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## Operating Manual

# Smart 15 Plus

Micro Centrifuge



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# 1. General Considerations

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## 1.1 Safety

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**Follow precautions and all the safety requirements described on this user manual to prevent any damage and failure of equipment and loss of lives.**

1. The centrifuge should be installed on flat surface to maintain level.  
Abnormal vibration is caused when the device is installed on an inclined surface.
2. Check the voltage to be used, before connecting the centrifuge to the power source.
3. Only use rotors, parts, and accessories provided by Hanil Science INC.  
Hanil Scientific INC. is not responsible for damages of the device and accidents caused by using parts and accessories not recommended.
4. Do not exceed the maximum rated speed of the rotor or buckets in use.
5. Make sure to prepare necessary safety measures before using samples that are toxic or radioactive samples or pathogenic or samples or infectious blood.
6. If the centrifuge is contaminated by toxic or radioactive samples or infectious blood samples, remove contaminants completely and take needful actions such as ventilation or isolation of centrifuge.
7. Substances that may generate volatile or explosive vapor can not be centrifuged.
8. The balancing work of samples should be done in advance before operation.
9. Before operation, rotor and chamber should be dry.
10. Do not attempt to slow or stop the spinning rotor by hand.
11. Only centrifuge with rotor and rotor lid firmly tightened.
12. Do not block vents.
13. When serving the centrifuge, be sure to remove contaminants in advance.
14. Repairs must be carried out by a technologist authorized by Hanil scientific INC.
15. According to IEC61010-2-020 maintain a 30cm "clearance envelope" around the centrifuge while the rotor is spinning.
16. Please contact the place of purchase for product repairs.

# 1. General Considerations

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## 1.2 Transport & Storage

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### Storage



- The device and the accessories may only be stored in dry rooms.

Ambient temperature 5°C ~ 35°C  
Maximum relative humidity 30% ~ 85%  
Air pressure 500 ~ 1060 hpa

### Transport



- Only lift and transport the device with sufficient number of helpers.

Ambient temperature -10°C ~ 40°C  
Relative humidity 10% ~ 90%  
Air pressure 500 ~ 1060 hpa

## 1.3 Safety label attached to products

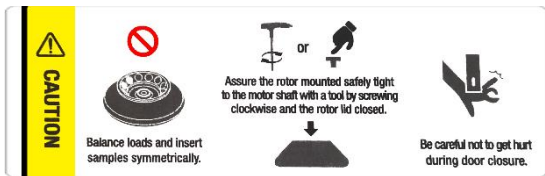
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Mark indicating danger and warning



Mark indicating a place in danger of electric shock



## 1.4 Electric safety information

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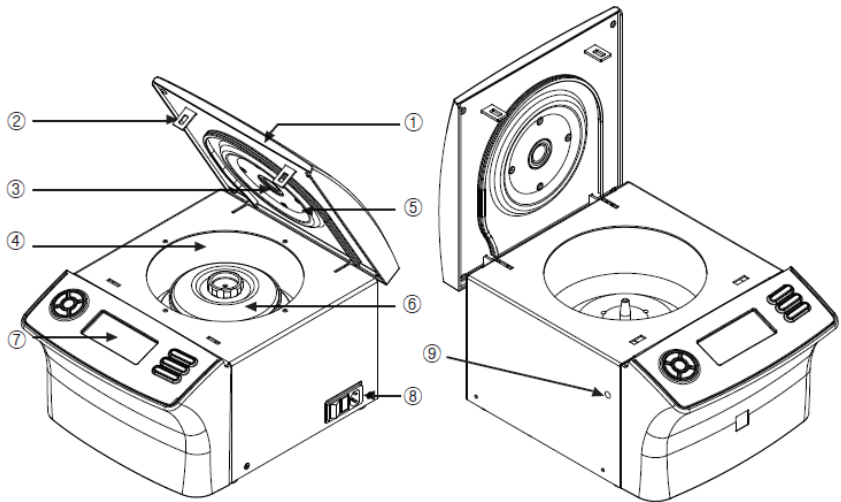
1. Use a power cord only provided with equipment.
2. Use sockets with a protective earth conductor and suitable power cord.
3. Do not use an extension cord.
4. Do not place anything on the power cable
5. Do not block vents.
6. If you have the following emergencies, shut off the power supply and unplug the power cord from outlet and contact your place of purchase.
  - Unusual noises or smell from the equipment.
  - Damage or wear of a power cord.
  - Breakdown of circuit breaker, fuse or safety device.
  - If you spill liquid on the equipment.
  - If the equipment is exposed to water.
  - If Some of equipment has been damaged.

# 2. Product description

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## 2.1 Structure

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- ① **Lid:**  
Lid protects the inside of the chamber.
- ② **Lid lock**
- ③ **RPM measuring window**  
Visual inspection for rotor stop or for a speed check using a stroboscope.
- ④ **Chamber**  
Where the rotor is loaded
- ⑤ **Lid packing:**
- ⑥ **Rotor**  
Connected to the motor shaft for centrifugal separation
- ⑦ **Operation panel**  
Display and keys for operating the centrifuge.
- ⑧ **Power switch:**  
Switch for switching the centrifuge on and off.
- ⑨ **Emergency Lid Open system**

## 2.2 Delivery package

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- ① Smart R15 Plus Main body
- ② Power cable
- ③ User manual
- ④ Rotor Locking Tool (T wrench)
- ⑤ Extra fuse

## 2. Installation

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### 2.3 Specifications

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Max. RPM	15,000 rpm
Max. RCF	21,055 xg
Max. Capacity	24 x 1.5/2.0ml
Time	99min 59sec
ACC ramps	6 steps
DEC ramps	6 steps
Power supply	AC 220V, 50Hz/60Hz
Dimension (W x D x H, mm)	293 x 380 x 242 mm
Weight (kg)	15 (Without rotor)
Cat. No.	SM-15PL

## 3. Installation

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### 3.1 Packing Inspection

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- Check packing conditions carefully, before unpacking.
- Contact Hanil Scientific INC. immediately if damages found
- Check the delivery for completeness.

- You can get contact details on packing boxes and the back of the manual.

### 3.2 Installation

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#### 3.2.1 Selecting the location

##### **Installation on hard and flat ground.**

- Centrifuge should be installed on hard and flat place.
- If the centrifuge is installed in an inclined place, the shaft may be bent due to the weight of the rotor.

##### **Good ventailation.**

- For air circulation and safety, maintain a 30cm “clearance envelope” around the centrifuge while the rotor is spinning.



##### **Constant temperature/humidity**

- Centrifuge equipped with the sensitive electronic software which is fragile with humidity and temperature.
- Must avoid direct ray or heater and be put in the ambience of controlled temp. and air

##### **Avoid the corrosive gas**

- Install the centrifuge in a place where corrosive gas is not generated.
- Sulfur dioxide gas and chlorine gas may cause corrosion

##### **Leveling**

- The shaft should be put exactly vertical on the hotizontaliy flat ground by the leveling tool

## 3. Installation

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### 3.2 Installation

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#### 3.2.2 Connect power connection



- Connect the device to voltage sources which correspond to the electrical requirements on the label attached to the device.
- Use sockets with a protective earth conductor and provided power cord.

1. Connect the power cable to the power socket on the right side of the product and plug the cord into the outlet.
2. Switch the centrifuge on using the power switch on the right side of the device.



# 4. Operation

## 4.1 Operation Panel



번호	버튼 설명		기능
①		Display	Set-up information, operating condition is displayed.
②		Up	Set the speed or runtime.
③		Down	Set the speed or runtime.
④			
⑤		Left Right	Moves the cursor left or right.
⑥		Enter	Save the setting value.
⑦		Call/Save	Save or load the programs.
⑧		Door	Release the lid.
⑨		Start/Stop/ Short	Starting and stopping or short run centrifugation.

## 4. Operation

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### 4.2 Opening and closing the lid

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- The lid can only be opened if the centrifuge is switched on.
- Do not reach with your fingers between the housing and lid.
- Close the lid completely before operation.

- **Opening the lid**

Press the  door key.

- **Closing the lid**

Put the lid on and press the edge of the lid.

### 4.3 Loading and removal of the rotor

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- Only use rotors, parts, and accessories provided by Hanil Science INC.
- Do not use scratched or cracked rotor in use.

- **Loading**

- ① Clean the motor shaft and the bore of the rotor.
- ② Load the rotor vertically onto the motor shaft.
- ③ Tighten the clamping of the rotor with wrench by turning clockwise.
- ③ Check the rotor to make sure it loaded firmly.

- **Loading**





- ① Loosen the clamping of the rotor by turning counter-clockwise with the wrench
- ② Lift up the rotor from the motor shaft.

### 4.4 Setting the Rotor ID.

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- Before the operation, check and set the rotor ID.
- Rotor ID. is engraved on the rotor.

- ① Press the Setup/Enter  key.
- ② Press the Left or right  key for the rotor ID. setting mode.
- ③ Press the Up or Down  key to set the rotor ID.
- ④ Press the Setup/Enter  key to save the rotor ID.

# 4. Operation

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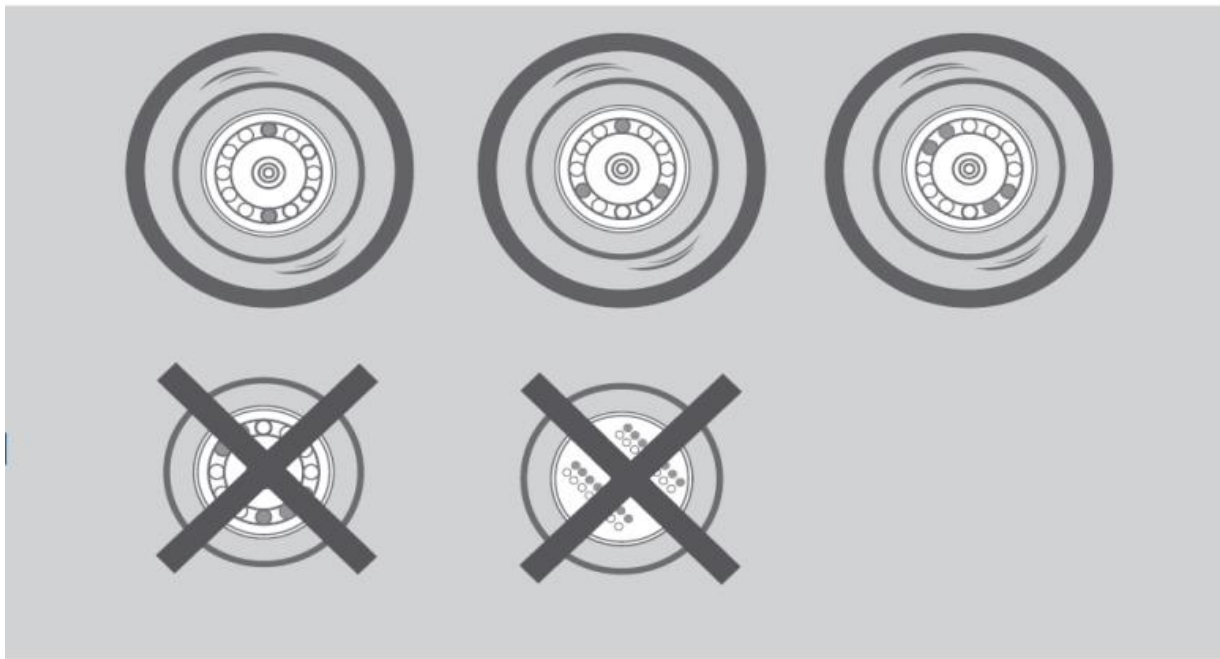
## 4.5 Loading tubes

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- Only use tubes provided or approved by Hanil Science INC.
- Always use the same type of tube.
- Tubes should be loaded symmetrically.
- Do not exceed the maximum rated speed of the tube.
- Same volume of sample should be put on tubes.
- Check symmetric loading by balancing tubes with scales.

- ① Check the maximum load for each tube.
- ② Put tubes into rotor holes.
- ③ Tubes located opposite each other must be the same type and contain the same quantity.









## 4. Operation

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### 4.6 Setting RPM/RCF

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- ① Press the Setup/Enter (  ) key to activate the RPM display
- ② Press Left (  ) or Right (  ) key to move the cursor to rpm or rcf mode
- ③ Press Up (  ) or Down (  ) key to input the setting value.
- ④ Press the Setup/Enter (  ) key to save the settings.







### 4.7 Setting run time

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- ① Press the Setup/Enter (  ) key.
- ② Press Left (  ) or Right (  ) key to move the cursor to Time setting mode.
- ③ Press Up (  ) or Down (  ) key to set the value.
- ④ Press the Setup/Enter (  ) key to save the settings.


### 4.8 Setting Accelation/Deceleration rate.

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- ① Press the Setup/Enter (  ) key.
- ② Press Left (  ) or Right (  ) key to move the cursor to Accel/Decel mode.
  - ▶ Accel mode: ACC display flashes
  - ▶ Decel mode: ACC display flashes
- ③ Press Up (  ) or Down (  ) key to set the value.
  - ▶ Accel/Decel step is 0 ~ 5.
  - ▶ Step 1 is the slowest and step 5 is the fastest.
  - ▶ Decel step '0' means natural brake.
- ④ Press the Setup/Enter (  ) key to save the settings.


### 4.9 Starting the centrifugation run

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- ① Check the all parameters are correct and the lid is closed.
- ② Press Start/Stop (  ) key.

### 4.10 End the centrifugation

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- Press Start/Stop (  ) key to abort centrifugation.
  - ▶ The centrifuge stops automatically when the set time is reached.

## 4. Operation

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### 4.11 Pulse Function





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- The pulse centrifugation runs as long as the Start/Stop(  ) key is pressed.
  - ▶ Press and hold Start/Stop(  ) key to pulse centrifugation.
  - ▶ If you release the Start/Stop(  ) key, it stops when set RPM is reached .





### 4.12 Saving / Recall programs

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#### Saving a program

1. Set the centrifugation time/speed/Accel/Decel values.
2. Press Call/Save (  ) key.
  - ▶ You can store 10 programs on the device: 0~9
3. Select the program slot by pressing Up (  ), down (  ) key.
4. Press the Setup/Enter (  ) key to save the program.

#### Recall a programs

1. Press Call/Save (  ) key.
2. Press Up (  ), down (  ) key to select the program slot you want.
3. Press the Setup/Enter (  ) key to call up a program.

## 5. Maintenance

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### 5.1 Care instructions

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- **The following procedures should be performed regularly.**

- ① Regularly inspect the rotor chamber for check the motor shaft is normal.
- ② Rotate the shaft with your hand to make sure it turns smoothly
- ③ Use the stopwatch to check that the time setting is correct

### 5.1 Cleaning

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• Before cleaning the centrifuge, be sure to switch off the device and disconnect the power cord.

- **Outside of the device**

- ① Clean the outside of equipment with a soft and dry cloth.
  - ▶ If the device is contaminated, use a mild cleaning fluid to clean.
- ② Do not use aggressive chemicals on the device such as alcohol, benzene, acetone or phenol.
- ③ Use the stopwatch to check that the time setting is correct
- ④ Make sure do not scratch the surface of equipment when cleaning it.
  - ▶ Do not use a metal sponge.
  - ▶ If the device is rusted, remove it with a mild detergent and wipe it with a dry cloth.

- **Chamber**

- ① If the rotor chamber is not dry, wipe moisture from the chamber with a dry cloth.
- ② If the rotor chamber is dirty, wipe moisture from the chamber with a dry cloth.

- **Rotor**

- ① To prevent corrosion, take out the rotor from the rotor chamber.
- ② If any sample is spilt inside the rotor, wash and dry the rotor well.

- **Disposal**

In case of product is to be disposed of, the local wastes laws and regulations are to be observed.

## 6. Troubleshooting

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### 6.1 General errors

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Problem	Recommended Action
Power failure	Check the power cord connection. Check the power fuse of the device.
Device cannot be started	Check the lid is closed completely.
Lid cannot be opened	Press the 'Lid open button'.
Lid cannot be closed	Remove the dirt at the door latch and close the lid. Check the lid latch is not damaged.
Unusual noise and vibration	Check the device whether it is installed on the hard and flat place
	Reload the rotor symmetrically. Reload the tubes symmetrically. Tighten the clamping of the rotor with wrench by turning clockwise

# 6. Troubleshooting

## 6.2 Error messages

Error code	Problem	Cause	Recommended Action
E1	Imbalance error	<ul style="list-style-type: none"><li>• Asymmetrical placement of tubes.</li><li>• Irregular volume of sample in tubes.</li><li>• Loosened rotor to the shaft.</li><li>• Swaying or operation the unstable ground.</li></ul>	<ul style="list-style-type: none"><li>• Check the tightness of rotor loading.</li><li>• Check the proper loading of tubes.</li><li>• Check the stable ground or worktable.</li></ul>
E2	Over speed	<ul style="list-style-type: none"><li>• 2% over the set RPM.</li><li>• Incorrect tuning of motor and controller.</li></ul>	<ul style="list-style-type: none"><li>• Check controller and motor.</li><li>• Switch power on/off and re-start.</li></ul>
E3	Motor overheat	<ul style="list-style-type: none"><li>• Temp. hike inside of motor.</li></ul>	<ul style="list-style-type: none"><li>• Check the stator of motor.</li><li>• Switch power off, restart after 1 hour.</li></ul>
E4	Low speed	<ul style="list-style-type: none"><li>• Deficiency, not reaching 200RPM within 2 secs.</li></ul>	<ul style="list-style-type: none"><li>• Check controller and motor.</li><li>• Switch power off and re-start.</li></ul>
E5	Door open(Start)	<ul style="list-style-type: none"><li>• Door open during operation.</li></ul>	<ul style="list-style-type: none"><li>• Check door-in switch.</li></ul>
E6	Under speed	<ul style="list-style-type: none"><li>• 2% under the set RPM during operation.</li></ul>	<ul style="list-style-type: none"><li>• Switch power off and re-start.</li></ul>
E7	System error	<ul style="list-style-type: none"><li>• Error of controlling system.</li><li>• Overload of motor, damage of IPM module.</li></ul>	<ul style="list-style-type: none"><li>• Switch power off and re-start.</li><li>• contact Hanil A/S center.</li></ul>
E8	Door Open(Stop)	<ul style="list-style-type: none"><li>• Door not open in the stop status.</li></ul>	<ul style="list-style-type: none"><li>• Check door-in switch.</li></ul>
E9	Door Close error	<ul style="list-style-type: none"><li>• Door not close in the stop status.</li></ul>	<ul style="list-style-type: none"><li>• Check door-in switch.</li></ul>
E10	Over Temp.	<ul style="list-style-type: none"><li>• Over the pre set limit.</li></ul>	<ul style="list-style-type: none"><li>• Re-set the preset value of the limit. (The value of L-Cal of the preset menu)</li></ul>
E11	Temp. Sensor error	<ul style="list-style-type: none"><li>• Temp sensor connector has not connected.</li></ul>	<ul style="list-style-type: none"><li>• Check the connection of mainboard connector.</li></ul>



## 6. Troubleshooting

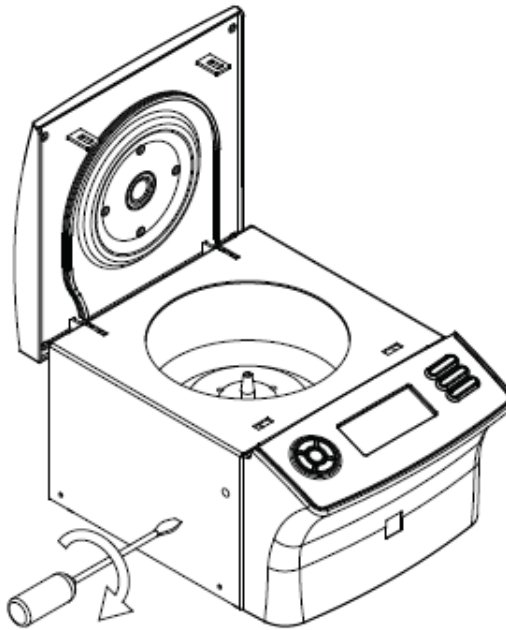
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### 6.3 Emergency release

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In the event of a power failure or the centrifuge lid cannot be opened, active the emergency release.

- ① Switch off the power switch.
- ② Wait for the rotor to stop completely.
- ③ Find the “emergency release hole” at the left side of the device.
- ④ Put a flat-head screwdriver into “emergency release hole” and turning clockwise




# 7. Rotors and tubes



## 7.1 Rotors for Smart 15 Plus

Rotor		용량	Rotor ID	MAX. RPM	MAX. RCF	MAX. R(mm)
Angle Rotors	A0.2M-32	32 x 0.2ml	2	12,500	9,695	55.5
	A2.0M-18	18 x 1.5/2.0ml	3	15,000	17,910	71.2
	A2.0M-24 A2.0MP-24 (Plastic lid available)	24 x 1.5/2.0ml	1	15,000	21,055	83.7

# 7. Rotors and accessories


## 7.2 Rotors and accessories for Smart 15 Plus







A0.2M - 32 (4-PCR Strips)	
	<div>Type : PCR Rotor ∠ 45°</div> <div>Max. RPM : 12,500 rpm</div> <div>Max. RCF : 9,695 xg</div> <div>Radius : 55.5mm</div> <div>Dim. Ø/H : Ø172x38.5</div>

Tube Capacity (ml)	0.2	0.2					
Dimensions Øx L mm	6 x 18	-					
Tube Type							
Adapter	-	-					
Tube per Rotor	32	4-PCR Strips					
Max.RCF	9,695						
radius (mm)	55.5						
boring Ø x L mm	6.5 x 17						
Color / Material	-	-					
Cat.NO.	-	-					
Max. length Ø x L	-	-					

# 7. Rotors and tubes


## 7.2 Rotors and accessories for Smart 15 Plus







A2.0M - 18	
	<div>Type : Angle Rotor ∠ 45°</div> <div>Max. RPM : 15,000 rpm</div> <div>Max. RCF : 17,910 x g</div> <div>Radius : 71.2 mm</div> <div>Dim. Ø/H : Ø147 x 38.5 mm</div>

Tube Capacity (ml)	0.2	0.5	1.5	2.0			
Dimensions Øx L mm	6 x 18	8 x 30	11 x 38	11 x 38			
Tube Type							
Adapter			-	-			
Tube per Rotor	18						
Max.RCF	14,087	16,602	17,910				
radius (mm)	56	66	71.2				
boring Ø x L mm	6 x 21	8 x 37	11 x 38	11 x 38			
Color / Material	Black	Black	-	-			
Cat.NO.	TR0.2	TR0.5					
Max. height for tube fit	11 x 45						

# 7. Rotors and tubes

## 7.2 Rotors and accessories for Smart 15 Plus

A2.0M - 24	
	<div>Type : Angle Rotor ∠ 45°</div> <div>Max. RPM : 15,000 rpm</div> <div>Max. RCF : 21,055 x g</div> <div>Radius : 83.7mm</div> <div>Dim. Ø/H : Ø172 x 38.5mm</div>

Tube Capacity (ml)	0.2	0.5	1.5	2.0			
Dimensions Øx L mm	6 x 18	8 x 30	11 x 38	11 x 38			
Tube Type							
Adapter			-	-			
Tube per Rotor	24						
Max.RCF	17,321	19,747	21,055				
radius (mm)	68.5	78.5	83.7				
boring Ø x L mm	6 x 21	8 x 37	11 x 38	11 x 38			
Color / Material	Black	Black	-	-			
Cat.NO.	TR0.2	TR0.5					
Max. height for tubefit	56 mm						

MEMO



Hanil Scientific Inc.  
16 Arayukro, Gimpo 10136, Rep. of KOREA  
T. 82-2-3452-8965  
info@ihanil.com  
www.ihanil.com