
16	Shutdown		・ Press OFF button of at-hand stand switch and insert lock pin. ・ Confirm pressure drop and stop rotation.	・ Wear protective glasses. ・ Point and check off aloud.
17	Lock the driving power source.	Key to unlock power source	・ Turn lever of NFB in switch room ON ⇒OFF and lock.	・ Point and check off aloud.
18	Drain the casing.		・ Open the casing drain valve and drain. ・ When drained to some extent, open and remove the plug of priming water funnel.	・ Wear protective glasses.
19	Tidy up・3S Put the equipment, parts, tools, measuring instruments and safety equipment, which were used, to the original place.		・ Wipe off the water spilled on the floor with a mop.	

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
1．	Daily check of centrifugal pump
1． 2	Check point of whole pump
1． 2． 1	Visual check of pump (part・item・method) 【Comparison of operation state and estimation of abnormal operation with P-1, 3, 4, 5】

№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
1	Preparation Prepare necessary equipment, parts, tools, measuring instrument and safety equipment.	・ Centrifugal pump ・ Auscultation rod ・ Portable vibration meter ・ Surface thermometer ・ Cramp meter ・ Monkey spanner ・ Key to unlock power source ・ Protective glasses ・ Protection gloves (work gloves)	P-1～P-5 (Permanent installation) 1 piece 1 set 1 set 1 set 150mm *2 sets or 200mm *2 sets For pump master power source for P-1, P-3, P-4, p-5. 1 set 1 set	
2	Confirm the lock of driving power source for P-1, P-3, P-4 and P-5.		・ At-hand stand switch shall be off and be inserted with lock pin. ・ NFB in switch room shall be off and be locked.	・ Point and check off aloud.
3	Confirm the state of open and shut and set valves for P-1.		Pump suction valve; fully open Pump discharge valve (for parallel operation) ; fully close Pump discharge valve (for series operation) ; fully close Pump P-2 discharge valve; fully close Suction pressure gauge master valve; fully open Discharge pressure gauge master valve; fully open Priming water introduce valve; fully close Casing drain valve; fully open	
4	Confirm bearing oil.		・ Confirm the amount of oil is appropriate or not by oil gauge.	
5	Confirm visually no abnormality of each part of pump.		・ Confirm no damage of each part nor bolt loosening of each bolt.	

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
１．	Daily check of centrifugal pump
１．２	Check point of whole pump
１．２．１	Visual check of pump (part・item・method) 【Comparison of operation state and estimation of abnormal operation with P-1, 3, 4, 5】

№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
6	Introduce priming water and fill the casing.	Monkey spanner	・Slightly open the priming water introducing valve and confirm filtered water drainage from casing drain valve. ・Once fully close the priming water introducing valve and close the casing drain valve. ・Slightly open the priming water introducing valve again, and release air by loosening the plug valve of priming water funnel while introducing priming water into the casing. ・Release air by loosening the casing air release plug. ・Release air with hand turning of pump. ・When water is spilled on the floor, wipe it off each time with a mop.	・Wear protective glasses. ・Pay attention to slip and fall.
7	Confirm visually no abnormality of each part of pump.		・No leakage from casing. ・Appropriate leakage amount from gland packing.	
8	Confirm normal turning by hand turning.		・Hand turning shall be done in the direction of pump rotation. ・Confirm the smooth turning.	
9	Unlock the driving power source.	Key to unlock power source.	・Unlock NFB in switch room and turn the lever OFF ⇒ON.	・Point and check off aloud.
10	Inching motion	Auscultation rod	・Remove the lock pin from OFF button of at-hand stand switch and push ON button. ・When pump stats to rotate, push OFF button. ・Confirm the direction of rotation, abnormal noise, smooth rotation and no sudden rotation stop after switch OFF. ・Perform inching motion 2～3 times.	・Wear protective glasses. ・Point and check off aloud.
11	Startup		・Push ON button of at-hand stand switch.	・Wear protective glasses. ・Point and check off aloud.

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
1.	Daily check of centrifugal pump
1. 2	Check point of whole pump
1. 2. 1	Visual check of pump (part・item・method) 【Comparison of operation state and estimation of abnormal operation with P-1, 3, 4, 5】

№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
12	Confirm abnormality of pump.	Auscultation rod	・Confirm abnormal noise, abnormal vibration, leakage from each part and amount of leakage from gland packing etc. ・Confirm that discharge pressure rises up to 0.11MPa under fully closing state of discharge valve.	・Wear protective glasses. ・Put off protective gloves (work gloves) when touching pump by hand. (However, when inner liquid is other than normal temperature water, the designated safety equipment shall be worn for work.)
13	Delivery of water by operating discharge valve.		・Gradually open the discharge valve until the discharge pressure becomes about 0.08MPa. (Proceed 10～20 seconds after pump startup.)	・Wear protective glasses.
14	Check and observe the operating state of pump and abnormality of each part.	Auscultation rod Portable vibration meter Surface thermometer Cramp meter	・Continue operation, checking and observing leakage, noise, vibration, temperature, suction pressure, discharge pressure and electric current. ・When vibration is felt to be large by hand touching, measure the vibration by portable vibration gauge. ・When temperature is felt to be high, measure the temperature by surface thermometer.	・Wear protective glasses. The handling method of portable measuring instrument is explained as an option.
15	Startup and continuous operation of P-3.		・Perform in the same way as item No.3 ～ item No.14.	・Wear protective glasses. ・Point and check off aloud.
16	Startup and continuous operation of P-4.		・Perform in the same way as item No. 3 ～ item No.14.	・Wear protective glasses. ・Point and check off aloud.
17	Startup and continuous operation of P-5.		・Perform in the same way as item No. 3 ～ item No.14.	・Wear protective glasses. ・Point and check off aloud.
18	Estimate existence and content of abnormality, comparing the operation state of each pump.		・Estimate with the comparison of leakage, noise, vibration, temperature, suction pressure and discharge pressure.	
19	Stop delivery of water by operating discharge valve.		・For each pump of P-1, P-3, P-4 and P-5, gradually close until fully close the discharge valve watching discharge pressure.	・Wear protective glasses.
20	Shutdown		・For each pump of P-1, P-3, P-4 and P-5, press OFF button of at-hand stand switch and insert lock pin.	・Wear protective glasses. ・Point and check off aloud.
21	Lock the driving power source.	Key to unlock power source	・For each pump of P-1, P-3, P-4 and P-5, Turn lever of NFB in switch room ON ⇒OFF and lock.	・Point and check off aloud.

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
１．	Daily check of centrifugal pump
１．２	Check point of whole pump
１．２．１	Visual check of pump (part･item･method) 【Comparison of operation state and estimation of abnormal operation with P-1, 3, 4, 5】

№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
22	Drain the casing.		・ For each pump of P-1, P-3, P-4 and P-5, open the casing drain valve and drain. ・ When drained to some extent, open and remove the plug of priming water funnel.	・ Wear protective glasses.
23	Tidy up ・ 3S Put to the original place the equipment, parts, tools, measuring instruments and safety equipment, which were used.		・ Wipe off the water spilled on the floor with a mop.	

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
１．	Daily check of centrifugal pump
１．２	Check point of whole pump
１．２．１	Visual check of pump (part・item・method) 【Understand cavitation principle with negative boiling equipment.】

№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
1	Preparation Prepare necessary equipment, parts, tools, measuring instrument and safety equipment.	Negative pressure generating device Water supply funnel Vacuum pump Piping between negative pressure generating device and vacuum pump Electric pot Stein Electric cable Monkey spanner Vapor pressure curve of water (graph) Protective glasses Protection gloves (work gloves)	1 set 1 piece 1 set 1 piece 1 set 1 piece 1 piece 150mm　2 sets 1 set	
2	Confirm the indication of pressure gauge and thermometer of negative pressure generating device is correct.	Negative pressure generating device		
3	Supply water to negative pressure generating device.		・Set funnel to negative pressure generating device. ・Open the water supply valve and the valve for vacuum pump. ・Supply appropriate amount of water with stein (The water level shall be around the edge of thermometer).	
4	Worm the water in negative pressure generating device up to about 55～60℃.		・Boil water with electric pot. ・Supply it to negative pressure generating device with stein. ・Perform the above, observing the thermometer of negative pressure generating device.	・Wear protective glasses. ・Pay attention to burn injury.
5	Depressurize the negative pressure generating device.		・Connect the vacuum pump to the negative pressure generating device with the piping between negative pressure generating device and vacuum pump. ・Start the vacuum pump and depressurize.	
6	Confirm that hot water in the negative pressure generating device boils.		・Confirm that it boils at the pressure corresponding to its temperature. ・Confirm the above, changing the hot water temperature of negative pressure generating device. ・The relation between boiling temperature and pressure shall be confirmed with the “Vapor pressure curve of water (graph)” at page 20. ・The “depressurize ⇔vacuum break operation” shall be repeated more than 2 times because at 1st time the air which remains on inner wall of negative pressure generating device comes out as bubbles. ・Vacuum beak is done by water supply valve operation.	・Wear protective glasses.
7	Tidy up・3S Put to the original place the equipment, tools, and safety equipment, which were used.			

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
１．	Daily check of centrifugal pump
１．２	Check point of whole pump
１．２．１	Visual check of pump (part・item・method) 【Understand cavitation phenomena with P-6】

№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
1	Preparation Prepare necessary equipment, parts, tools, measuring instrument and safety equipment.	Centrifugal pump Stroboscope Rod thermometer Key to unlock power source Vapor pressure curve for water (graph) Protective glasses Protection gloves (work gloves)	P-4 (Permanent installation) P-6 (Portable) 1 set 0～100℃　1 piece For pump master power source, Foe P-6 1 set 1 set 1 set	
2	Confirm the lock of driving power source.		・ At-hand stand switch shall be off and be inserted with lock pin. ・ NFB in switch room shall be off and be locked.	・ Point and check off aloud.
3	Confirm the state of open and shut and set valves for P-6.		・ Pump suction valve; fully open Pump discharge valve; fully open Discharge valve of water tank (T-2) for P-6; fully close The valve of water tank side for P-6 line; fully open The valve for pit ⇒suction line ; fully close Drain valve for suction line ⇒pit ; fully close Casing drain valve; fully close.	
4	Confirm bearing oil.		・ Confirm the amount of oil is appropriate or not by oil gauge.	
5	Confirm visually no abnormality of each part of pump.		・ Confirm no damage of each part nor bolt loosening of each bolt.	
6	Operate P-4 and store water in water tank (T-2). Introduce water and fill the casing.		・ Operation method of P-4 shall depend on “1.2.1 Visual check of pump (point・item・method)【Practical training of startup, continuous operation and shutdown with P-4】”. ・ The level of water tank (T-2) shall be about 70～80% of level gauge. ・ When storing water in water tank (T-2) is finished, then stop P-4.	・ Wear protective glasses.
7	Supply water to P-6 and fill the casing.		・ Gradually open discharge valve of water tank (T-2) for P-6. ・ Remove air from suction piping and pump casing by hand turning of pump. ・ When finished, fully close the discharge valve of pump.	・ Wear protective glasses.

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
１．	Daily check of centrifugal pump
１．２	Check point of whole pump
１．２．１	Visual check of pump (part・item・method) 【Understand cavitation phenomena with P-6】

№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
8	Confirm visually no abnormality of each part of pump.		・No leakage from casing. ・Appropriate leakage amount from gland packing.	
9	Confirm normal turning by hand turning.		・Hand turning shall be done in the direction of pump rotation. ・Confirm the smooth turning.	
10	Plug in power source cable to the outlet.			・Point and check off aloud.
11	Unlock the driving power source.	Key to unlock power source.	・Unlock NFB in switch room and turn the lever OFF ⇒ ON.	・Point and check off aloud.
12	Inching motion	Auscultation rod	・Remove the lock pin from OFF button of at-hand stand switch (which is set on the wall of house) and push ON button. ・When pump stats to rotate, push OFF button. ・Confirm the direction of rotation, abnormal noise, smooth rotation and no sudden rotation stop after switch OFF. ・Perform inching motion 2～3 times.	・Wear protective glasses. ・Point and check off aloud.
13	Startup		・Push ON button of at-hand stand switch.	・Wear protective glasses. ・Point and check off aloud.
14	Confirm abnormality of pump.	Auscultation rod	・Confirm abnormal noise, abnormal vibration, leakage from each part and amount of leakage from gland packing etc. ・Confirm that discharge pressure rises up to ■■ MPa under fully closing state of discharge valve.	・Wear protective glasses. ・Put off protective gloves (work gloves) when touching pump by hand. (However, when inner liquid is other than normal temperature water, the designated safety equipment shall be worn for work.)
15	Delivery of water by operating discharge valve.		・Gradually open the discharge valve up to fully open. (Proceed 10～20 seconds after pump startup.)	・Wear protective glasses.
16	Check and observe the operating state of pump and abnormality of each part.	Auscultation rod	・Continue operation, checking and observing leakage, noise, vibration, temperature, suction pressure, discharge pressure.	・Wear protective glasses.

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Practical training guidelines	
Lecture course name	Basic of centrifugal pump
１．	Daily check of centrifugal pump
１．２	Check point of whole pump
１．２．１	Visual check of pump (part・item・method) 【Understand cavitation phenomena with P-6】

№	Work procedure	Tool etc. to be used	Work point etc.	Safety precautions
17	Generate cavitation of P-6, and observe.		・ Gradually close the suction valve of P-6 and depressurize pump suction. ・ Confirm the generation of vapor (white bubbles) in suction side of impeller. ・ Confirm the relation between pump suction pressure and cavitation strength by open/close operation of suction valve of P-6.	・ Wear protective glasses.
18	Observe cavitation state by stroboscope.	Stroboscope	・ Adjust indicator of stroboscope to rotation speed of pump. ・ Observe the generating position, vanishing position and strength of vapor.	・ Wear protective glasses.
19	Stop water delivery by discharge valve operation.		・ Observing discharge pressure, gradually close the discharge valve until fully close.	・ Wear protective glasses.
20	Shutdown		・ Press OFF button of at-hand stand switch and insert lock pin.	・ Wear protective glasses. ・ Point and check off aloud.
21	Cut off driving power source and lock.	Key to unlock power source	・ Plug off power source cable from the outlet. ・ NFB ON ⇒ OFF in switch room and lock.	・ Point and check off aloud.
22	Drain suction piping, casing and discharge piping.		・ Fully close the discharge valve for water tank (T-2) of P-6. ・ Open the drain valve for pit before the suction valve and drain into pit.	・ Wear protective glasses.
23	Drain water tank (T-2).		・ Open water tank (T-2) ⇒ pit valve and drain into pit.	・ Wear protective glasses.
24	Tidy up・3S Put to the original place the equipment, parts, tools, measuring instruments and safety equipment, which were used.		・ Wipe off the water spilled on the floor with a mop.	

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Check at start up

Date of check：

Name：

Check item	Point	Decision
1. Isn't there any damage or bolt loosening?	・Visual check.	
2. Isn't there any contact?	・Hand turn the pump.	
3. Isn't the gland packing too tight?	・Hand turn the pump.	
4. Are bearings oiled?	・Is oil level appropriate? ・Isn't there any contamination?	
5. Is the suction valve fully opened?		
6. Is the discharge valve fully closed?		
7. Is the opening/closing state of other valves appropriate?		
8. Is the casing filled?	・Priming water is supplied up to overflowing the funnel. ・Doesn't air come out from the air vent plug of casing?	
9. Inching motion (2～3 times　SW ON)	・Is the rotating direction right? ・Isn't there any contact point?	
10. Startup	・Gradually open the discharge valve after 10～20 sec.	

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Check in continuous operation

Date of check : _____

Name : _____

Check item	Point	Decision
1. Is suction pressure normal?	・ Is suction pressure rated value? ・ Isn't there any vibration of needle of suction pressure gauge?	
2. Is discharge pressure normal?	・ Is discharge pressure rated value? ・ Isn't there any vibration of needle of discharge pressure gauge?	
3. Is electric current normal?	・ Is it in rated current? ・ Does needle point a constant value?	
4. Isn't there abnormal heat generation at bearing?	・ Touch with hand. ↓ Is it 60℃ or lower? (It can be in contact with for about 3 seconds.) The upper limit of temperature is: Room temperature＋40℃, or 70℃ or lower.	
5. Isn't there abnormal heat generation at gland?	・ Same as above	
6. Is there a small amount of water leak from grand?		
7. Isn't there abnormal vibration?	・ Is it in permissible value of vibration velocity and amplitude value?	

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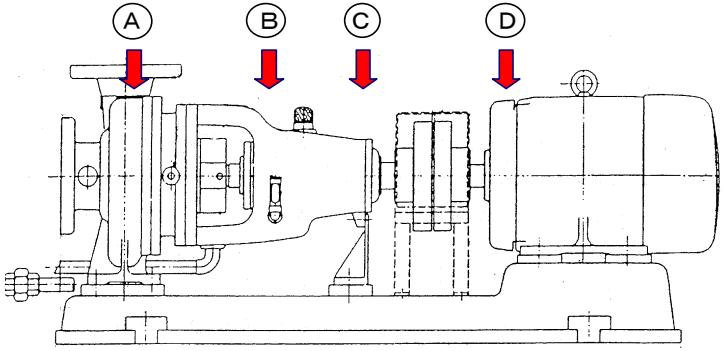
Measurement data sheet of vibration・electric current of centrifugal pump

(Measuring point : Three directions at each point)



・Measurement date ：

・Measurement person ：

・Pump No. ：P－

・State of abnormality ：

* Vibration meter to be used ： Rion Co. VM-63A

		Ⓐ Casing			Ⓑ Bearing (Casing side)			Ⓒ Bearing (Motor side)			Ⓓ Motor (Pump side)			Operating condition
		V	H	A	V	H	A	V	H	A	V	H	A	
Abnormal	Displacement													Pressure (Fully open) ：〔MPa〕
	Velocity													
	Acceleration													Current ：〔A〕
Normal	Displacement													Pressure (Fully open) ：〔MPa〕
	Velocity													
	Acceleration													Current ：〔A〕

Displacement 〔μm〕
Velocity 〔mm/s〕
Acceleration 〔mm/s^2〕

V ： Vertical
H ： Horizontal
A ： Axial

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Summary cause of trouble

	Ｐ－１	Ｐ－２	Ｐ－３	Ｐ－４	Ｐ－５
Name					
Trouble part and cause					

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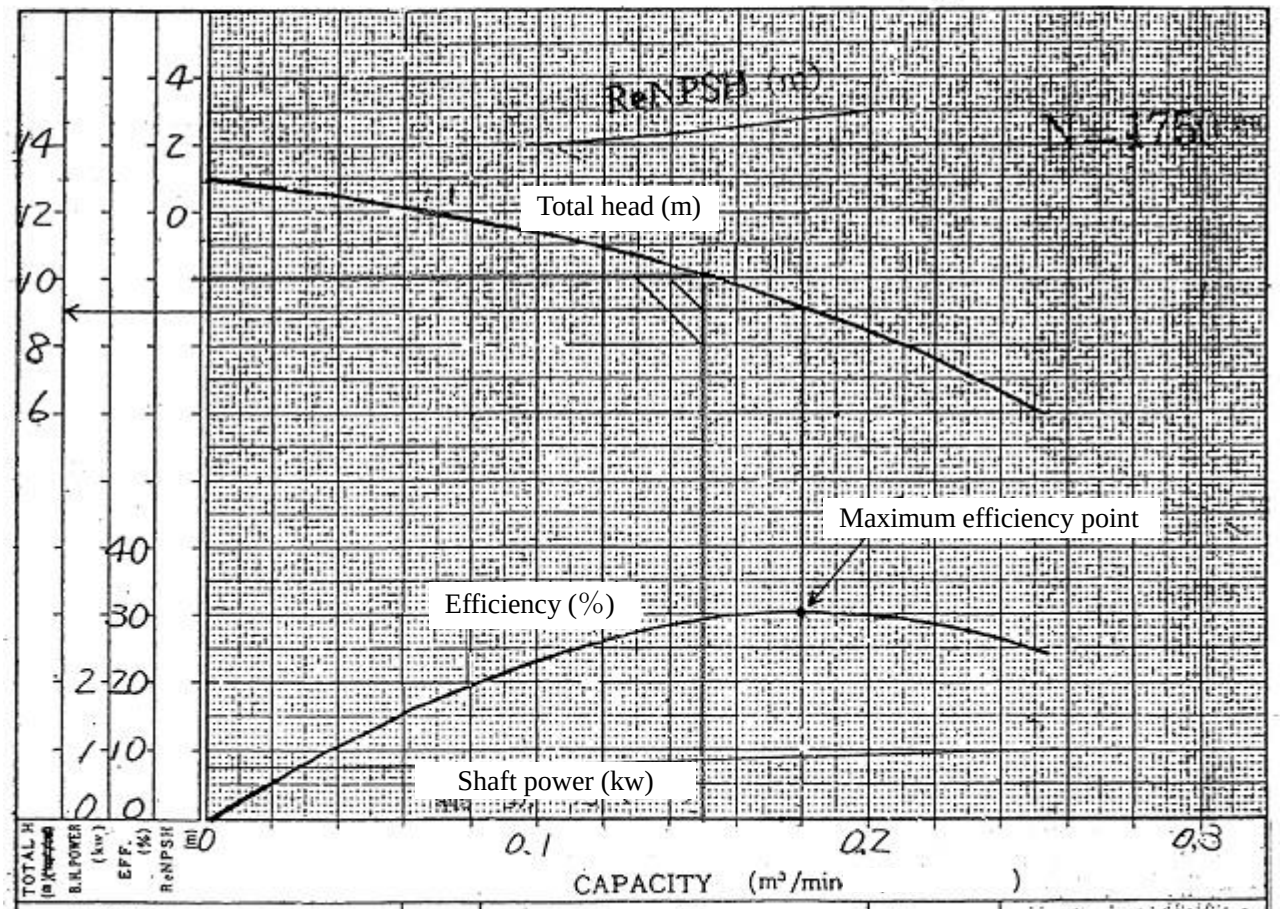
ESTIMATED PERFORMANCE CURVE

予 想 性 能 曲 線 図

ESQ 殿

VIA ESQ. 殿経由

ITEM No.	P-1,2,3,4,5				
ARTICLE 名 称					
TYPE 形 式	HCS (419) 吸込Suction mm 吐出Discharge mm S	REVOLUTION 回 転 数	1750 rpm		
BORE STAGE 口径 段数	40 × 40	B. HORSE POWER 所要動力	0.8 kw	OUT PUT モーター出力	1.5 kw
CAPACITY 吐 出 量	0.15 m³/min	FREQUENCY 周 波 数	60 Hz		
TOTAL HEAD 全 揚 程	10 m	VOLTAGE 電 圧	220 V		
NPSH	Av m / Re 2.4 m				



NOTE Liq. : 工業用水 γ : 1.0 Vis : 1cp T : 40°c	Cη : Cq : Ch :	HONDA PUMP HONDA KIKO Co., Ltd. FUKUOKA, JAPAN	DATE	54.10.9	
			APRD	CHKD	DRAWN

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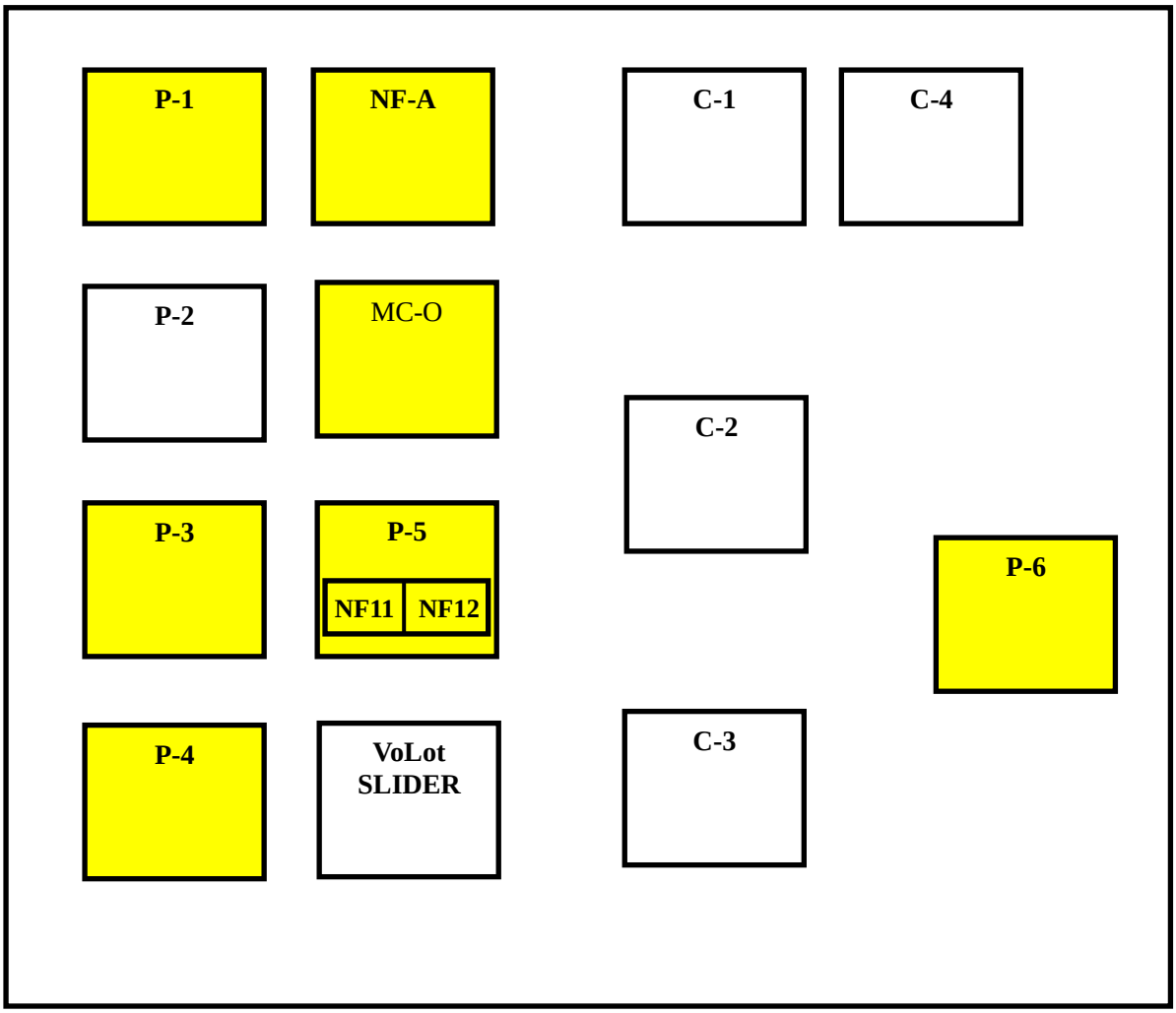
NFB layout in switch room



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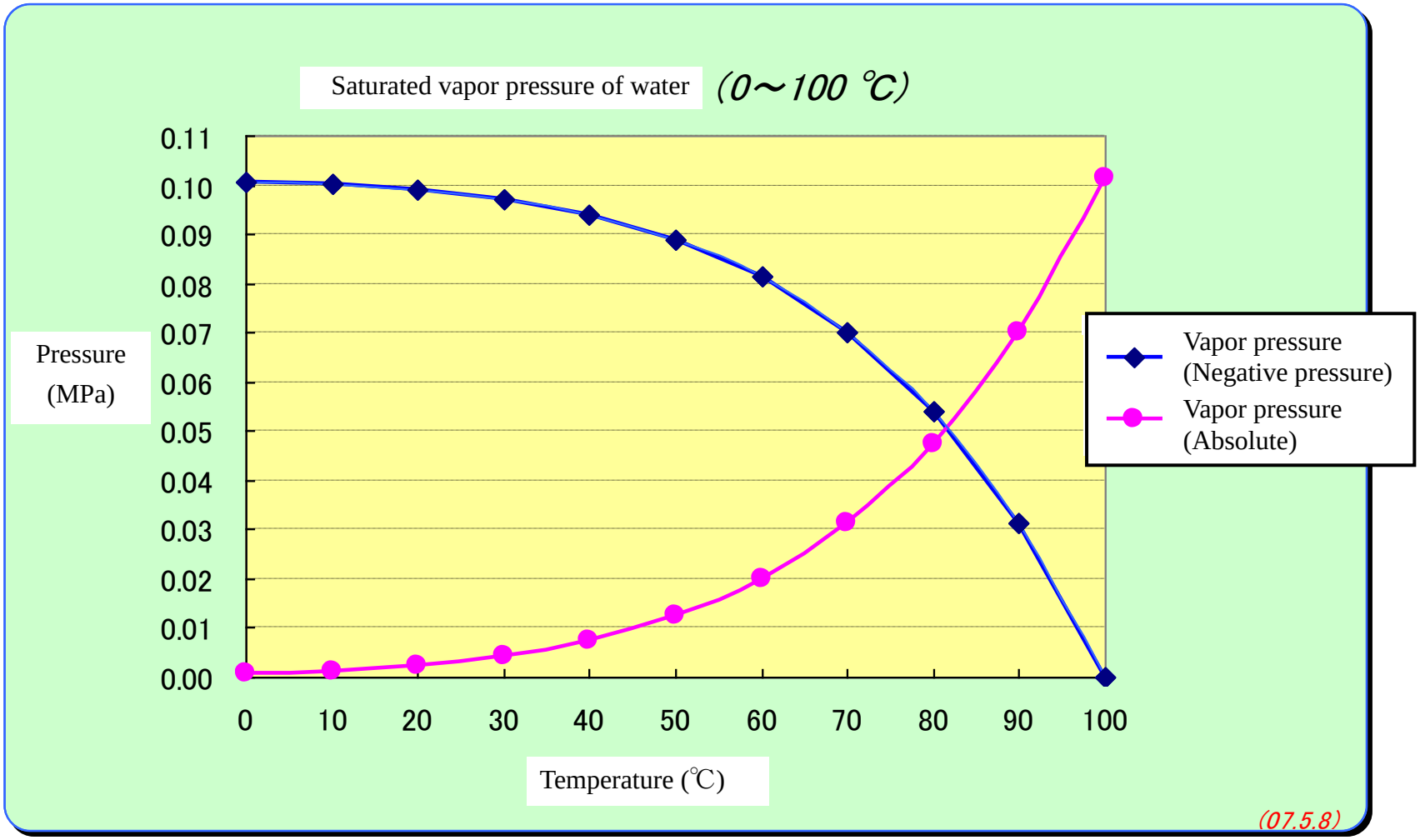
Saturated vapor pressure of water (graph)



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