

**SPUTTER ION PUMP  
INSTRUCTION MANUAL**



**CAUTION**

*Read this manual carefully before operation and keep it at hand for immediate reference.*

**ULVAC , Inc.**

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## Before using this Pump

Read this manual carefully and operate the pump correctly.



### Warning



- This manual contains important information for safe operation of this pump.
- Carefully read this manual and thoroughly understand it before operation.
- Keep this manual at hand for immediate reference.
- If the manual is lost or marred, contact your local ULVAC for an additional copy.
- If you come up with any question or trouble, contact your local ULVAC representative or Advanced Equipment Division, ULVAC, Inc., Japan.

## About Safety Notations




In this manual and warning signs on the machine, signal words and symbol marks are displayed in order for you to understand the matters adhere. The meanings are shown below:

### ► Meaning of signal words:

The terms that signify the warning level for safety are referred to as “signal words.”

	<b>WARNING</b>	This safety symbol indicates the possibility that improper handling will result in serious injury or loss of life.
	<b>CAUTION</b>	This safety symbol indicates the possibility that improper handling may result in serious injury which has a risk of developing disability and property damage.










### ► Meaning of symbol marks:

	Indicates potential risks related to high temperature.
	Indicates potential risks related to heavy goods.
	Indicates that a ground connection is required.







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## Safety Precautions

Read this manual and the following safety precautions before using this pump.

 <b>WARNING</b>	<p>Shut off power If the pump fails, immediately shut off the power. If the pump is used without shutting off the power, fire or electric shock can result. Contact your local ULVAC representative or Advanced Equipment Division, ULVAC, Inc., Japan for repair.</p>
 <b>WARNING</b>	<p>Shut off power If the pump is overheated or gives out smoke or smell, immediately shut off the power. Otherwise, fire or electric shock can result. For safety, contact your local ULVAC representative or Advanced Equipment Division, ULVAC, Inc., Japan.</p>
 <b>WARNING</b>	<p>Check grounding Securely ground the earth wire of the system in which this pump is installed.</p>
 <b>CAUTION</b>	<p>Do not disassemble. Do not try to disassemble the pump.</p>
 <b>CAUTION</b>	<p>Do not modify. Do not try to modify the pump. If modified, ULVAC will not be in a position to warrant pump actions. Also fire or electric shock can result.</p>
 <b>CAUTION</b>	<p>Beware of Operating environment High voltage is present in this pumping unit. Do not remove connectors immediately after the power is turned off because they may be charged up. Wait for about one minute or so before removal. Also lock out the power supply.</p>
 <b>CAUTION</b>	<p>Beware of Static Magnetic Field This pump uses a magnet. Operators wearing electronics medical equipment like pace maker must stay away from the pump.</p>
 <b>CAUTION</b>	<p>Caution in transit This pump is heavy. Use a dolly, crane or other carrying or lifting equipment for transit.</p>
 <b>CAUTION</b>	<p>Beware of high temperature This pump exhibits higher performance by baking. The pump and its surrounding area are heated to a high temperature. Do not place any combustibles around the pump. You may get burned on contact with the pump. If you are forced to work on a component heated to a high temperature to obtain an ultrahigh vacuum, put on protective wear and do not work with naked hands (do not expose your skin).</p>




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 <b>CAUTION</b>	<b>Beware of Operating environment</b> Do not use the pump in a place where it may be splashed with water. The pump may fail or electric leak or fire can result.
 <b>CAUTION</b>	<b>Check applied voltage.</b> Before starting this pump, make sure that the operating voltage of this pump and the supply voltage are in agreement. If a voltage higher than operating voltage is applied, abnormal discharge, insulation failure or other trouble can result.
 <b>CAUTION</b>	<b>Check connection.</b> Make sure that the connected cable does not come into contact with other conductive parts.
 <b>CAUTION</b>	<b>Comply with specified operating conditions.</b> Use this pump in the specified environment.
 <b>CAUTION</b>	<b>Caution in repacking</b> When shipping this pump, pack it as shipped from ULVAC plant. The pump may be damaged if it is shipped bare.
 <b>CAUTION</b>	<b>Discarding</b> When discarding this pump, comply with the regulations of your local government.

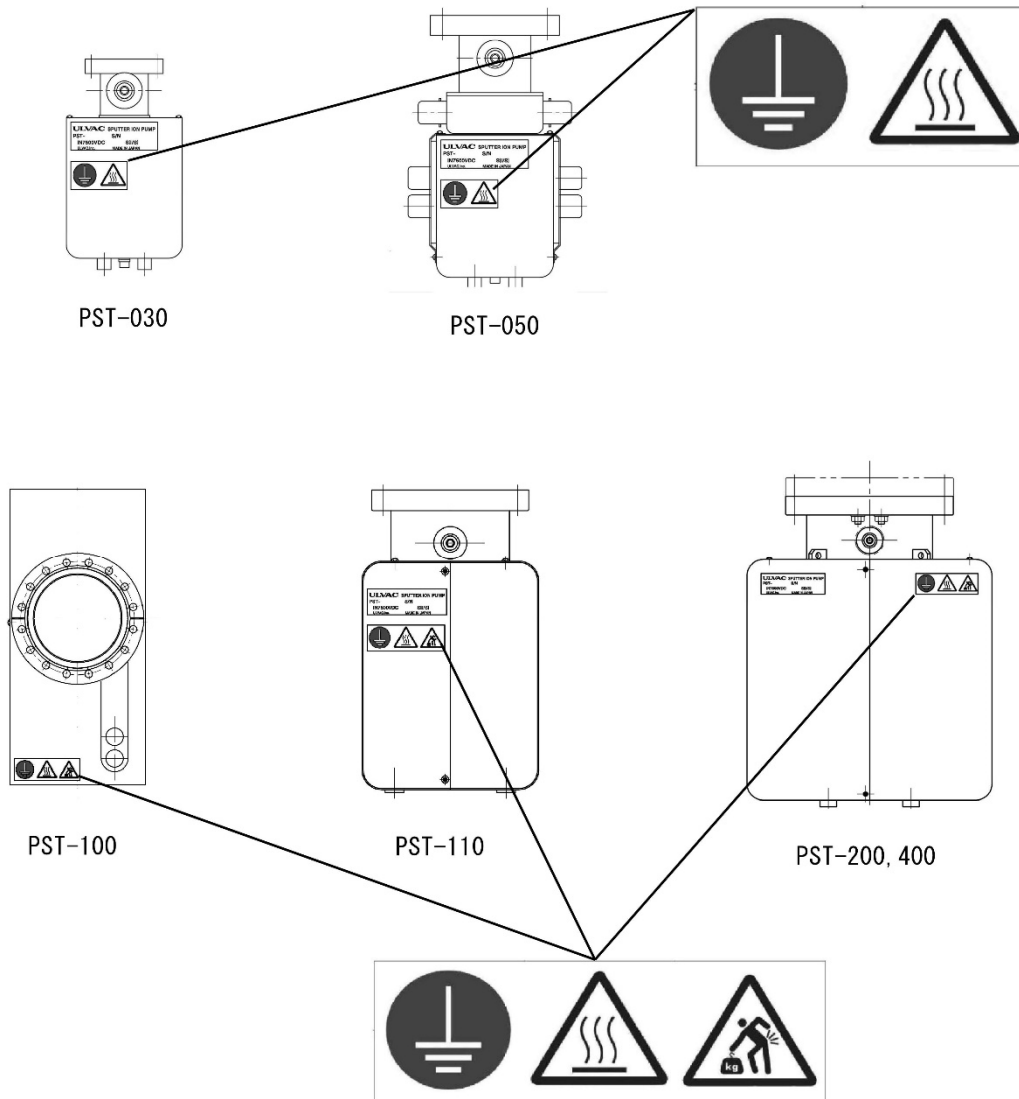
## Types and display position on warning labels.

A warning labels is attached onto a warning location on the machine. Never fail to check these labels before operating machine.

### Type and explanation on warning labels

	<p>During baking, the pump and its surroundings get hot. Please do not touch it. There is a risk of burns if it comes in contact with human body.</p>
	<p>Do not lift or move without mechanical assistance to avoid injury.</p>
	<p>Be sure to ground the earth of the equipment installed to this unit.</p>

### Warning Label display position



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# 1. Overview

## 1.1 Features

Unlike conventional ion pumps, the ULVAC ACTER pump, with its high throughput characteristics, can attain an extra- and ultra-high vacuum in the  $10^{-10}$  Pa range without using a titanium sublimation pump.

- (1) Throughput characteristics in (extra) high vacuum region  
An ultimate pressure of  $10^{-10}$  range has been attained in ultimate pressure test using the ISO standard test dome. (CXII/AXII series)
- (2) High pumping speed in ultra-high vacuum region  
As compared with ULVAC predecessor models, a high, stable pumping speed can be attained from a high vacuum region to an ultra-high vacuum region.
- (3) Bake-out heater is standard.  
(\*PST-030AU/CU ·PST-110AU not included)  
Employment of a dedicated heater allows bake-out with high efficiency.
- (4) Shield cover is standard. (\*PST-030AU/CU and PST-050AU/CU not included)  
A dedicated shield cover is provided to reduce leakage magnetic flux density outside the pump. It also provides heat insulating effect in baking out.
- (5) Two types of pump elements are available depending on the specie of the gas to be exhausted.  
For active gas: CXII ·CU  
For inert gas : AXII ·AU  
\* The inert gas-compatible type provides a pumping performance twice as high for argon gas.

## 1.2 Specifications

Item	PST-030 AU/CU	PST-050 AU/CU	PST-100 AX/CX	PST-200 AXII/CXII	PST-400 AXII/CXII
Regenerating pumping speed for N <sub>2</sub> (m <sup>3</sup> /sec)	0.03 (0.02)* * at 1.0 × 10 <sup>-7</sup>	0.045 (0.03)* * at 1.0 × 10 <sup>-7</sup>	0.10 (0.08)* * at 1.0 × 10 <sup>-7</sup>	0.20 * at 1.0 × 10 <sup>-7</sup>	0.36 * at 1.0 × 10 <sup>-7</sup>
Regenerating pumping speed for Ar (m <sup>3</sup> /sec)	0.013- at 1.0 × 10 <sup>-7</sup>	0.016 at 1.0 × 10 <sup>-7</sup>	0.015 at 1.0 × 10 <sup>-7</sup>	0.105 (AXII) 0.02 (CXII) at 1.0 × 10 <sup>-7</sup>	0.19 (AXII) 1.04 (CXII) at 1.0 × 10 <sup>-7</sup>
Ultimate pressure	10 <sup>-9</sup> Pa	10 <sup>-9</sup> Pa	10 <sup>-9</sup> Pa	10 <sup>-10</sup> Pa	10 <sup>-10</sup> Pa
Operating voltage	DC +7.5 kV	DC +7.5 kV	DC +7.5 kV	DC +7.5 kV	DC +7.5 kV
Discharge intensity characteristic value	3 A/Pa	3 A/Pa	6 A/Pa	8 A/Pa	10 A/Pa
Tie-in flange	CF70	CF114	CF152	CF203	CF203
Inner volume (m <sup>3</sup> )	0.67 × 10 <sup>-3</sup>	1.3 × 10 <sup>-3</sup>	3.3 × 10 <sup>-3</sup>	11 × 10 <sup>-3</sup>	14 × 10 <sup>-3</sup>
Operating pressure (recommended value)	<8.0 × 10 <sup>-3</sup> Pa	<8.0 × 10 <sup>-3</sup> Pa	<5.0 × 10 <sup>-3</sup> Pa	<3.8 × 10 <sup>-3</sup> Pa	<3.0 × 10 <sup>-3</sup> Pa
Standard bake-out temperature	250°C	250°C	250°C	250°C	250°C
Bake-out heater	No setting	200V AC, single phase, 300 W	200V AC, single phase, 320 W	200V AC, single phase, 600 W	200V AC, single phase, 800 W
Weight	9.5 kg	12 kg	37 kg	65 kg	124 kg
Outside dimensions (mm)	103 × 183 × 187 (W×D×H)	(153) × 204 × 241 (W×D×H)	155 × 336 × 340 (W×D×H)	296 × 361 × 376 (W×D×H)	296 × 544 × 376 (W×D×H)
Pump fixing bolt hole *	Four M5	Four M5	Four M8	Four M8	Six M8

\* For the size and position of bolt holes, refer to the dimensions of each model at the end of this specification.

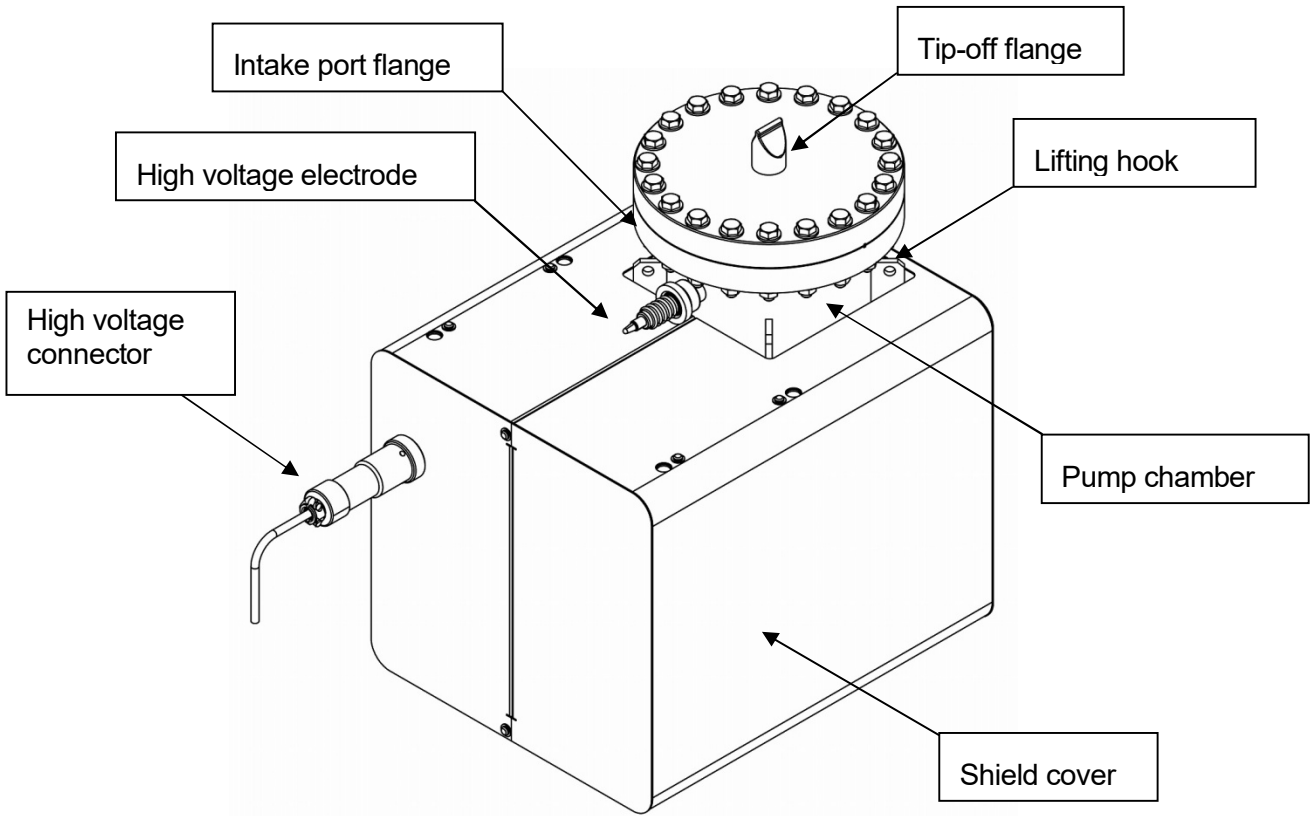


Item					
Model	PST-110 AU/CU				
Regenerating pumping speed for N <sub>2</sub> (m <sup>3</sup> /sec)	0.11 (0.06)* * at 1.0 × 10 <sup>-7</sup>				
Regenerating pumping speed for Ar (m <sup>3</sup> /sec)	-				
Ultimate pressure	10 <sup>-9</sup> Pa				
Operating voltage	DC +7.5 kV				
Discharge intensity characteristic value	6.6 A/Pa				
Tie-in flange	CF152				
Inner volume (m <sup>3</sup> )	6.5 × 10 <sup>-3</sup>				
Operating pressure (recommended value)	<4.5 × 10 <sup>-3</sup> Pa				
Standard bake-out temperature	250°C				
Bake-out heater	No setting				
Weight	36.5 kg				
Outside dimensions (mm)	(186)×387×293 (W×D×H)				
Pump fixing bolt hole *	Four M6				

\* For the size and position of bolt holes, refer to the dimensions of each model at the end of this specification.

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### 1.3 Nomenclature of Components



#### Names of ion pump components

\* Models PST-030 and PST-050 are not equipped with shield covers.

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## 1.4 Accessories

The standard pump comes with the following accessories.

Description	Quantities
Instruction manual	1 copy
Tip-off Flange	1 pc.
Mounting gasket	1 pc.

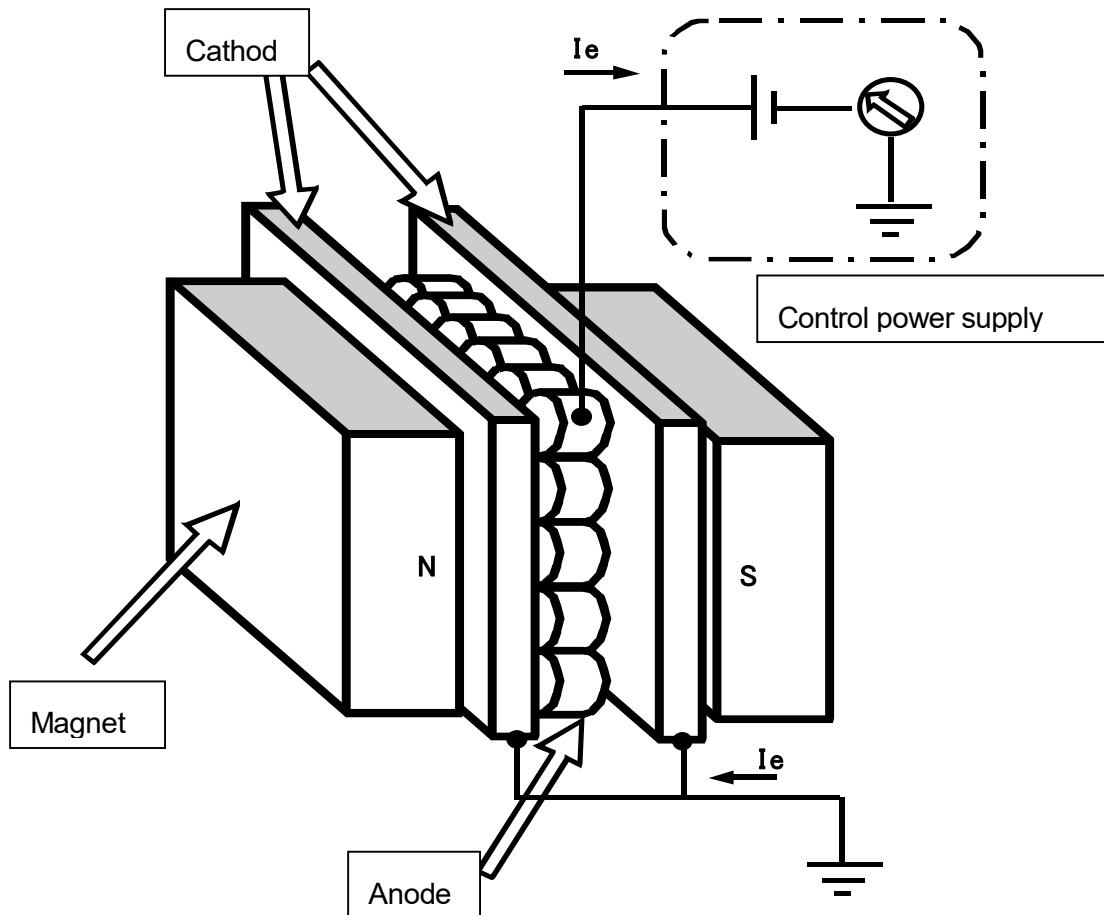
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## 2. Principles of Operation and Structure

### 2.1 Concept of Evacuation

The ion pump is so constructed that an anode is located between two opposing titanium cathodes, and a voltage is applied between them.

A magnetic field is applied in the same direction as the electric field with a permanent magnet located outside the electrode assembly.



Ion pump schematic diagram

The ion pump pumping action is based on the principle of Penning discharge.

Normally, cold cathode glow discharge disappears at a pressure of about 1 Pa.

Discharge can be maintained even under a pressure of 1 Pa or higher by applying a magnetic field. The electrons generated in the space enclosed with the opposing cathodes and the cylindrical anode repeat spiral action toward magnetic field in the space, reciprocating between opposing cathodes, and the electrons collide with gas molecules and ionize them.

Since positive ions generated by ion collision have a high mass as compared with electrons, they are not so much deflected by magnetic field and are accelerated toward the cathode, bombarding the cathode surface with ions.

Titanium atoms sputtered from the cathode surface by ion bombardment are deposited on the anode and opposing cathodes, forming new titanium film.

Titanium is a chemically active metal and has a capability of chemically adsorbing hydrogen, oxygen, carbon monoxide, and many other active gases.

The active gas remaining in the space is chemically adsorbed to the titanium film and is removed from the space.

Thus, the ion pump has two actions: the getter action which a clean titanium deposited film has and the action of ions, atoms or molecules penetrating into the cathode with their own incident energy and being captured, thereby pumping action being performed by these two actions.

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## 2.2 Characteristics

### 2.2.1 Operating pressure range

Pumping action can be performed in a stable condition within a range from  $10^{-3}$  to  $10^{-9}$  Pa.

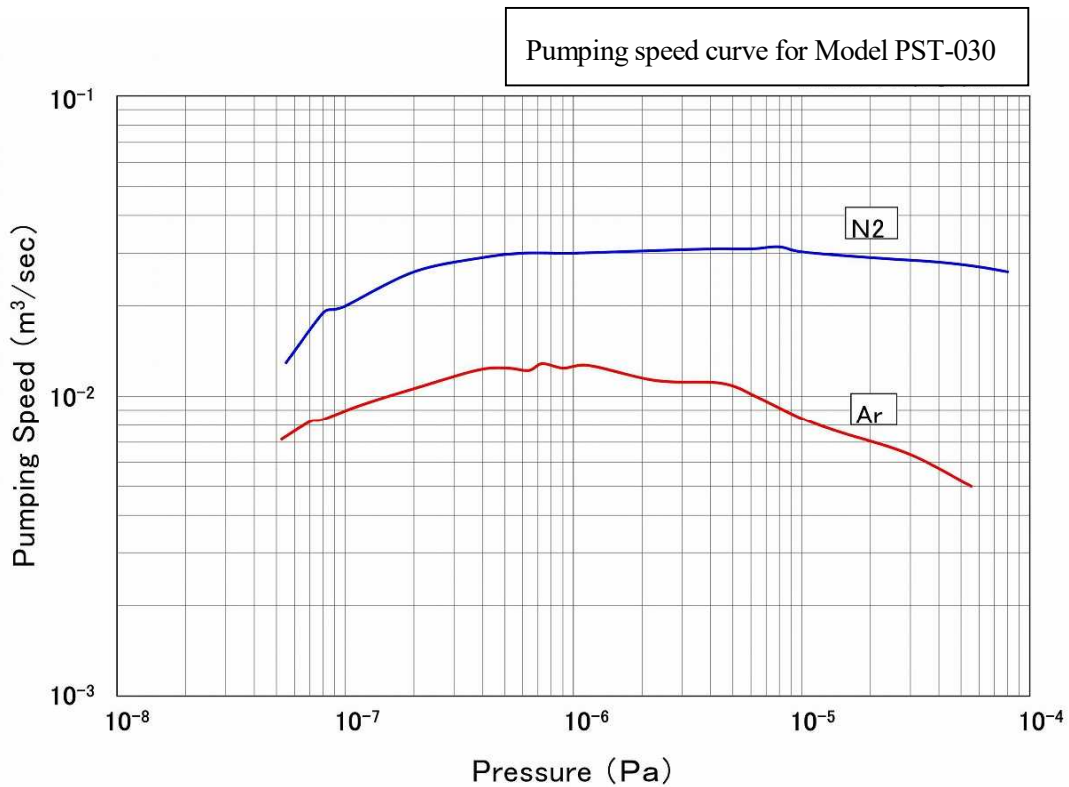
This pump offers stable operational characteristics without extinction of discharge even in an extra- or ultra-high vacuum region.

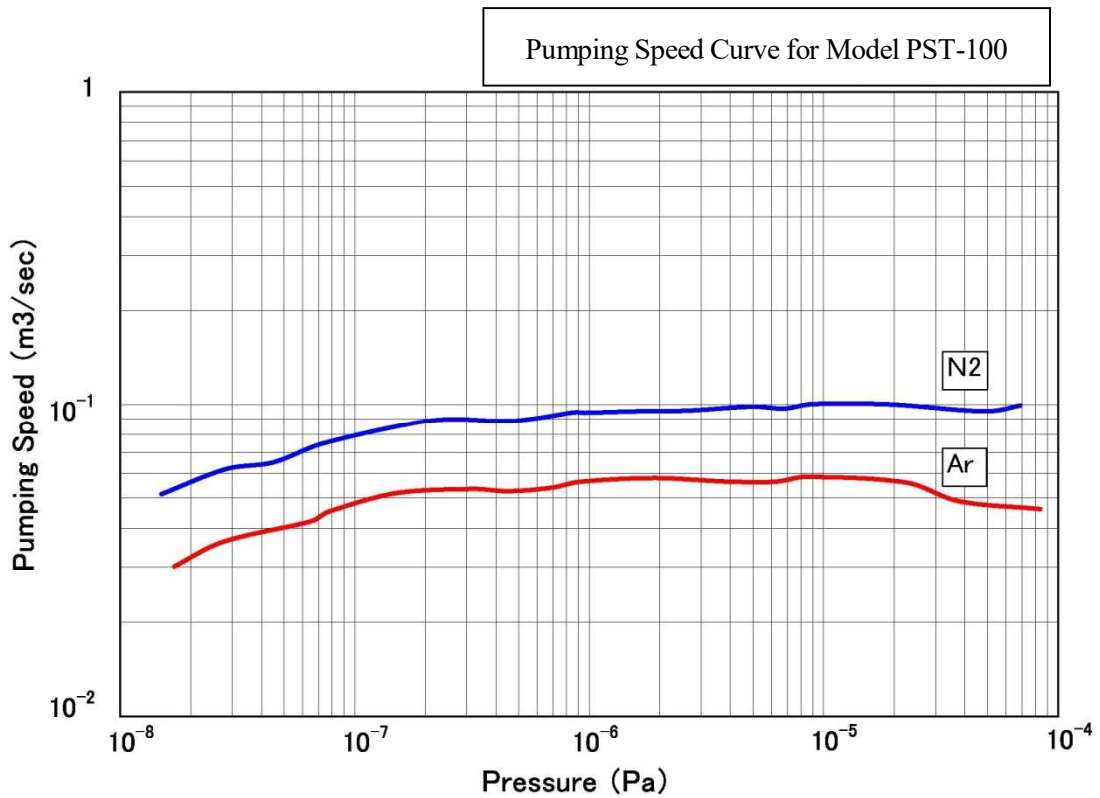
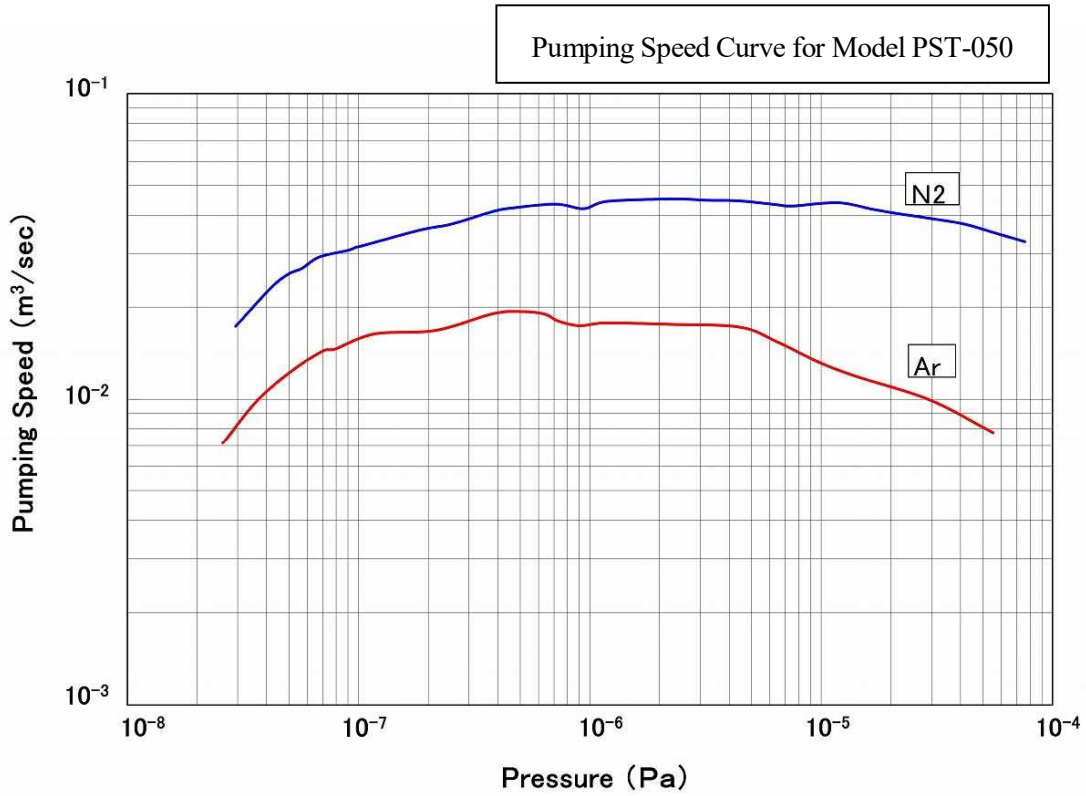
To prevent contamination or overheating of pump elements, however, operation in a high vacuum region for an extended time is not recommended. It is be noted that such operation will lead short lifetime of the pump.

### 2.2.2 Pumping speed

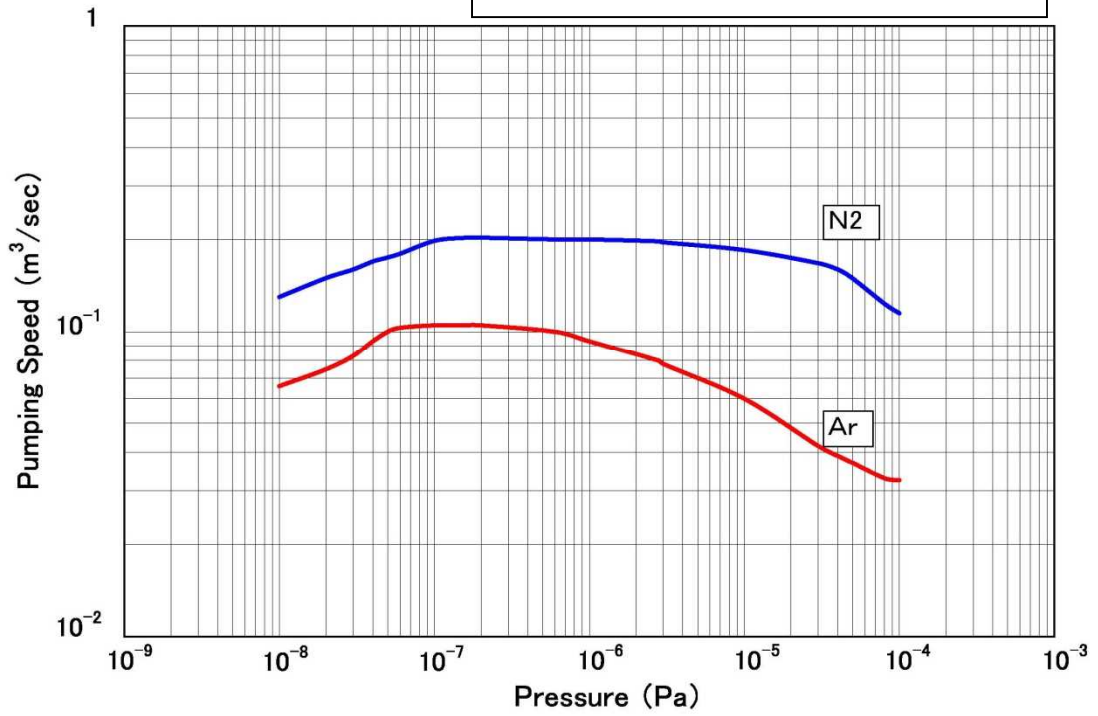
The ACTER pump features a high pumping speed in an ultra-high vacuum region.

The graph below shows the pumping speeds obtained with different models.

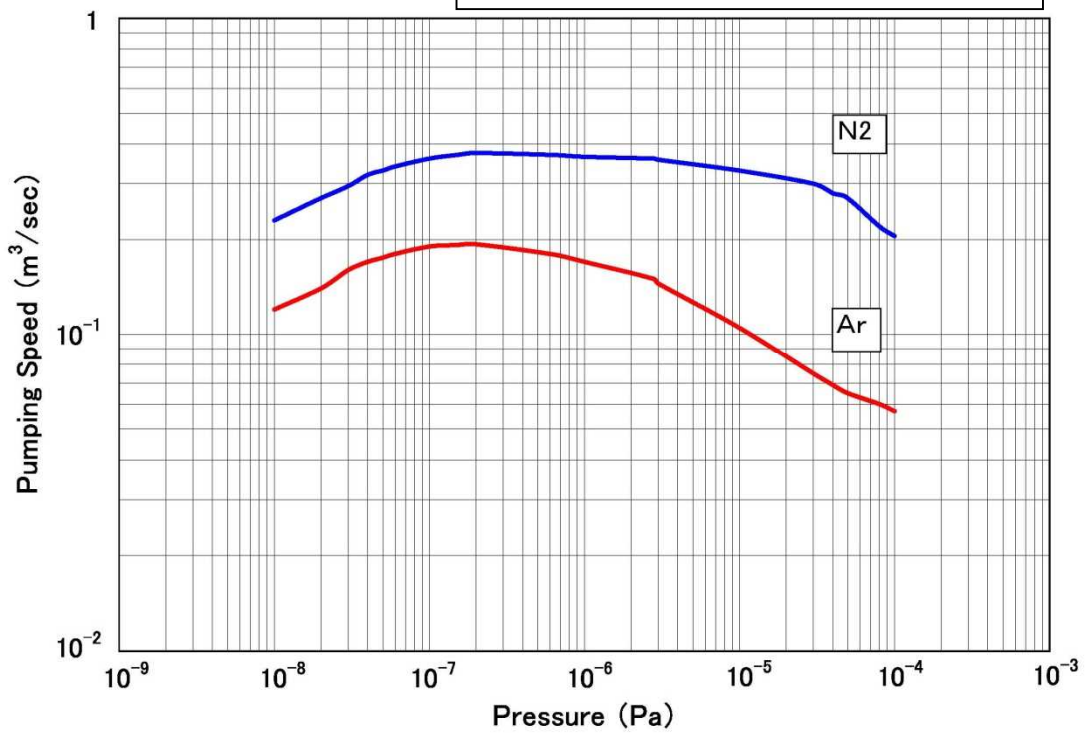




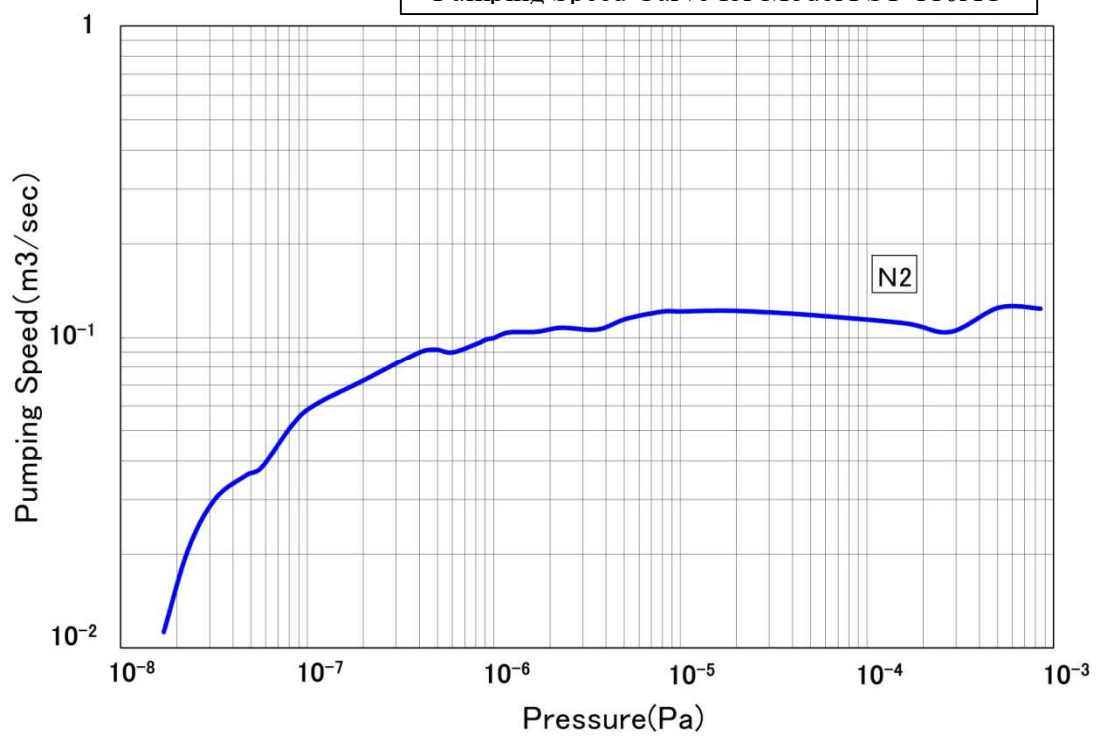
Pumping Speed Curve for Model PST-200



Pumping Speed Curve for Model PST-400



Pumping Speed Curve for Model PST-110AU





### 2.2.3 Concept of life expectancy

Generally, the life expectancy of an ion pump changes with pressure and is in inverse relation to the operating pressure.

It also changes with operating conditions and specie of gas to pump.

The table below gives a guideline based on prediction.

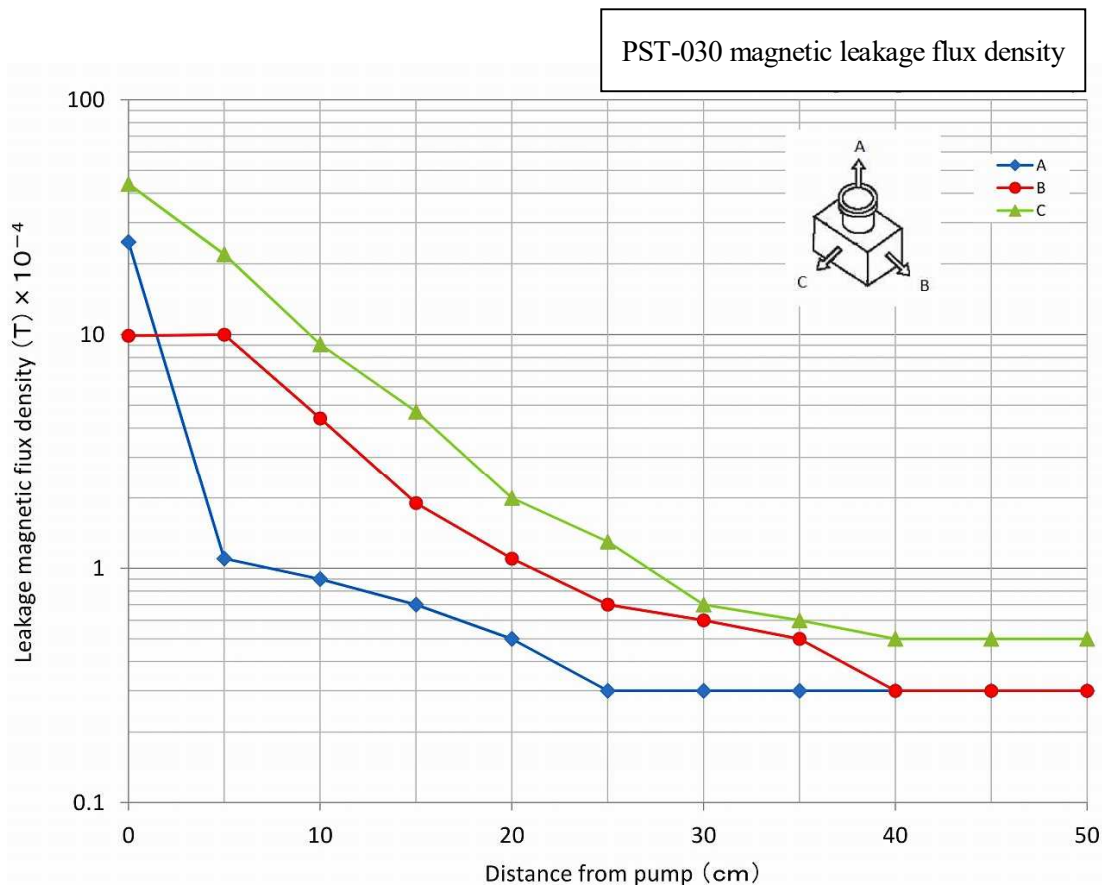
Pressure (Pa)	Time (h)
$10^{-5}$	$4.0 \times 10^5$
$10^{-4}$	$4.0 \times 10^4$
$10^{-3}$ *	$4.0 \times 10^3$

\* The cathode will be heated if the pump is operated for a long time.

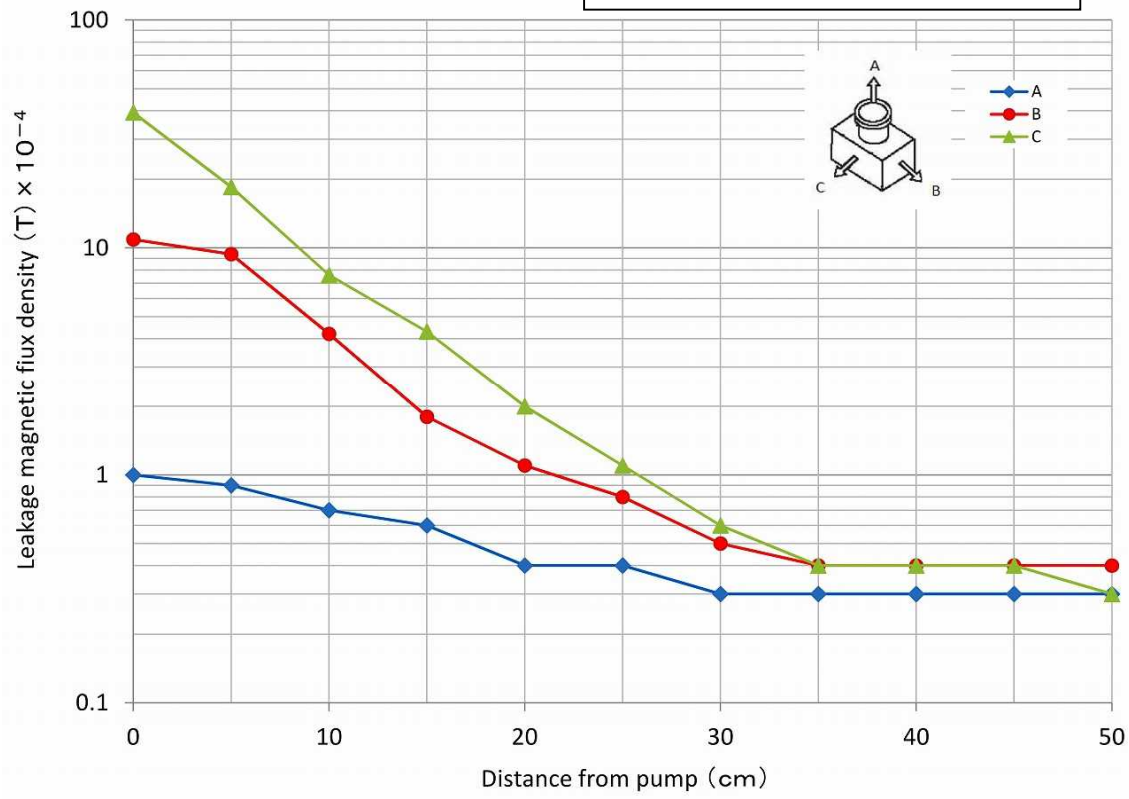
The pump can be used for a long time if it is operated under a high vacuum.

### 2.2.4 Leakage magnetic flux density

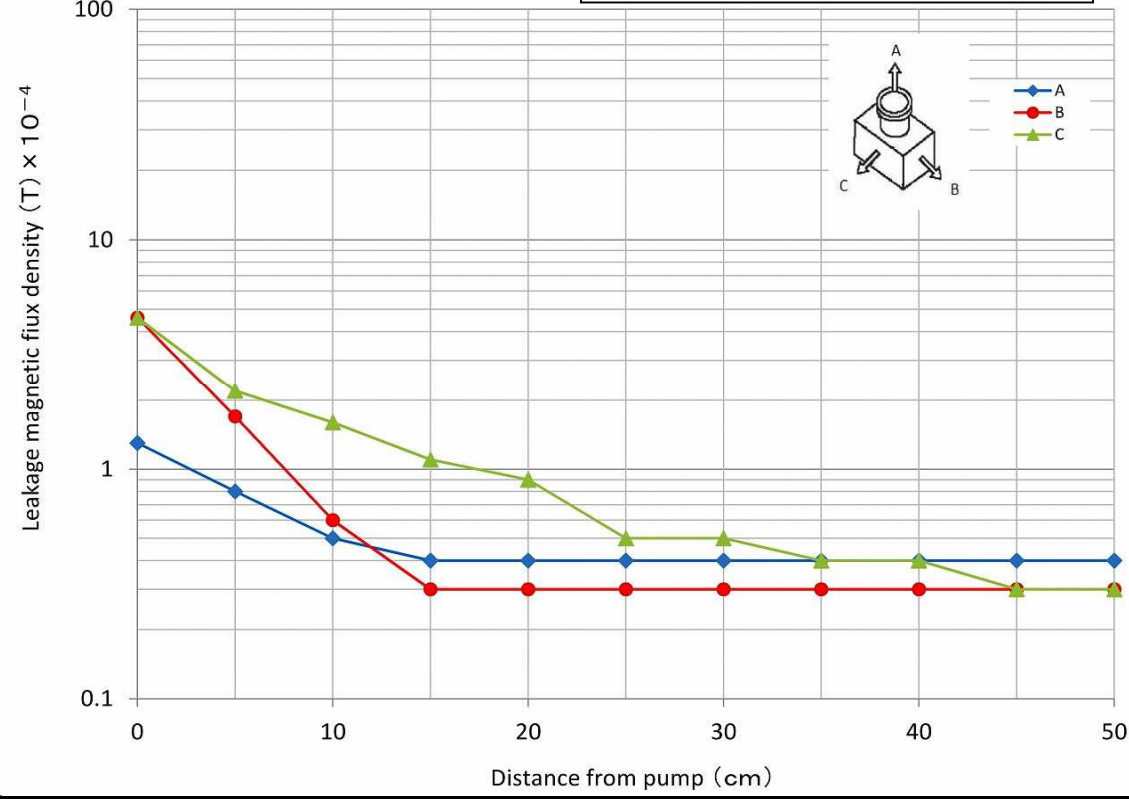
The table below gives the leakage magnetic flux density on the outside of the pump for different types of ACTER pump.



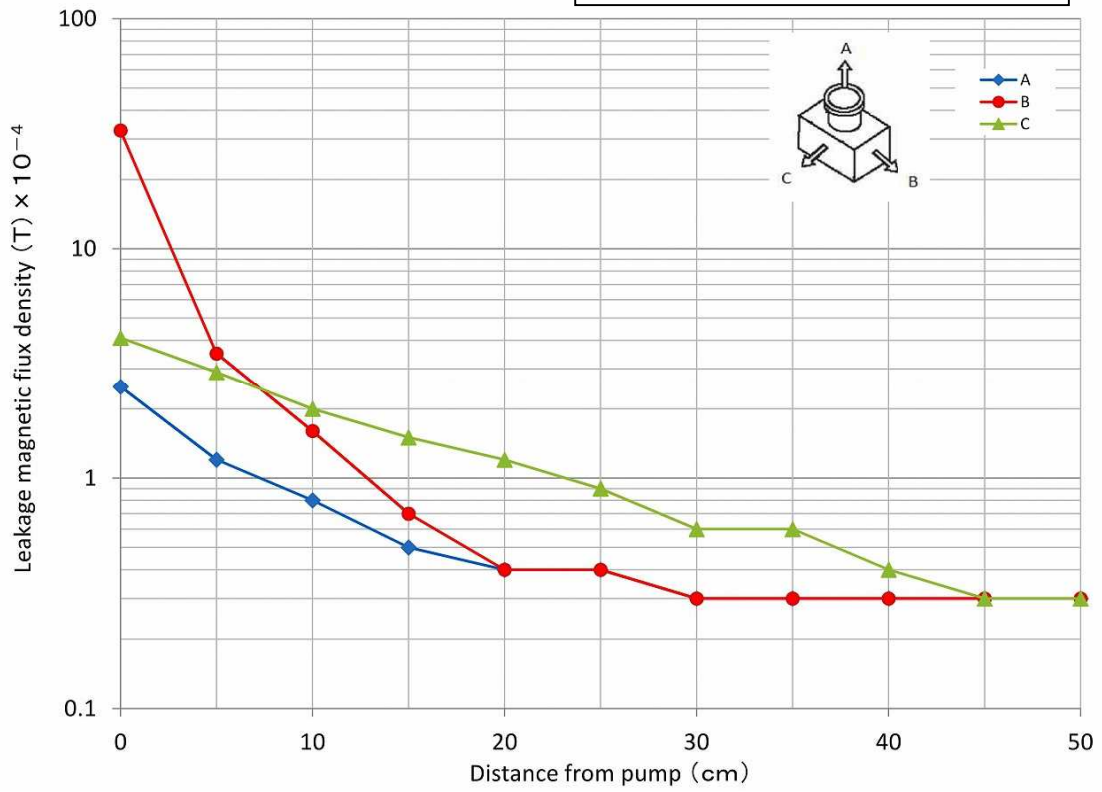
PST-050 magnetic leakage flux density



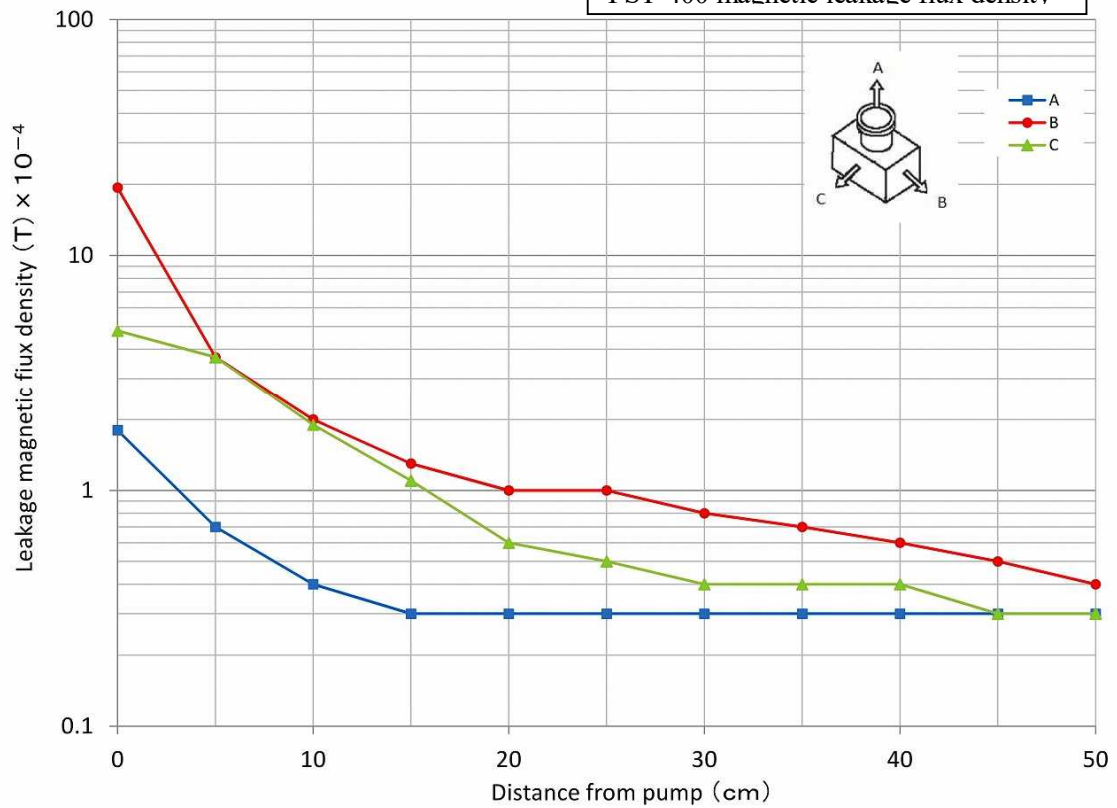
PST-100 magnetic leakage flux density



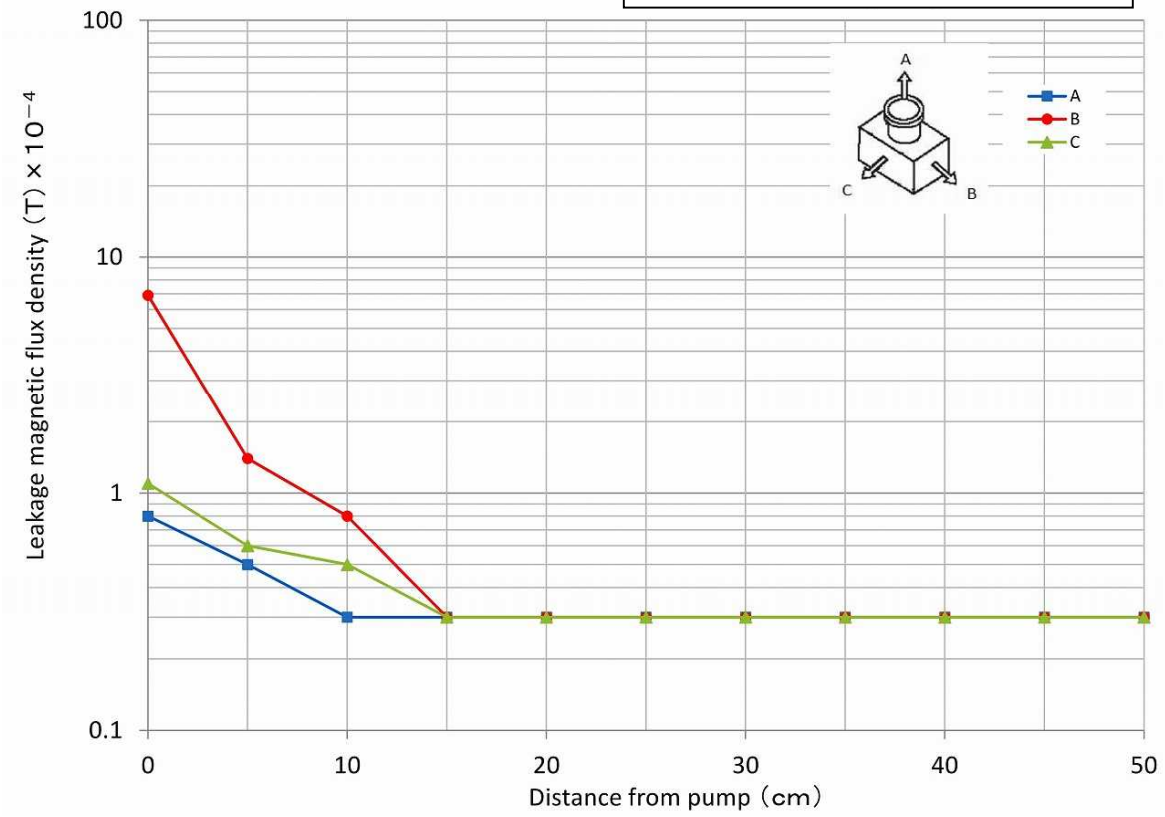
PST-200 magnetic leakage flux density



PST-400 magnetic leakage flux density



PST-110 magnetic leakage flux density



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## 2.2.5 Discharge intensity

The ion pump allows prediction of an approximate vacuum by reading discharge current (ion current) as follows.

Example of calculation

When the discharge intensity is 10 A/Pa and the discharge current is 1 mA,

a) Conversion of pressure

$$10 \text{ A/Pa} = 1 \text{ mA}/X$$

$$X = 1.0 \times 10^{-4} \text{ Pa}$$

b) Conversion of discharge current

$$10 \text{ A/Pa} = X/1.0 \times 10^{-4} \text{ Pa}$$

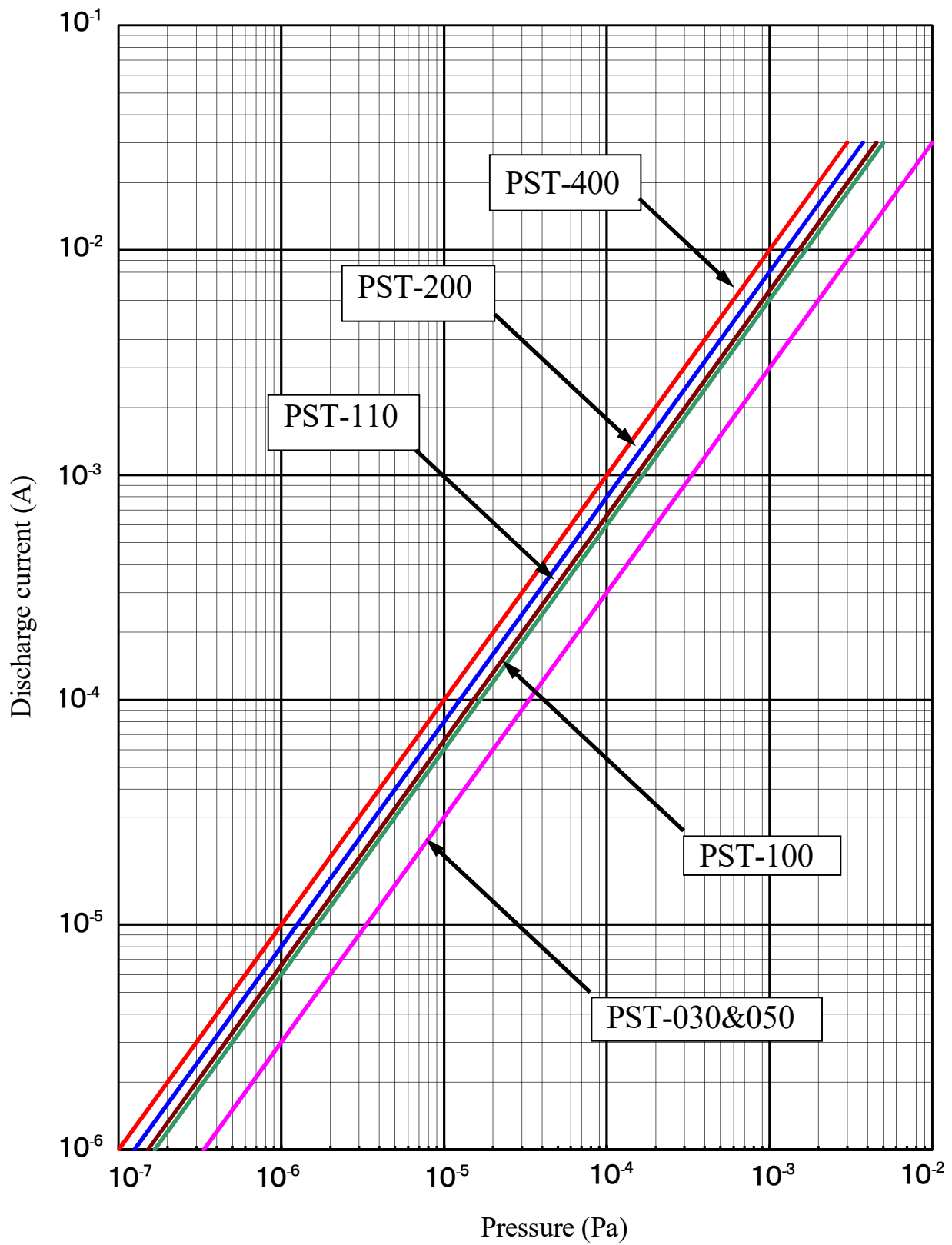
$$X = 1.0 \times 10^{-3} \text{ Pa}$$

For more accurate measurement of pressure (degree of vacuum), the use of an ionization vacuum gauge is recommended. It is also to be understood that an ionization gauge should be used for accurate measurement of a pressure of  $10^{-7}$  Pa or lower.

Discharge intensity characteristics value by model of pump

Model	PST-030 AU/CU	PST-050 AU/CU	PST-100 AX/CX	PST-200 AXII/CXII	PST-400 AXII/CXII	PST-110 AU
Discharge intensity characteristic value	3 A/Pa	3 A/Pa	6 A/Pa	8 A/Pa	10 A/Pa	6.6 A/Pa

Discharge intensity characteristics curve of different models is shown on the next page.



Discharge current characteristics curve

### 3. Preliminary Operation

#### 3.1 Environment of installation site.

Use the ion pump indoors.

Operating environment	Temperature range:	5°C to 40°C
	Humidity range:	not higher than 85%, not condensing

Do not install the pump in the following places.

- Place where the pump may be splashed with water
- Dusty place
- Place where explosive or combustible gas is present
- Place where corrosive gas is present
- Place where vibration is at a high level
- Place exposed to direct sunlight
- Place where high intensity magnetic field or electric field is present
- Place where the pump is exposed to radiation.

<Recommendation>

The ion pump is energized with a high voltage of 7.5 kV DC.  
The high voltage electrode tends to gather dust, dirt and others because of electric field.  
Scheduled cleaning of the electrode area is recommended.

#### 3.2 Installing the Pump

\* The pump has been pumped down before shipment.


- (1) Check components to make sure that they are free from damage.
- (2) Loosen the bolt of the intake port flange to remove the tip-off flange.  
When handling the intake port, which will be in vacuum, wear nylon gloves so as not to soil it with hand grease.
- (3) Install the pump in a system.  
The pump can be installed in any orientation, but it is recommended to install it in the downward direction.  
The pump has bolt holes for installation in a framework or other.

#### Characteristic values by model of pump

Model	PST-030 AU/CU	PST-050 AU/CU	PST-100 AX/CX	PST-200 AXII/CXII	PST-400 AXII/CXII	PST-110 AU
Pump fixing bolt hole	M5 × 4 pcs.	M5 × 4 pcs.	M6 × 4 pcs.	M8 × 4 pcs.	M8 × 6 pcs.	M6 × 4 pcs.

\* For the dimensions of bolt holes, refer to the dimensions of each model at the end of this specification.

- (4) Securely ground the grounding wire of the system in which the pump is to be installed. (A class)

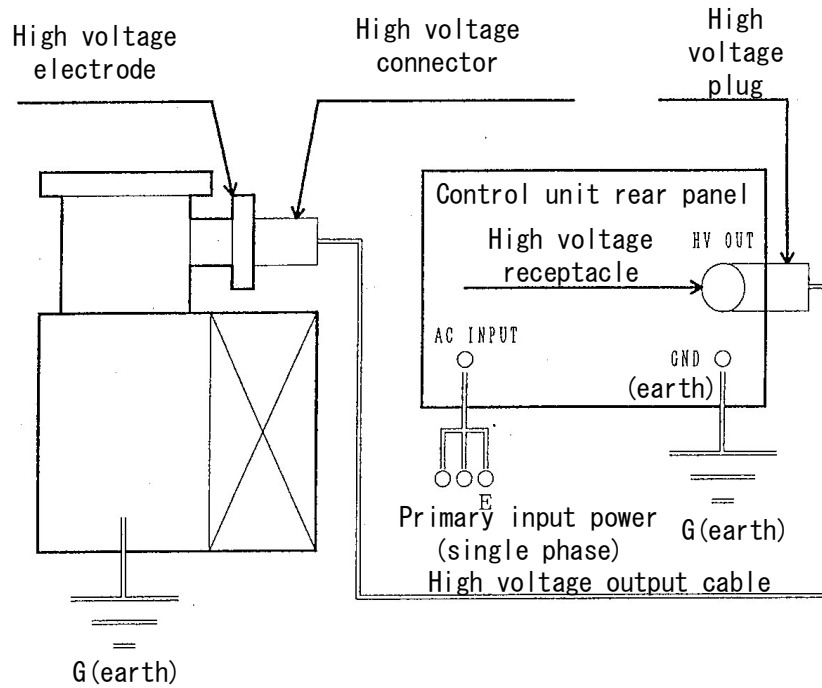
	<p><b>WARNING</b></p> <p>Check grounding</p> <p>Securely ground the grounding wire of the system in which this pump is to be installed.</p>
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<Note>

- The ion pump is heavy. Securely fix the pump to a framework.
- If it is anticipated that strain may be caused by thermal expansion, contrive a method for relieving stress when installing the pump.
- If fall of an object into the pump is anticipated, provide a mesh or other for the intake port flange.
- When you install an ion pump, please perform flange clamping with a new bolt by all means
- Once used, gaskets cannot be reused. Change them in order.  
A scarred flange edge can be a cause of leak. If scarred, consult with ULVAC.

### 3.3 Connection to Control Unit

Connect the ion pump and the control unit referring to the connection diagram below.



Always connect the grounding wires of the ion pump and control unit. (A class)

	<b>WARNING</b>	Check grounding Securely ground the grounding wire of the system in which this pump is installed.
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### 3.4 Bake-out Heater

The ACTER pump comes with a bake-out heater.

\* PST-030AU/CU ·PST-110AU is not included.

The heating temperature of the pump has been controlled at about 250°C when temperature is not controlled. Note the following when installing the pump in a system.

- (1) Use 200VAC single phase power as heater input.  
Use a power supply that meets the safety standard for heater power supplies (CE Marking).
- (2) For added precaution, it is recommended to take measures against overheating.  
Measure temperature in the vicinity of the pump intake port flange to detect overheating (200°C maximum).

An example of connection is given below.

Power	Heater
R .....	U1 (U2)
S .....	V1 (V2)

#### Heater power capacity of pumps

Model	PST-030 AU/CU	PST-050 AU/CU	PST-100 AX/CX	PST-200 AXII/CXII	PST-400 AXII/CXII	PST-110 AU
Bake-out heater	No setting	200 VAC, single phase, 300 W	200 VAC, single phase, 320 W	200 VAC, single phase, 600 W	200 VAC, single phase, 800 W	No setting



#### CAUTION

Beware of high temperature.

This pump exhibits higher performance by bake-out. The pump and its surrounding area are heated to a high temperature. Do not place any combustibles around the pump. You may get burned on contact with the pump. If you are forced to work on a component heated to a high temperature to obtain an ultrahigh vacuum, put on protective wear and do not work with naked hands (do not expose your skin).

- (3) When the entire system is baked, the ion pump temperature also changes. Control the temperature at 200°C maximum.
- (4) About the thermal insulation method of the ion pump  
PST-030 · PST-050 : Please keep it warm with a thermal insulator including the aluminum foil.  
PST-100 · PST-200 · PST-400 :  
I have a bake-out heater built-in inside of a shielding cover.  
Shielding cover can be used as a keeping warm box.  
It is not necessary to add a thermal insulator by addition.  
※The change of color of a gossan and the shielding cover of the warning label may occur when I add a thermal insulator to a shielding cover.  
PST-110: There is no bake-out heater inside of a shielding cover.  
When you perform bake-out, please remove a shielding cover.
- (5) Temperature around the pump becomes high.  
Do not place any combustibles near the pump and pay attention to the surrounding area.

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### 3.5 Conflat Flange

The ion pump uses a Conflat flange for the connection flange.

The Conflat flange is a seal for use in ultrahigh vacuum, which is clean and contains no organic substance. It provides stable air-tightness free from leak even in cyclic baking.


The following gives an example of tightening the Conflat flange.

- (1) It is recommended to apply solid lubricant like Molikot to the engagements of bolts.
- (2) Tighten bolts diagonally in order.
- (3) After tightening bolts with the specified maximum torque, tighten them with the same torque.

#### Example of tightening

No. of tightening times	M6 bolt	M8 bolt
1 <sup>st</sup> turn	5 N•m/tighten diagonally	5 N•m/tighten diagonally
2 <sup>nd</sup> turn	8 N•m/tighten diagonally	10 N•m/tighten diagonally
3 <sup>rd</sup> turn	10 N•m/tighten diagonally	15 N•m/tighten diagonally
Last turn	10 N•m/tighten diagonally	15 N•m/tighten diagonally

\* 1N•m=approx. 10 kgr•cm

	<b>CAUTION</b> Do not contaminate the surface exposed to vacuum with solid lubricant like Molikot to be applied to bolt engagements. Do not handle flanges and gaskets with naked hands, but wear nylon gloves. Handle the seat surface carefully so that it is not scarred.
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## 4. Operation

### 4.1 Checks before Operation

Make sure that the ion pump is correctly connected to the ion pump power supply.  
Make sure that the pump body and the ion pump power supply are grounded.

### 4.2 Startup

Actuate the rough pumping system to pump the system and ion pump down to a pressure of  $4.0 \times 10^{-3}$  Pa or less.

Recommended value:  $1.3 \times 10^{-4}$  Pa or less

After rough-pumping the system to the above pressure, apply a high voltage from the ion pump power supply, with the rough valve opened.

Note that gas will be released for a while at startup.

Approximate pressure in the ion pump can be checked with the discharge current value.

### 4.3 Bake-out

If the system is vented to atmospheric pressure or a large volume of gas is exhausted by the pump and a desired pressure cannot be attained, it is necessary to bake out the entire pumping system and the ion pump.

A representative method of bake-out is described below.

#### a) Routine operation

- (1) Wind a heater around the pumping system, including the ion pump, and insulate heat with aluminum foil or other.
  - (2) Raise temperature while taking care to the bake-out temperature and pressure in the system.  
Ion pump bake-out temperature:  $250^{\circ}\text{C}$  or less
  - (3) Keep the pressure in the system at  $1.3 \times 10^{-3}$  Pa or less during bake-out.  
Recommended value:  $1.3 \times 10^{-4}$  Pa or less
  - (4) The bake-out time is 48 hours or more as a guideline when the pump has been vented to atmospheric pressure  
The bake-out time varies with the system condition and specifications. Set any empirical value. After bake-out, allow the temperature to lower.
  - (5) Make sure that the temperature of the ion pump high voltage electrode is not higher than  $80^{\circ}\text{C}$ .
  - (6) Connect the high voltage cable and start up the ion pump.
  - (7) Close the roughing valve and pump the system using the ion pump alone.  
If the ion pump discharge current value exceeds twice or more when the valve is closed, open the valve and rough-pump the system for a while.
  - (8) It takes about 48 hours for the entire pump to return to room temperature.
- \* It is important that the ion pump is started when the entire system is hot.  
It is recommended to remove heat insulator from the high voltage electrode after bake-out before starting up the ion pump.

#### b) When a $250^{\circ}\text{C}$ heat resistant high voltage output cable is used

- The ion pump can be started up during baking by using the  $250^{\circ}\text{C}$  heat resistant high voltage cable.
- (1) Start up the ion pump about 24 hours after starting bake-out.  
Here, make sure that the ion pump discharge current value lowers to 1 mA or less in about 5 minutes.
  - (2) Continue bake-out in this condition for about 20 hours.
  - (3) Close the roughing valve and pump the system with the ion pump alone.  
If the ion pump discharge current value rises twice or more when the valve is closed, open the valve again and rough-pump the system for a while.
  - (4) Continue bake-out for another 4 hours in this condition.
  - (5) Finish bake-out.
  - (6) It takes about 48 hours before the entire pump returns to room temperature.

<Note>

- If bake-out can be made for a longer time, a cleaner and lower ultimate pressure can be attained.
- Forced cooling after bake-out can lead to re-adsorption of gas and leak due to temperature differences of components. Natural cooling is recommended down to about  $100^{\circ}\text{C}$ .

---

#### 4.4 Shutdown

\* Do not touch the pump with wet hand.

- (1) Shut off high voltage.
- (2) Wait until the voltmeter on the control unit indicates 0 kV.  
With the Model GST-07L controller recommended by ULVAC, it is recommended to wait for 1 minute or more.
- (3) The ion pump may not be charged up.  
It is recommended to touch the ion pump with an earth rod or other after grounding the ion pump and high voltage electrode.

#### 4.5 Emergency Shutdown

For emergency shutdown of the pump, provide an adequate EMO circuit in the equipment in which the pump is to be installed.

---

## 5. Maintenance

Because of its characteristics, the ion pump is used for a considerably long time if it is run in an ultra-high vacuum or high vacuum region and the pressure variation is small.

This is not applicable if the pump is held in a low vacuum for a long time at startup.

Because of its small number of parts and no mechanical drives, the pump virtually needs no maintenance parts to be stocked by the user.

If the pressure varies greatly or is not relatively low when the pump is run for many hours, the following troubles can occur.

### 5.1 Checking Leak Current

The ion pump uses a ceramics insulator for insulation of the high voltage feedthrough terminal and the anode and cathode of the ion pump element.

They will be contaminated with time or the insulation may be deteriorated, increasing the leak current.

The following shows a method of checking whether the current indication on the control unit is the pump discharge current itself or it contains a leak current.

- (1) Bake out and start up the ion pump.
- (2) Lower the pressure in the ion pump to  $10^{-7}$  Pa or less.
- (3) Check the current indication at this time.

The current indication is normal if it is 5  $\mu$ A or less.

### 5.2 Checking abnormal discharge

Abnormal discharge may occur in the pump because of inclusion of foreign substance or Ti film coming off, in addition to the same cause as that of leakage current.

In this case, the current indication deflects unusually as with spark current.

These symptoms appear instantaneously and may be restored soon in many cases.

It is recommended to take record of the discharge current value or pressure from the ion pump controller on a recorder.

One method of correcting these problems is to polish the outside surface of the high voltage electrode and washing it several times by discharge using a 3.2 kV neon transformer (induction coil).

This method restores the pump to the original state in relatively many cases.

Another method is activation with argon gas.

For more information, contact ULVAC, Inc.

## 6. Inspection

Trouble symptom	Possible cause	Corrective action
Pressure does not lower.	Leak	Conduct leak test, correct leak, and retighten flange.
	Contaminated chamber interior	Inside surface treatment; disassemble, degrease and wash; and bakeout
	Contamination or expiring life of pump element	Conduct bakeout.
	Deteriorated insulation	Check ion pump discharge current value.
	Abnormal discharge	Discharge washing and activation with argon
	Source of outgas in the system	Remove source of outgas or degas.
	Bake-out not complete	Conduct bake-out.
Pump does not start.	Leak	Make leak test and correct leak, retighten flange clamp.
	Contamination of system interior	Conduct internal surface treatment, interior, disassemble, degrease, and wash; bake-out
	Contamination of pump element and expiring life	Conduct bake-out.
	Source of outgas in the system	Remove source of outgas or degas.
	Incomplete bake-out	Check heating temperature.
	Incomplete roughing	Check roughing system.
	Excessive gas load on pump	Reduce gas load.
Discharge current has increased.	Abnormal discharge	Activate by discharge washing and with argon
	Deteriorated insulation	Check ion pump discharge current value.
	Contamination or expiring life of pump element	Conduct bake-out.
	Contaminated system interior	Conduct internal surface treatment, disassemble, degrease and wash, conduct bake-out.
Fluctuating discharge current	Abnormal discharge	Conduct discharge washing and activation with argon.
	Deteriorated insulation	Check ion pump discharge current value.
	Leak	Conduct leak test, correct leak, and retighten flange clamp.

Trouble symptom	Possible cause	Corrective action
	Contaminated pump interior	Conduct internal surface treatment, disassemble, degrease and wash, conduct bake-out.
	Contamination and expiring life of pump element	Conduct bake-out.
	Outgas from heated pump element	Lower pressure for natural cooling.
No voltage and short-circuit current flows.	High pressure in the pump.	Conduct pumping again and leak test.
	Short-circuit between anode and cathode	Measure resistance between anode and cathode
	Poor insulation of high voltage electrode	Check discharging part.

For the repair,

In case the situation cannot be confirmed by the inspection, it need to be repaired. Please inquire to us.

As for the inspection or the repair of the products, please return to us by the separated product itself. After the inspection or the repair is completed and the condition is confirmed, we'll return it to you.

In case the products have been used under the special gas or special environment, or used more than ten years after shipment, or extremely damaged, we may judge the repair is impossible.

We don't do the removal operation of hazardous substance such as radioactive or chemical substance. When the such contamination is suspected, please inquire to us.

---

## **WARRANTY**

This pump is warranted free from defects in material and workmanship for a period of twelve (12) months from the date of acceptance.

If any trouble imputable to such defects should occur within the warranty period, ULVAC will correct it free of charge either by repair or replacement of defective parts.

Troubles imputable to the following are not covered by this warranty.

- (1) Operation not in conformity with the instructions given in this manual.
- (2) Operation in a place where inflammable gas and/or corrosive gas is generated, dusty place, place where temperature and/or humidity is high, place where vibration and/or radiation is generated or under other special conditions.
- (3) Unauthorized repair or modification by other than ULVAC (including erasure of job No.)
- (4) Acts of God or force majeure, such as fire, earthquake, etc.
- (5) Consumable parts
- (6) Troubles deemed by ULVAC engineer not suited to the operating conditions of this pump.

The scope of ULVAC's liability for a repaired product is limited to repair or replacement of repaired or replaced parts.

ULVAC shall not be held liable for any secondary or consequential damage to a system caused by this pump.



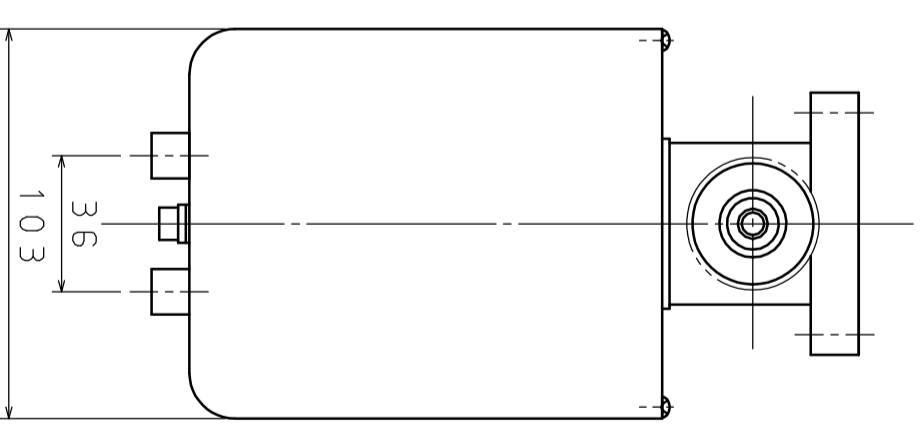
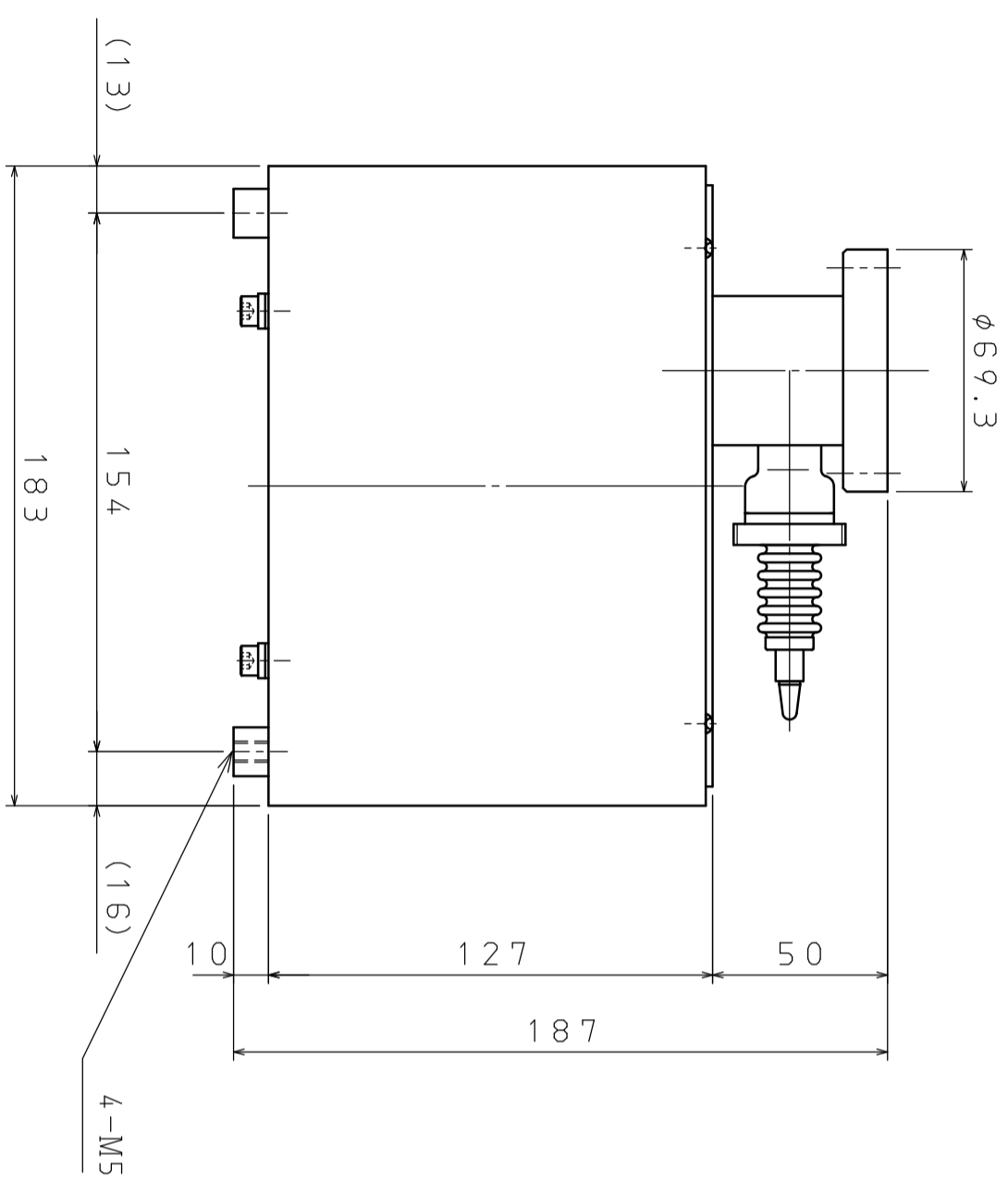
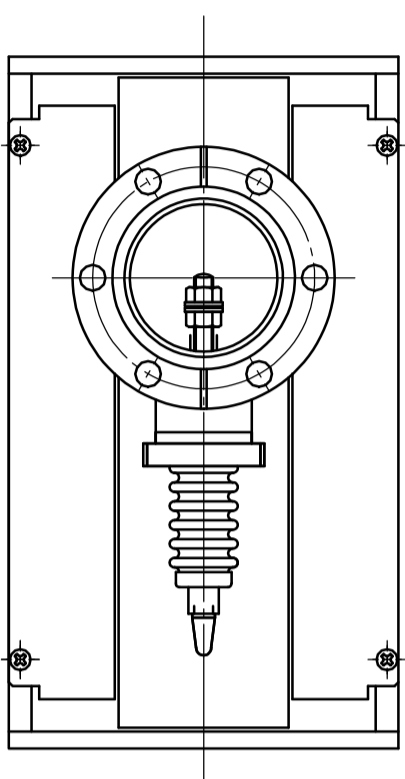


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 \*The environmental protection validity date is not the product warranty period.

Table. Making format for names and contents of hazardous substances or elements

Name of parts	Hazardous substances or elements					
	Pb	Hg	Cd	Cr <sup>6+</sup>	PBB	PBDE
Body	○	○	○	○	○	○

○: indicating that content of the hazardous substance or element in all homogeneous materials of the part does not exceed the requirements for concentration limits specified by SJ/T11363-2006.  
 ×: indicating that content of the hazardous substance or element in, at least one kind of, homogeneous materials of the part exceeds the requirements for concentration limits specified by SJ/T11363-2006. Producer may further explain the technical excuse to the items marked with "X" perspecific conditions here.

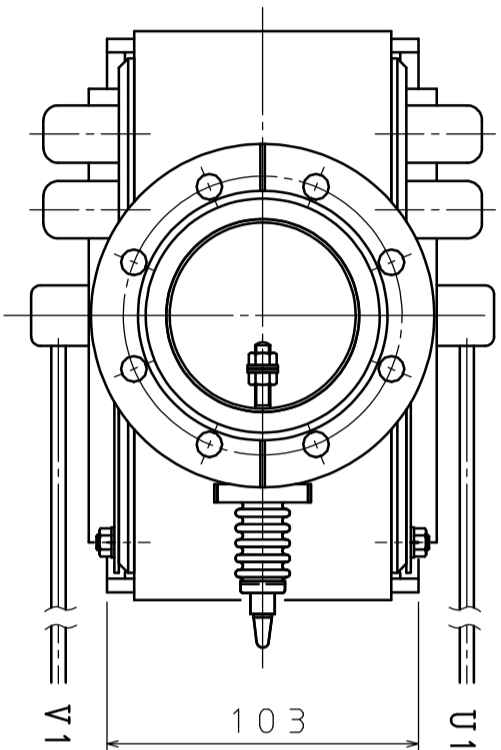


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TOLERANCES UNLESS NOTED	JIS B 0419-mH級	JIS B 0408-B 級	A3	△ -	2007/01/27	不要線削除・修正
APPRV 承認	CHECK 検図	DESIG 設計	DRAW 製図	REVISION		
				MARK	DATE	REMARKS
				TITLE		

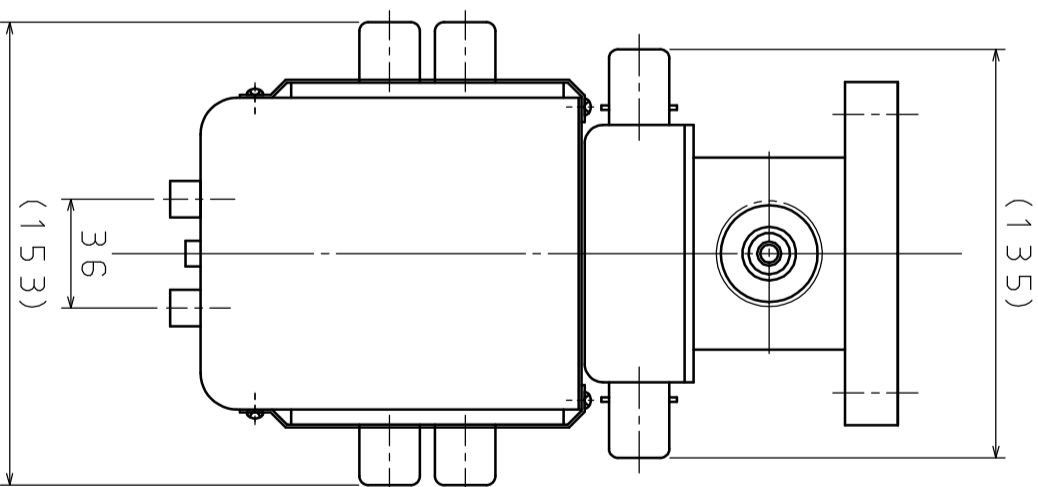
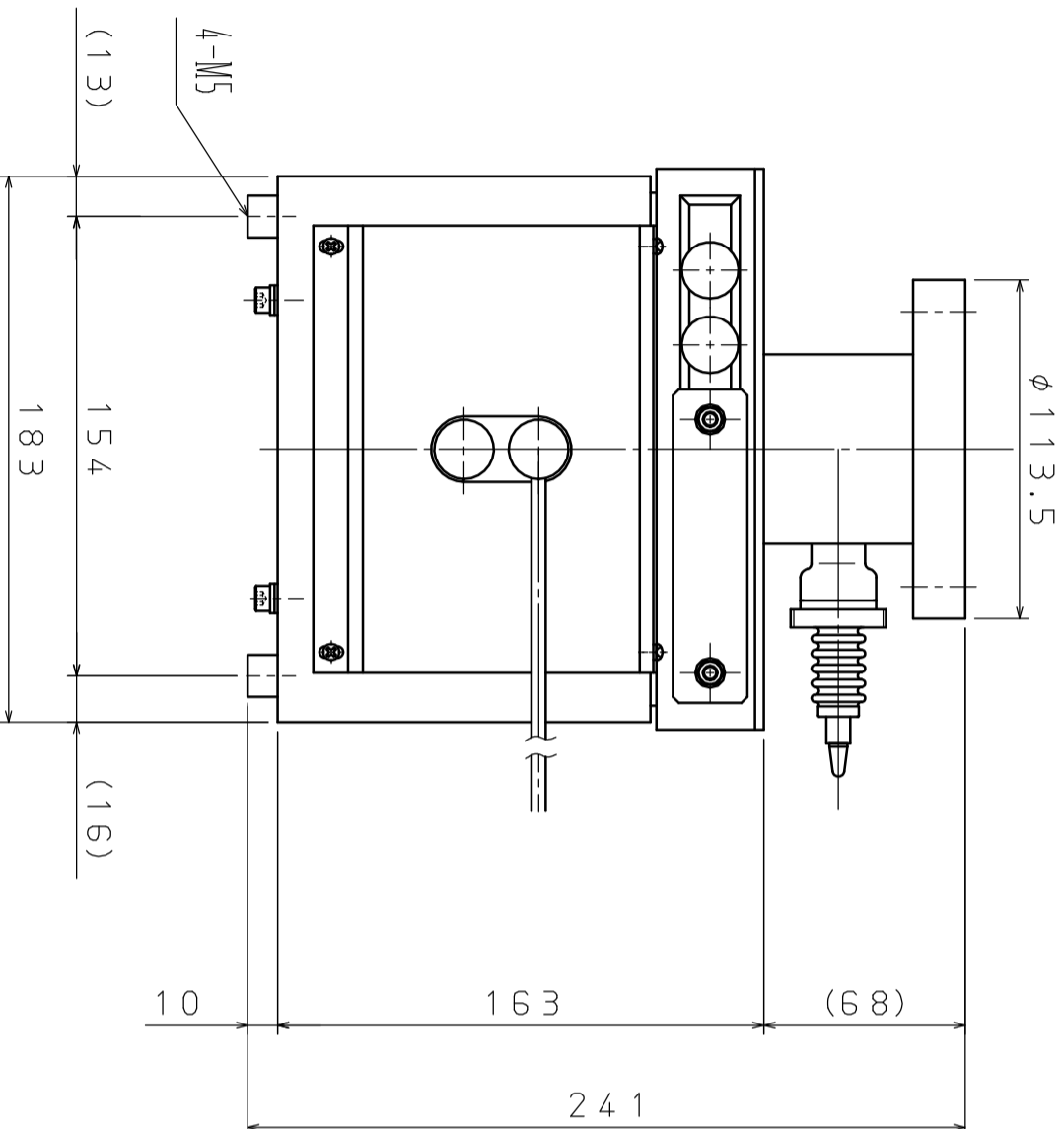
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BS0808-039D 1/1

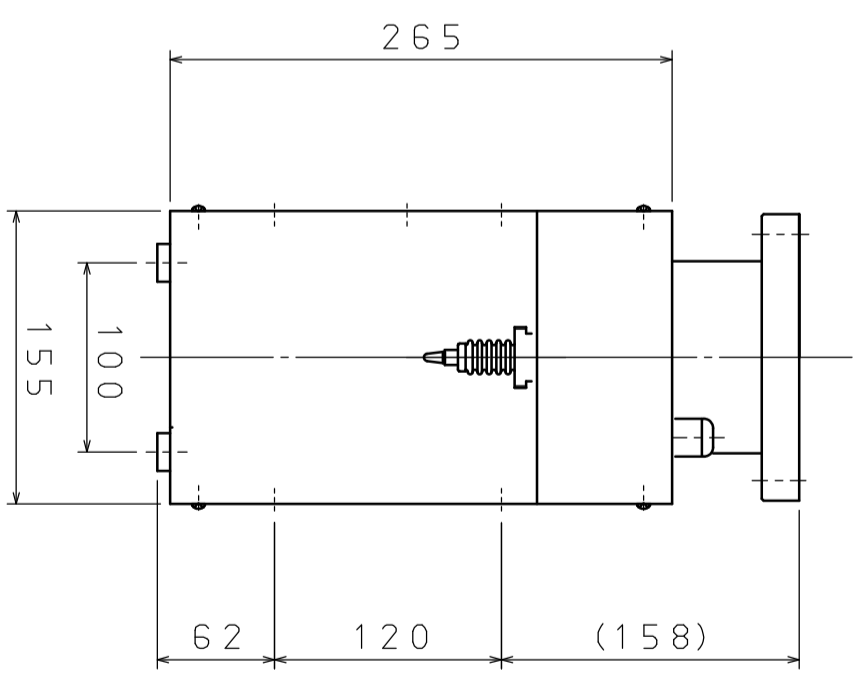
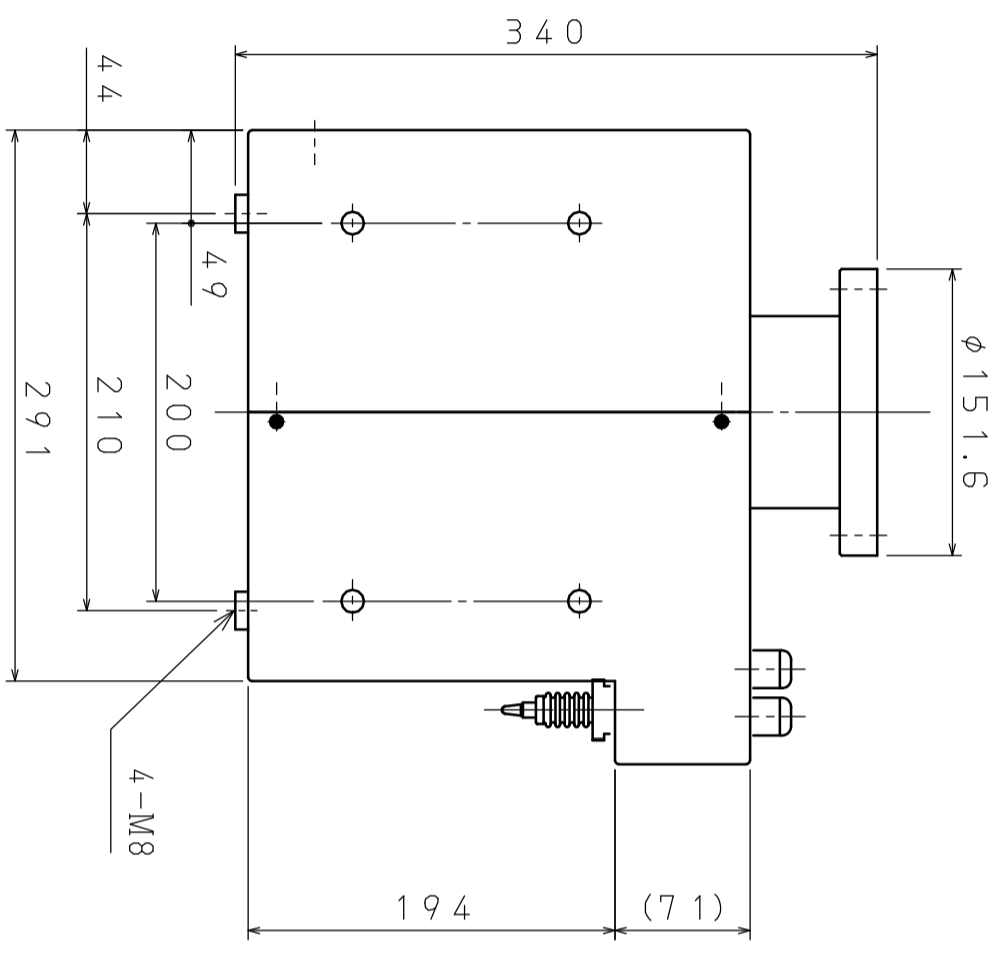
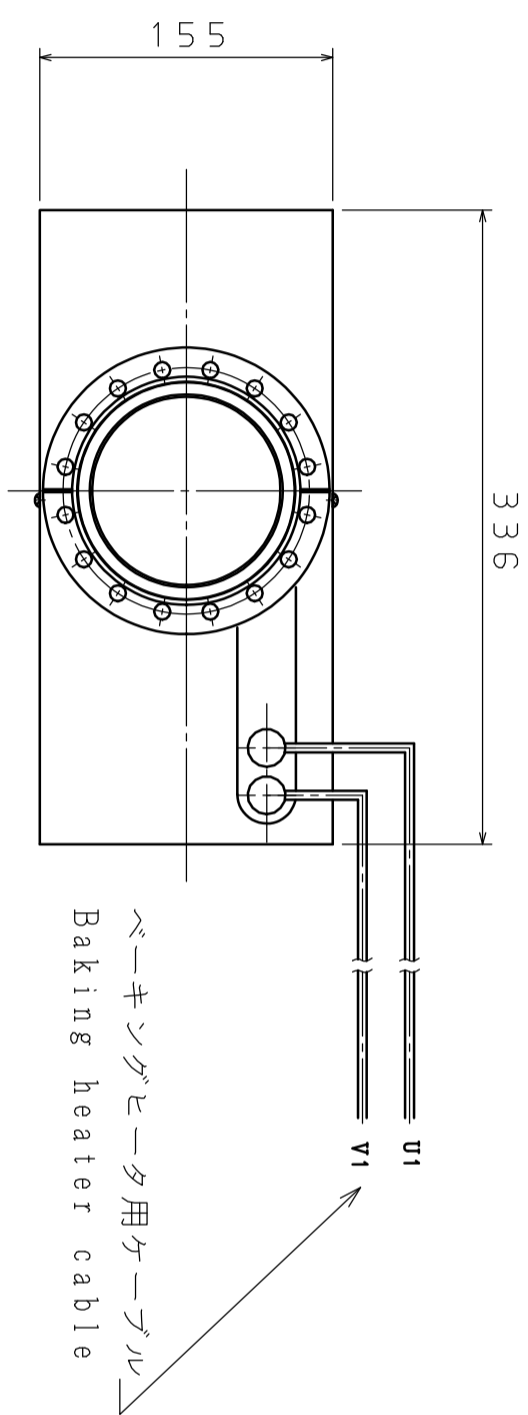


ベーキングヒータ用ケーブル  
Baking heater cable



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流元図番			計算重量	△ -	2020/09/10
TOLERANCES UNLESS NOTED	JIS B 0419-mH級	JIS B 0408-B 級	A3	△ -	2017/07/13
APPRV 承認	CHECK 検図	DESIG 設計	DRAW 製図	REVISION	
				TITLE	
				PST-050CU/AU	
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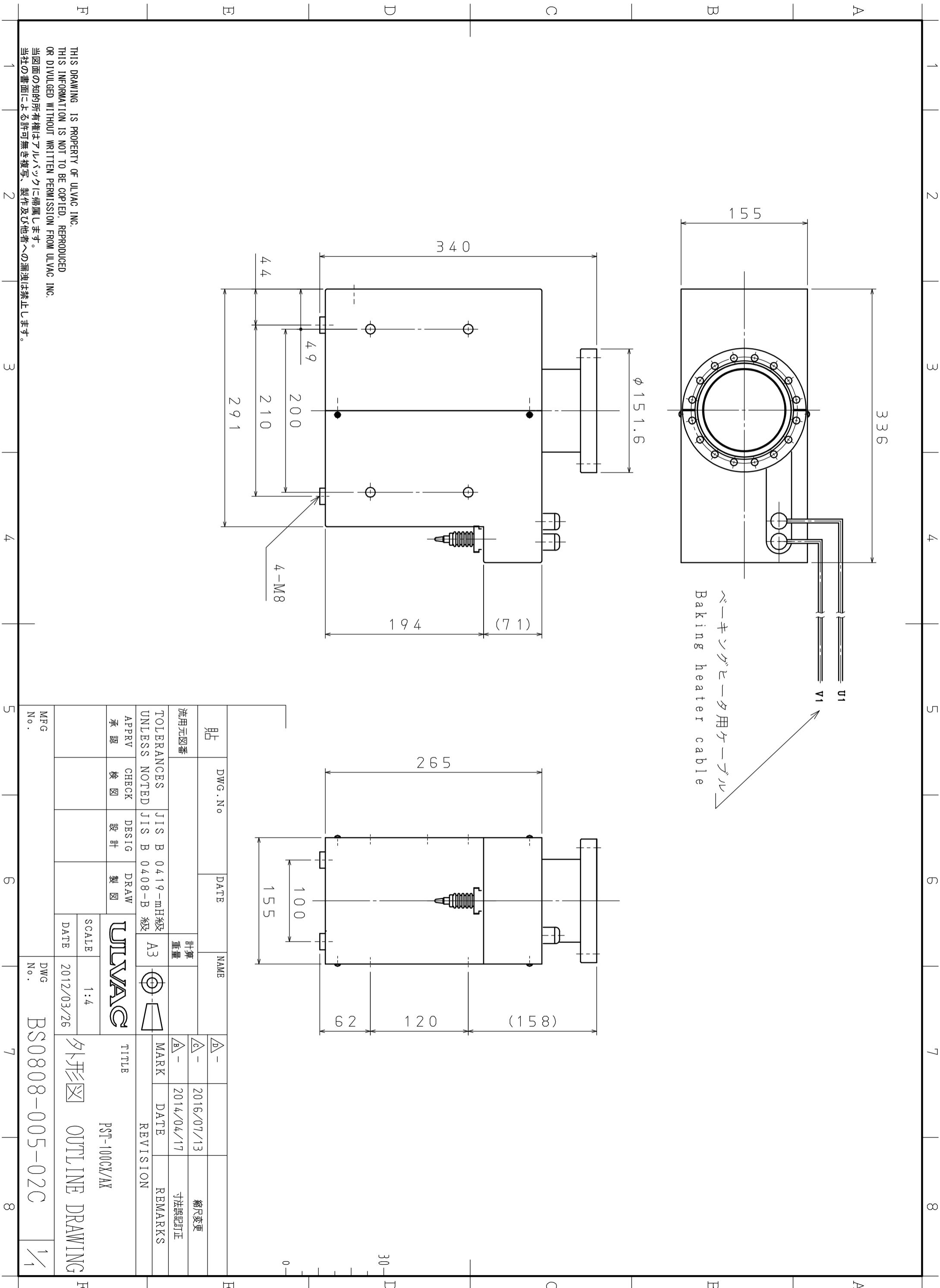
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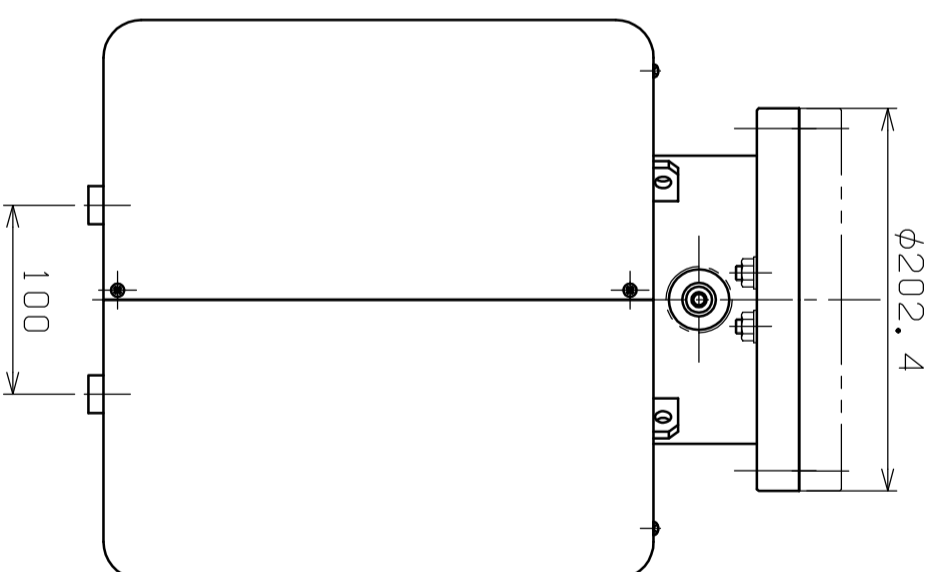
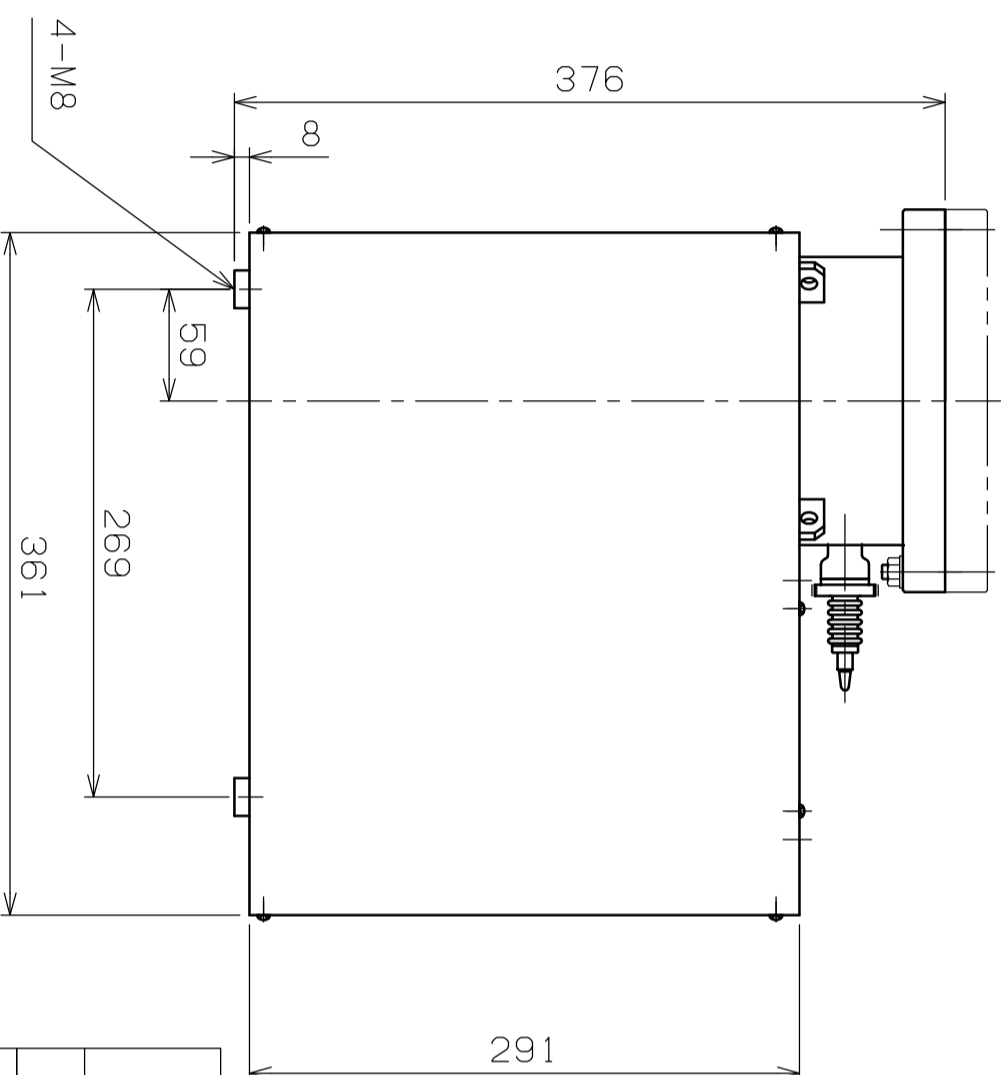
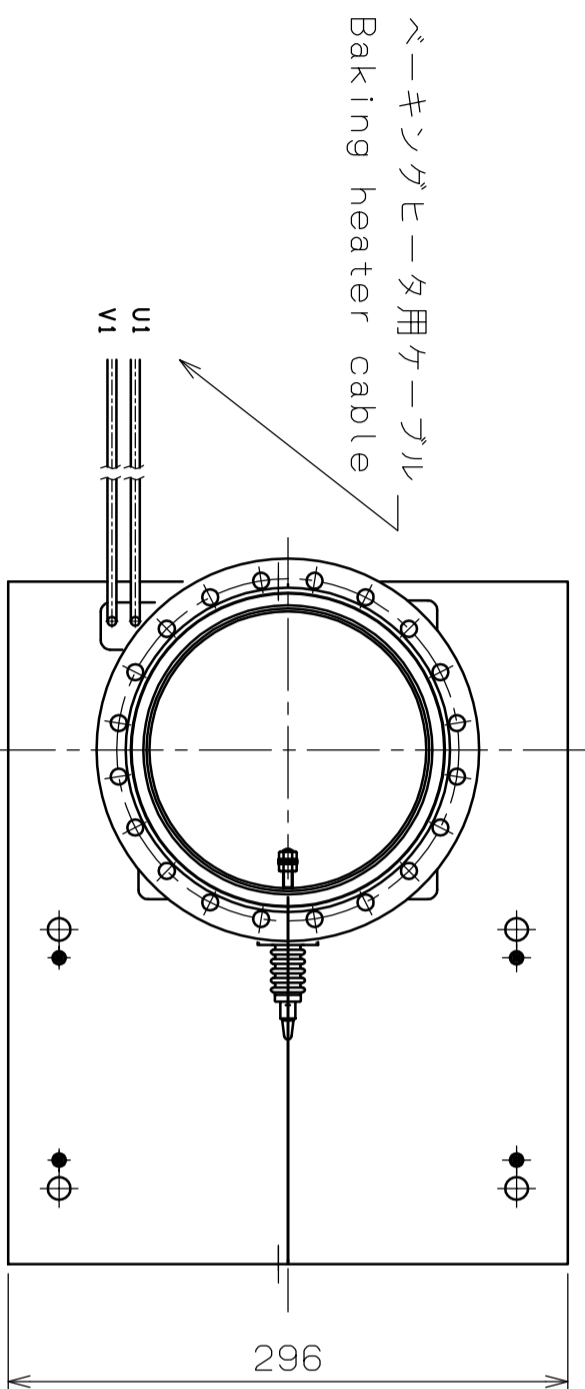


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				REVISION	
TITLE				REMARKS	
PST-100CX/AX				縮尺変更	
外形図				寸法誤記訂正	
SCALE 1:4					
DATE 2012/03/26					

MFG No.	DWG No.	BS0808-005-02C	1/1
TITLE			
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外形図			
SCALE 1:4			
DATE 2012/03/26			
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CHECK 検図			
APPRV 承認			
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A3			
DRAW 製図			
DATE 2014/04/17			
MARK			
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REMARKS			
縮尺変更			
寸法誤記訂正			

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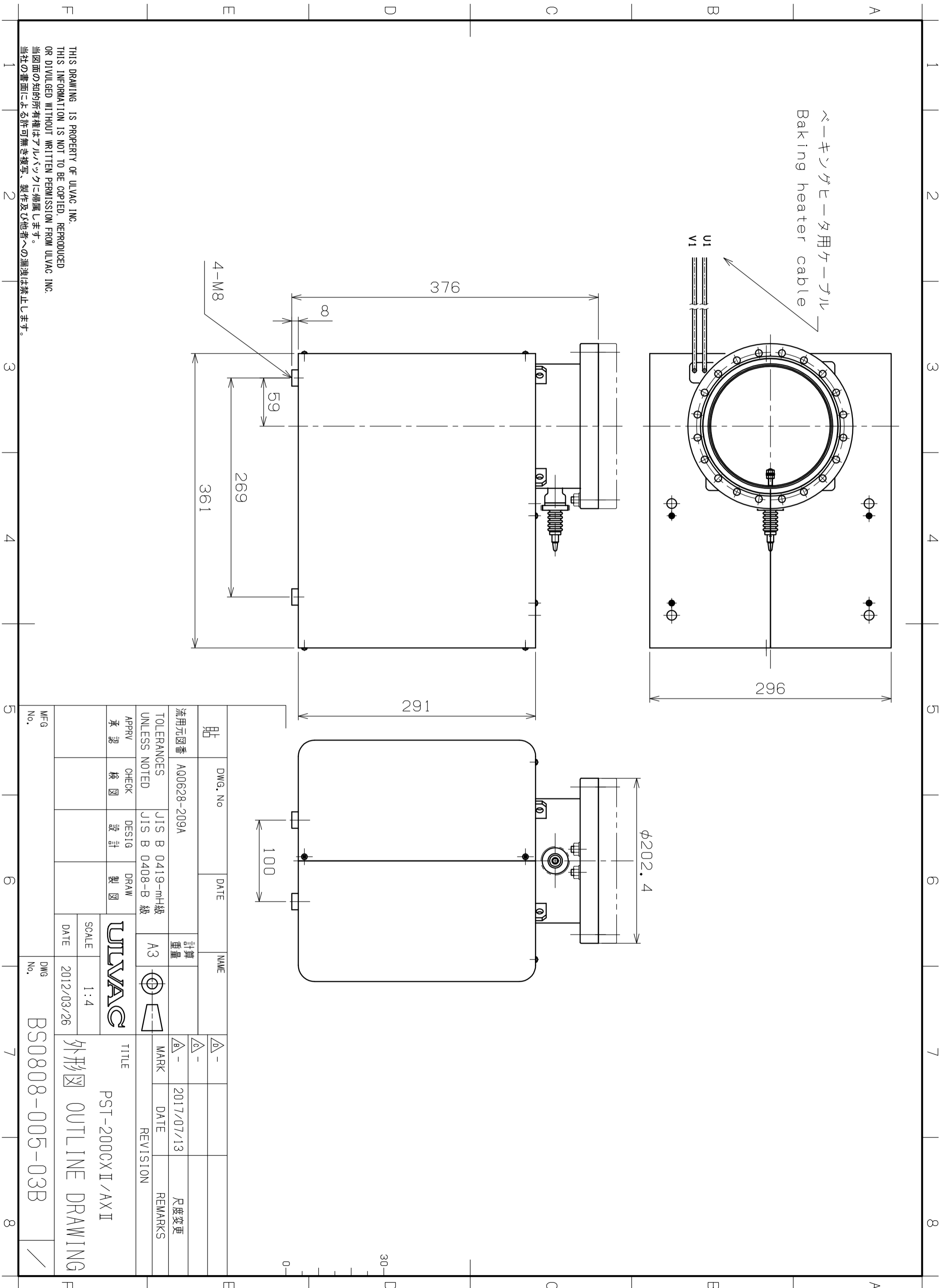
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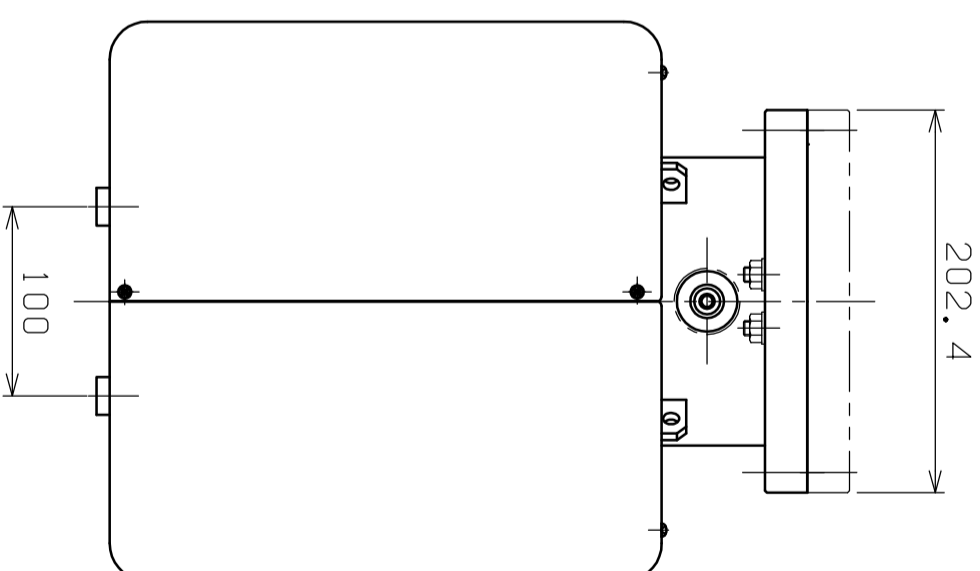
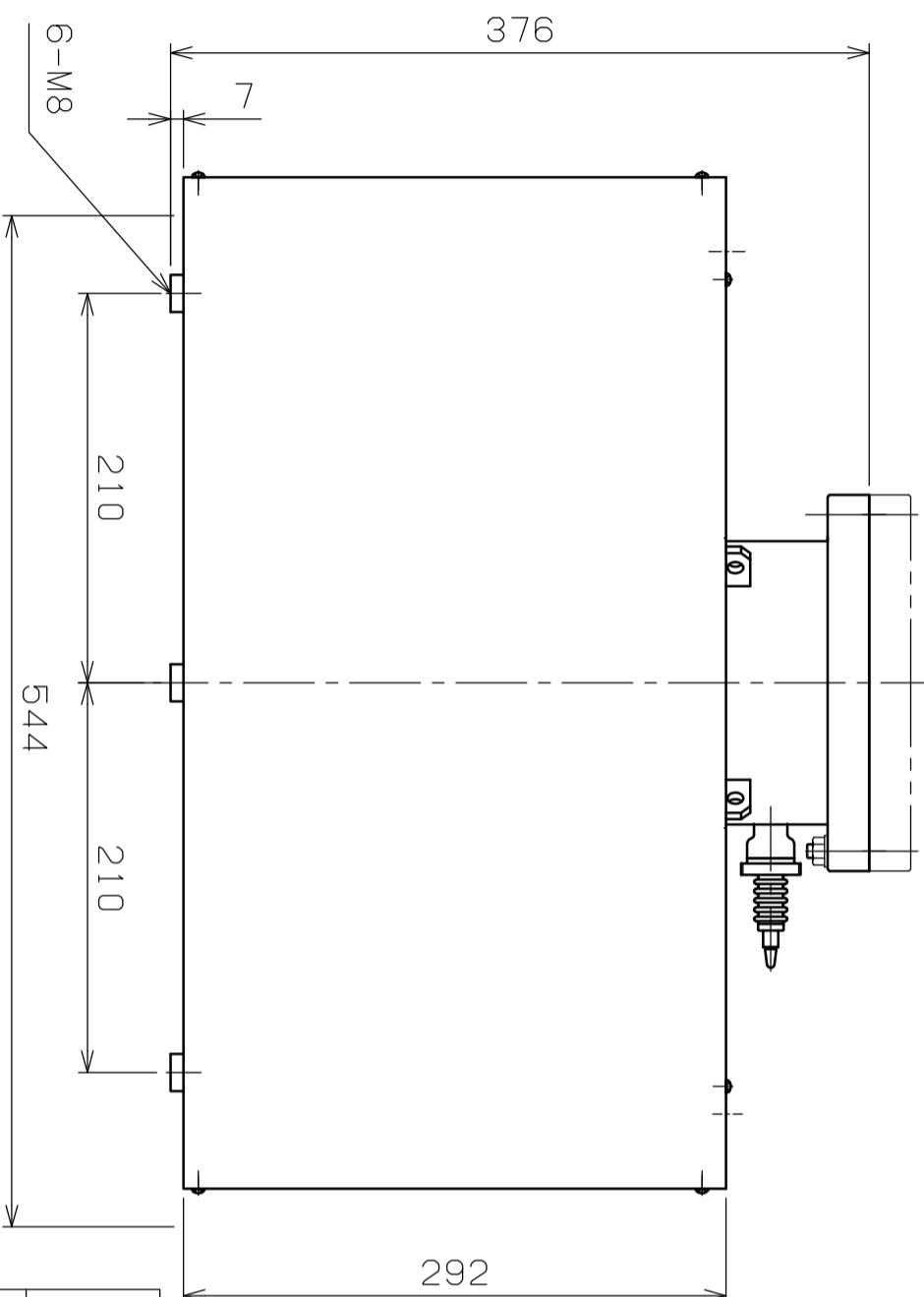
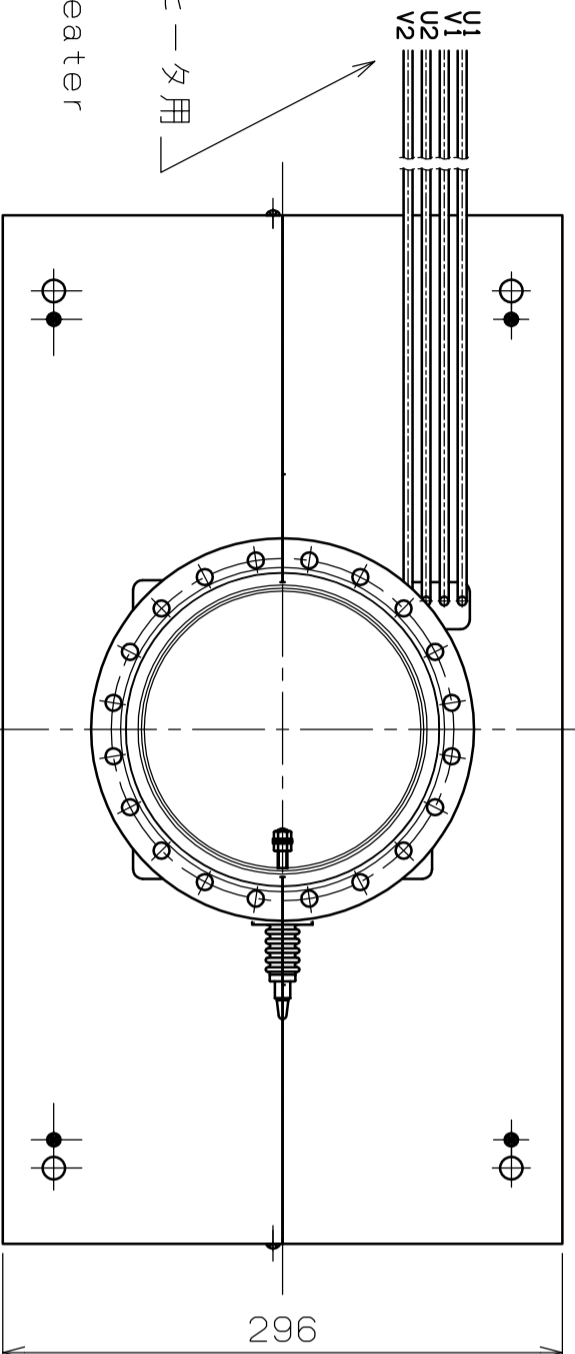
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BS0808-005-03B

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ベーキングヒーター用  
ケーブル  
Baking heater  
cable



貼

DWG. No

DATE

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A00628-409A

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JIS B 0408-B 級

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2012/03/26

TITLE

PST-400CX II / AX II

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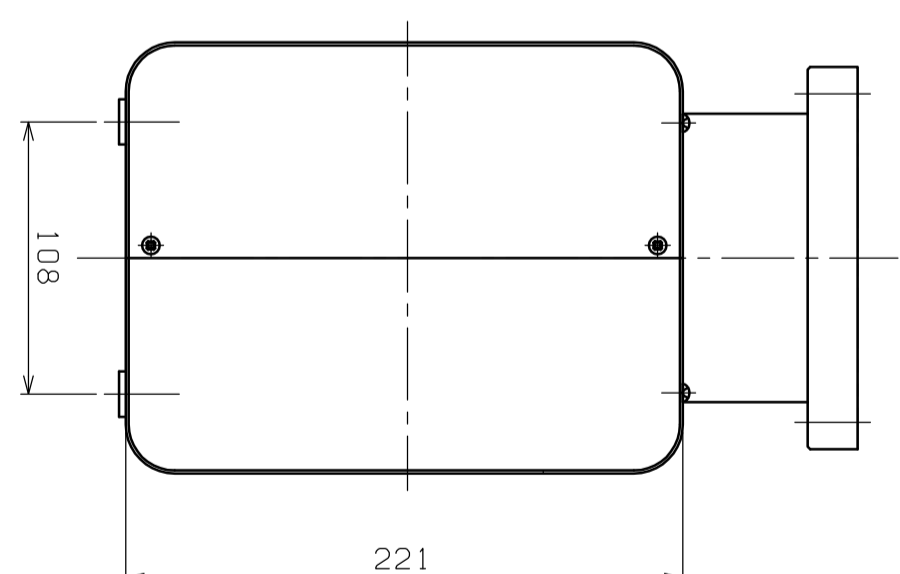
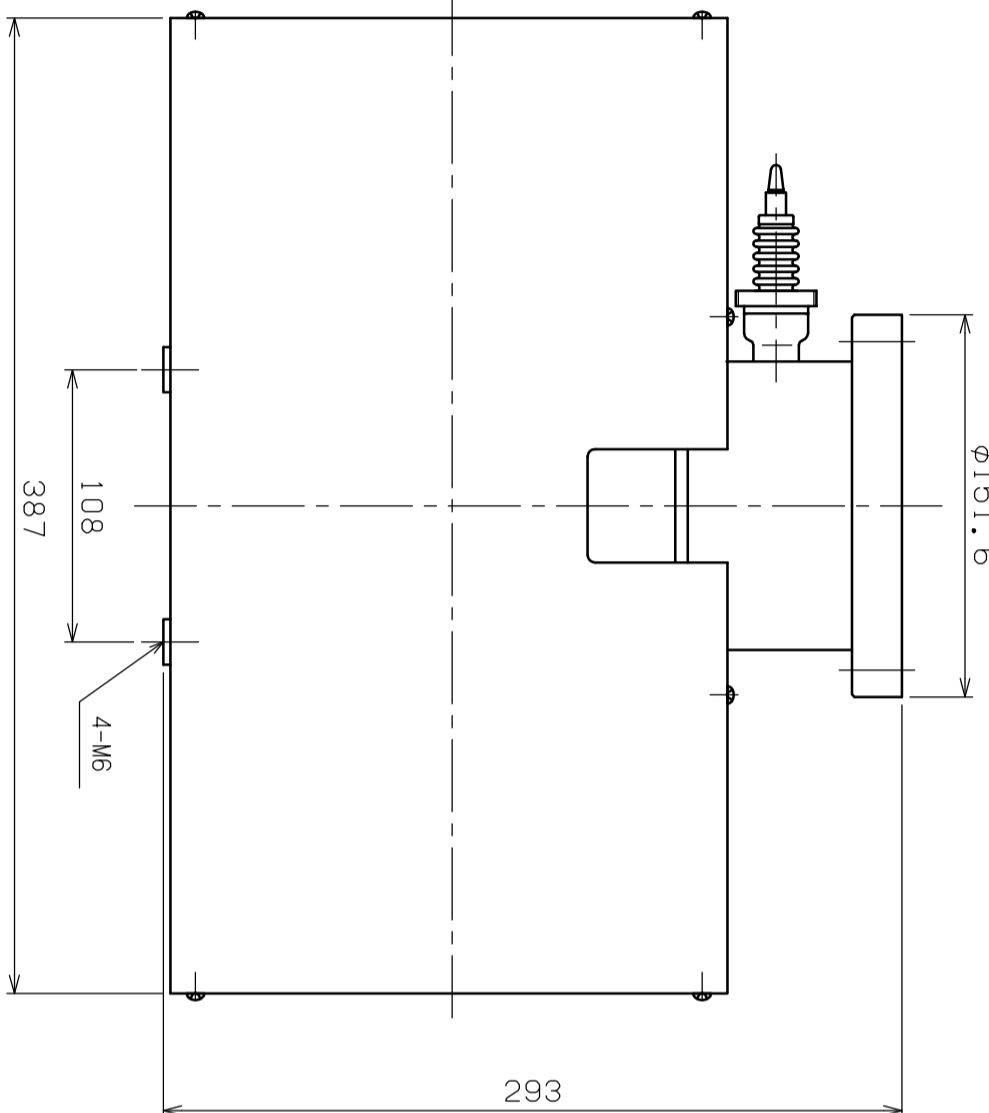
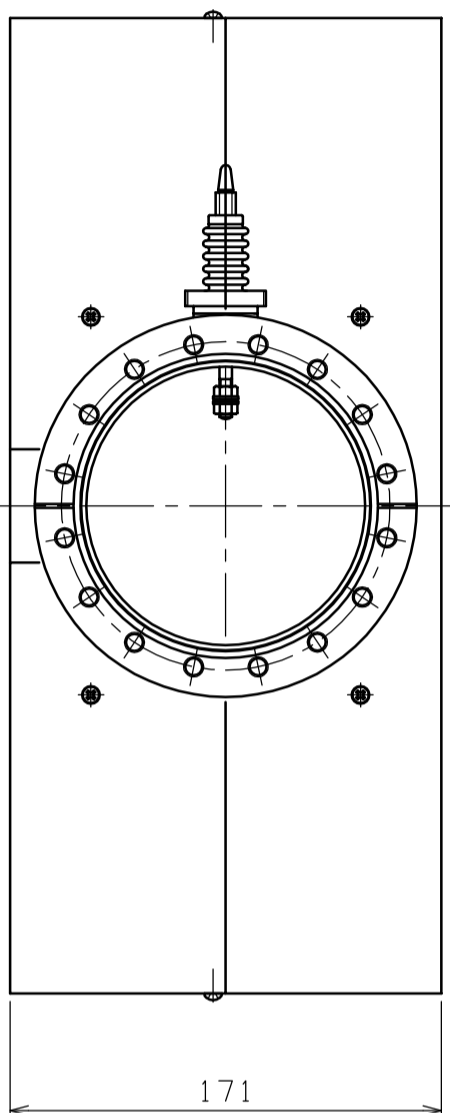
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流用元図番	BS0808-089C		計算重量	△ - 0	2015/2/5	ヒータ削除
TOLERANCES UNLESS NOTED	JIS B 0419-mH級		A3	MARK	DATE	REMARKS
UNLESS NOTED	JIS B 0408-B 級			REVISION		
APPRV 承認	CHECK 検図	DESIG 設計	DRAW 製図	TITLE		
				PST-110AU		
				外形図 OUTLINE DRAWING		
MFG No.		SCALE 1:3	DATE 2012/03/26	BS0808-005-05D		
				DWG No.		

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