Instruction Manual

HITACHI

HITACHI LARGE CAPACITY REFRIGERATED CENTRIFUGE

CR7

IMPORTANT:

Before using this CENTRIFUGE, carefully read through this INSTRUCTION MANUAL to ensure efficient and safe operation. Always keep this INSTRUCTION MANUAL handy as an important reference when using this CENTRIFUGE.



Hitachi Koki

▲ SAFETY NOTICE

The international symbol displayed above is a reminder that all safety instructions should be read and understood before installation, operation, or maintenance of this instrument is attempted. When you see the symbol on other pages, pay special attention to the safety information presented.

Safety During Installation and/or Maintenance

- Be sure to level the centrifuge with the level adjuster (leveling bolt) and secure the centrifuge in place. Properly securing the unit will reduce the possibility of injury or damage which could result from instrument movement in the event of a major rotor mishap.
- 2. To avoid the risk of electrical shock, be sure to properly ground the centrifuge. The grounding (grounding resistance is 100 Ω or less) is surely required to comply with electrical standards.
- 3. Do not install the centrifuge in wet locations such as the vicinity of water supplies.
- 4. Before performing maintenance and inspection of this instrument, make sure that the circuit breaker of the unit is off and also the circuit breaker of the room is off. If it is necessary to perform maintenance or inspection with the centrifuge power on, pay special attention to avoid electrical shocks. Before removing any covers, turn off the centrifuge power and wait at least three minutes or more to reduce the risk of electrical shock.
- 5. Fuses protect certain electrical circuits within the centrifuge against overcurrent conditions. For continued protection against the risk of fire, replace fuses only with the same type and specified rating.
- 6. Never attempt to repair or disassemble the centrifuge. Refer such servicing to qualified personnel.

Mechanical Safety

- Use only the Hitachi Koki's accessories such as buckets and assemblies. For other accessories such as tubes, bottles and adapters, use the Hitachi-designated ones. Refer to the catalogs attached to the centrifuge accessories such as rotor, adapter, tube, bottle and cap for details.
- 2. Check that there is no abnormality on the rotor, buckets and assemblies before use. If any corrosion, scratch or crack is found on them, do not use them.
- 3. Do not exceed the maximum rated speed of the rotor or buckets in use.
- Buckets may corrode or break if samples and water being left.Wash and dry the buckets after use and apply silicon grease to them to avoid personal injury or property damage.
- Install the rotor on the drive shaft (crown) correctly. In the case of a covered rotor, be sure to set the rotor cover before starting operation. In the case of a screw type cover, check that the screw is tightened completely.
 Before starting the centrifuge, be sure to set the cover on the rotor. If the cover is a screw cover, make sure that the cover is screwed down completely.
- Check the chemical resistance chart in separate manual, and do not use any sample inapplicable to the rotor (including buckets). Using such a sample could corrode the rotor (including buckets).
- 7. Be sure to set all buckets which are same type in the rotor.
- 8. Do not exceed the allowable imbalance.
- 9. Never attempt to slow or stop the spinning rotor by hand.
- 10. Never attempt to override the door interlock system while the rotor is spinning.
- 11. Do not lift or move the centrifuge while the rotor is spinning.
- 12. For operator safety, maintain a 30 cm "clearance envelope" around the centrifuge while it is running.
- 13. If a glass tube should break inside the rotor chamber, be sure to completely remove the fragments before use.

- 14. Clean the inside of the drive hole (crown hole) of the rotor and the surface of the drive shaft (crown) of the centrifuge once a month.
- 15. If any condensation is found inside the rotor chamber, discharge the condensation through the drain to protect the sample and prevent exposure the drive unit to water. If your centrifuge has no drain, wipe away all condensation of water with a cloth.
- 16. Do not place containers holding liquid on or near the centrifuge. If they spill, liquid may get into the instrument and damage electrical or mechanical components.
- 17. If the centrifuge is exposed to ultraviolet rays for a long time, the covers discolor and their coating peels off easily. Cover the centrifuge with a cloth after operation to avoid direct ultraviolet rays.
- 18. This centrifuge is not designed for use with materials capable of developing flammable or explosive vapors. Do not centrifuge such materials in this instrument nor handle or store them near the centrifuge.
- 19. Do not use samples that are toxic, radioactive, or pathogenic. If it is absolutely necessary, be sure to take necessary measures to prevent discharge of such samples out of the centrifuge. It is your responsibility to decontaminate the instrument and accessories completely before requesting service by Hitachi Koki authorized sales / service representative to avoid infection.
- 20. If any abnormality is found in the centrifuge, stop using the centrifuge immediately and call Hitachi Koki authorized sales / service representative. If the centrifuge displays an error code, inform Hitachi Koki authorized sales / service representative.
- 21. An earthquake may cause some abnormalities to the centrifuge depending on the magnitude. If any abnormality is found, request service by Hitachi Koki authorized sales / service representative.

The symbol \triangle is used throughout this manual to emphasize important and critical instructions. Readers are expected to be familiar with the meaning and to read instructions carefully before using the centrifuge.

\Lambda WARNING:

Indicates a potentially hazardous situation which, if not avoided, could result in severe personal injury or possible death.

▲ CAUTION:

Indicates a hazardous situation which, if not avoided, could result in personal injury or severe damage to the instrument.

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COMPONENT LOCATIONS





SPECIFICATIONS

	CR7
Maximum speed	7,000 rpm
Maximum RCF	9,430 G
Maximum capacity	6,000 ml (R5S2 Rotor)
Driving system	Brushless high frequency motor
Speed control range	300~7,000 rpm
Settable temperature range	-20°C~+40°C
Timer	1 second~99 minutes and 59 seconds, HOLD (option : 1 minute~99 hours and 59 minutes)
Program function	30 conditions memory
Refrigerator capacity / refrigerant	1.5 KW / R404a
Dimensions	730(W) × 910(D) × 1,150(H) mm Height to table 870 mm
Power requirements	200/220/230/240 VAC±10 % 50/60 Hz Single phase 30 A
Weight	300 kg

• Before using the rotor, tubes and adapters, read through the instruction manuals attached to them.

• The timer counts up or down the actual run time from when the rotor reaches the set speed.

MARNING:

Use the rotor correctly. Improper use of the rotor can cause serious injury and breakage of tubes.

INSTALLATION AND RELOCATION

In order to use the centrifuge safely, follow the instructions below installing or relocating the centrifuge.



CAUTION:

Before moving the centrifuge, be sure to remove the rotor from the drive shaft to avoid bending the drive shaft.

OPERATION

Normal Run /// This procedure shows the method with different operating conditions each time.





Centrifugal Force Function



OPERATION



Operation with priority of timer

When the centrifuge is put into operation with a run time set, an integration of $G \cdot \sec$ from start to stop of the rotor will be calculated automatically. The $G \cdot \sec$ indicator shows "----" when calling up the set conditions. The timer counts the actual run time from when the rotor reaches the set speed. The centrifuge decelerates automatically when the TIME indicator shows "0".



Operation with priority of G • sec

When the centrifuge is put into operation with a value of $G \cdot \sec$ set, an the rotor will automatically decelerate when the integration of $G \cdot \sec$ has reached the set value. However, the $G \cdot \sec$ indicator shows values from start to stop of operation. The TIME indicator shows "-----" when calling up the set conditions. The timer counts the actual run time from when the rotor reaches the set speed and the TIME indicator shows the time until deceleration starts.



Programmed Operating Condition

For the purp can be kept. For the purpose of frequent operating conditions 30 Kinds of condition



Enter the desired address (NO.) by TEN-KEY.

- When calling up a condition among P1 to P9, enter the desired address number. FUNCTION display shows the flashing address number. Wait four seconds or push ENTER switch to change the indication from flashing to lighting.
- e.g.) When calling up the address number 1



·When calling up a condition among P10 to P30, enter the second digit of the address number. Then each display shows the operating conditions of the address number among P.1 to P.9. Continuously enter the next digit of the address number. The desired conditions are displayed.

e.g.) When calling up the address number 15



When called up, the operating conditions are shown in each display and FUNCTION display shows the address number. By pressing FUNCTION switch, the address number goes out and the designated items are displayed.

Press START.

How to call up programmed conditions when the key lock switch functions:

- This centrifuge has a key lock switch to protect the customer-programmed operating conditions. The operating conditions cannot be changed while the key lock switch functions.
- In such case, the address number can be entered without pressing CALL switch (direct call).
- e.g.) When calling up the address number 20



· You can set desired operating conditions even if the key lock switch functions by calling up the address number 0.

OPERATION

Step Run

This centrifuge can perform three steps of programmed operations and each step has three types.

This is a function to perform three steps of programmed operations in a set. When a programmed operation is completed, the centrifuge calls up the next programmed operating conditions and performs the operation automatically.



The centrifuge can perform up to three step runs. Combine the programmed operating conditions as follows.

• For the first step run, choose from the address numbers P31 to P33.

• For the second step run, choose from the address numbers P41 to P43.

• For the third step run, choose from the address numbers P51 to P53.

Program the operating conditions in desired address numbers (for example, p31, P32 and P33) and press CALL switch to call up the address number.

(This is the same procedure as the programmed in the previous page.)

When the operation is started by calling up P31, the first step will be P31, second step P32 and the third step P33. When only two steps are required for the run, program the operating conditions in P32 and P33 and call up P32. The first step will be P32 and the second step P33.

(NOTE)

Enter the same rotor number when programming the operating conditions of each step. Be careful not to program a speed exceeded the maximum speed of the rotor. An entering error can cause the operation alarms such as OP-6 and OP-8 and result in stop of operation.

Acceleration and Deceleration Rates

You can change the acceleration and deceleration rates within the range $0 \sim 500$ rpm.

Please select according to the rotor and the sample.

Press FUNCTION to start the ACCEL-DECEL lamp blinking. Then, input the code numbers of both ACCEL and DECEL by TEN-KEY. The acceleration and deceleration time for each code number is shown in the table below.

e.g.) Entry procedure for acceleration at rate 9 and deceleration at rate 7.



Acceleration/Deceleration time				
Rate	Time for acceleration from 0 to 500 rpm.	Time for deceleration from 500 to 0 rpm.		
9	Within 30 seconds	Within 45 seconds		
8	Approx. 45 seconds	1 minute		
7	1 minute	1 minute and		
		30 seconds		
6	1 minute and	2 minutes		
	30 seconds			
5	2 minutes	2 minutes and		
		30 seconds		
4	2 minutes and	3 minutes		
	30 seconds			
3	3 minutes	4 minutes		
2	4 minutes	6 minutes		
1	6 minutes	Free slowdown from		
		500 rpm		
0	—	Free slowdown		

The shortest acceleration time or the shortest deceleration time may be longer than the time listed in the above list depending on the kind of rotor. This centrifuge cannot decelerate slower than the rate 0.

Note.

When running the centrifuge at a speed under 500 rpm, the speed may become a little higher. If this is undesirable in view of centrifugation, set the acceleration rate to 7 or lower.

Temperature Control

Room temperature

In order to have the best performance of the centrifuge and also increase the life span, an optimum room temperature from 15 degree C to 25 degree C is highly recommended.

Precooling

Precooling of rotor helps to perform centrifugation without rising of sample temperature. When precooling a rotor using this centrifuge, set the sample temperature to be kept and run the centrifuge at about 1,500 rpm. The time required to precool a rotor depends on the set temperature and the shape of the rotor to be used. For example, R5S2 rotor has a wind shield around the outside and it takes 30 minutes or more to precool the rotor from room temperature (25°C) to 4°C, operating the centrifuge at 1,500 rpm. It is possible to control the temperature more accurately by cooling the rotor and keeping sample to the desired temperature before operation.

CAUTION:

Do not keep the refrigerator turning on for a long time when the centrifuge stops. Keeping the refrigerator turned on can cause frosting of the rotor chamber and condensation in the motor, and result in mixing of water into sample.

Maintenance after Operation

Maintain the following components for long life of the centrifuge.

ROTOR chamber

If frost or condensation is found in the evaporator, remove the drain cap and discharge water or wipe with a soft cloth. If the rotor chamber is heavily stained, clean the rotor chamber with a cloth or sponge moistened with dilution of neutral detergent.

Drive shaft

CAUTION:

Clean the inside of the drive hole (crown hole) of the rotor and the surface of the drive shaft (crown) of the centrifuge once a month. If the drive hole or the drive shaft is stained or any foreign matter is adhered, the rotor may be improperly installed and come off during operation.

This part is very important because the rotor is mounted on it and the crown transmits driving force to the rotor. Before mounting a rotor, wipe the outer surface of the crown with a soft cloth dampened with water sufficiently.

Door

Turn off the centrifuge power and keep the door open half a day after operation to dry out the rotor chamber. (For example, when using the centrifuge in the day time, keep the door open at night to dry out the rotor chamber.)

ROTOR

Be sure to take out the rotor from the rotor chamber and remove the rotor cover to dry out the inside of the tube holes.

If sample is leaked in the rotor, wash the rotor with clean water and dry out. Apply a light coat of stop cock grease over it.

Radiator

In order to function the refrigerator fully, remove the front cover and clean the radiator with a vacuum cleaner every 6 months.



TROUBLESHOOTING



When the Alarm Code lights.

Alarm Code	Cause and Symptom	Remedy
OP:1	Power failure occurs during operation. When recovered, the rotor speed is; more than 300 rpm … re-accelerate less than 300 rpm … stop	If the rotor is stopped, check the remaining time and restart, if necessary.
POWER FAILURE		
	The room temperature is over 35°C.	Bring down the room temperature or decelerate the rotor speed.
OVER TEMP.	The radiator at the front is clogged with dust.	Clean the radiator. Refer to OPERATION "Maintenance after Operation" for cleaning.
	START switch is pressed when the door is	Be sure to close the door securely.
OP:5	DOOR lamp lights.	
DOOR		
	The rotor speed setting is higher than the allowable maximum speed.	Check the set speed and reset it below the allowable maximum speed of the rotor.
OP:6	The rotor number setting is wrong.	Check the set rotor number and reset it accurately.
SPEED SET		
OP:8	The rotor number setting is wrong.	Check the set rotor number and reset it accurately.
ROTOR		
	Sample imbalance.	Balance the sample.
OP:9		
IMBALANCE		

TROUBLESHOOTING

When the A The centrifuge by the qualified p Please inform alarm code sho to Hitachi Koki C	Iarm Code E- lights. requires a maintenance × 1,000rpm bersonnel. × 1,000rpm the maintenance × 1,000 rpm win in TIME display Co., Ltd.	TIME TEMP minutes seconds °c E- 13	
Maintenance alarm code	Cause	Remedy	
E13~15*	The motor or the speed detector is abnormal.		
E16~20	The motor control circuit is abnormal.	SERVICE CALL	
E21~23	The microcomputer circuit is abnormal.	When requesting service, please provide the	
E24, 25, 28	The motor control power supply is abnormal.	[indicated maintenance alarm code as well.]	
E26	Faulty discrimination of the power supply frequency.		
E30~32	The temperature controller is abnormal.		
CP**	The circuit breaker for motor is turned off.	Turn on the circuit breaker. If the circuit breaker is frequently turned off, make a service call.	

* The maintenance alarm code E13 indicates abnormality of the rotor speed detection signal. If the alarm code is displayed, it is impossible to reset the centrifuge for 60 minutes (until the rotor stops completely) to ensure operator safety. Wait 60 minutes keeping the centrifuge power turned on. It is impossible to open the door while E13 is displayed.

** The circuit breaker for motor is located at the left side of the control panel.

WARNING:

Never attempt to repair or disassemble the centrifuge. Refer such servicing to qualified personnel.

How to Clear Alarm Code

Perform proper remedies and press CE switch to clear the alarm code.

In the case of two or more alarms, the next alarm code is displayed after clearing an alarm code displayed first by pressing CE switch.





Problem	Cause	Remedy	
Operating condition cannot be	ENTER switch is pressed after entering conditions.	Press ENTER switch after entering conditions by ten-key.	
enterea.	Key lock condition is maintained.	Release the key lock.	
Centrifuge can not start even if START switch is pressed.	The beeper sounds three short beeps when START switch is pressed.	Press CHECK, then press START. In this case, check the operating condition again.	
When you want to know set conditions.		Press Check.	
Programming or calling up cannot be done.	Rotor is running.	Set or call up MEMORY when the rotor is not running. You can not set and call up MEMORY while the rotor is running.	
	Key lock switch condition is maintained.	Release the key lock.	
Contents of called program is changed.	The battery for MEMORY backup is used up.	Reset MEMORY and turn on the POWER switch for about 10 hours to charge the battery.	
Speed displays ""	The battery for MEMORY backup is used up.	Set the operating conditions. Turn on the power switch for about 10 hours to charge the battery.	
	There are other heating units such as refrigerator or generator, etc.	Relocate the heating unit to other place or contact the field service representative to relocate the centrifuge to the place without heating unit.	
Rotor cannot be cooled.	Radiator at the front is clogged with dust?	Clean the radiator. Refer to OPERATION "Maintenance after Operation" for cleaning.	

TROUBLESHOOTING

How to remove Sample in a power failure

This operation shall be done only in an emergency, never attempt to do this under normal circumstances.

1. Wait until the rotor stops.

• The waiting time depends on the type of rotor and the speed at a power failure. Generally it takes 30 to 60 minutes until a rotor stops completely from its maximum speed.

\Lambda WARNING:

All the indications displayed on the control panel are extinguished at a power failure. Be sure to wait until the rotor stops completely, then commence this operation.

- 2. Turn off the power switch of the centrifuge and the power line switch.
- 3. For the door lock at the rear of the centrifuge, insert a screwdriver into the hole at the right side of the centrifuge and pull it toward the front of the centrifuge to release the door lock.

For the door lock at the front of the centrifuge, remove four fixing screws and the front cover, then pull the door lock solenoid forward to release the door lock.



Never attempt to do this operation while the rotor is spinning. Never attempt to touch the spinning rotor as it is very dangerous.

ROTOR

Following table shows the specifications of each rotor applicable to CR7 centrifuge such as rotor number, maximum rotor speed and maximum relative centrifugal force (RCF).

Rotor type	Rotor model	Max. rotor speed (rpm)	Max RCF (×g)	Allowable imbalance (gram × number of tubes)	Nominal tube capacity (ml)	Tube quantity	Tube size $(\phi \times mm)$	Angle (deg)	Weight (kg)	Rotor No.
	R5S2 (RR5S2)	4,200	5,150	50×3	1,000	6	Bucket size ϕ 99 × 150	0~90	28	6
tor	R5S3	4,200	5,030	50×3	*1	-	-	0~90	32	9
ving ro	R4S2 (RPRS4-7)	3,200	2,540	30×1	15 5	100 168	φ 17 × 120 φ 12 × 120	0~90	18	3
Ŝ	R3S (RPRS3-3)	3,000	1,870	6×2	500	4	ϕ 98 × 100	0~90	7	40
	R7S (SRR7SA)	7,000	9,430	2×2	300	4	ϕ 62 × 137	0~90	9	37
	R14A (RR14A)	7,000	7,560	4×2	300	4	ϕ 62 × 137	35	17	29
	R14A2	7,000	7,560	4×3	300	6	ϕ 62×137	23	14	43
	R12A (RR12A)	7,000	8,270	6×2	500	4	ϕ 73 × 163	26	21	31
rotor	R12A3	7,000	8,110	4×6	300	6	ϕ 62×137	30	16	41
angle	R10A (RR10A)	7,000	9,200	6×3	500	6	ϕ 73 × 163	26	24	30
Fixed	R10A3	7,000	9,200	6×3	500	6	ϕ 73 × 163	26	14.5	45
	RPR12-2	7,000	7,560	4×2	300	4	ϕ 62 × 137	35	14	11
	RPR10-2	7,000	8,270	6×2	500	4	ϕ 73 × 163	26	20	12
	RPR9-2	7,000	9,200	6×3	500	6	ϕ 73 × 163	26	23	13

(NOTE)

• For detail of the rotors other than R5S2 and R4S2 rotors, refer to the instruction manuals of each rotor.

• Refer to the rotor/tube catalog for further information such as chemical resistance of tubes and bottles.

*1 400 ml Blood bag × 2. Refer to the rotor instruction manual.

R5S2 Swing Rotor

1. Rotor Specifications

	CR7
Rotor model	R5S2 (ROTOR NO. 6
Max. rotor speed	4,200 rpm
Max. RCF buckets	5,150×g
Quantity of buckets	6
Bucket size	φ99×150
Max. capacity	6,000 ml (1,000 ml × 6 pcs,)
Life	7 years from the date of delivery

CAUTION:

Replace the inner cups with new ones periodically as they are consumables. Although the inner cups can be used again and again, they may have fine cracks when used about 1,000 times. Running of the cracked inner cups can cause breakage and result in spoilage of precious sample. Do not use cracked inner cups. The inner cups can also be degraded by ultraviolet ray, replace them periodically (once a year).

CAUTION:

When centrifuging sample other than blood bags, use bottles with cap.

Running of the inner cups or bottles without cap filled full can cause a sample spill as the buckets are swung and result in a deformation of the rotor shell. Be sure to fill the cups or bottles with sample 70% of the actual capacity or less. (In the case of the inner cup (L), the level 50 mm below the top of the cup indicates 70% of the actual capacity, as a standard,)

2. Allowable rotor speed When Centrifuging Heavy Sample

In the case of R5S2 rotor, control the weight of contents in each bucket (gross weight of the inner cups, blood bags, bottles, sample, etc.) less than 1,000 g to perform centrifugation at the maximum rotor speed 4,200 rpm.

MARNING:

When the weight of contents in a bucket exceeds 1,000 g, be sure to reduce the speed according to the following. Running the centrifuge at an exceeded speed can result in bucket disruption or serious injury.

Allowable speed = $4,200 \times$

1,000 (g)

Weight of contents in a bucket (g)

	-
Weight of contents in a bucket (g)	Allowable speed (rpm)
1,000	4,200
1,200	3,830
1,400	3,550
1,600	3,320
1,800	3,310
2,000	2,970

Weight of contents in a bucket and the allowable speed



ROTOR

MARNING:

Be sure to load all buckets which are the same type in the rotor for safety. Check the rotor for reliable engagement with the pins before operation.

CAUTION:

Load tubes in the rotor symmetrically in relation to the axis of rotation to keep the balance.

Do Not exceed the allowable imbalance weight 50 g × 3 specified for this rotor.



Example of allowable imbalance weight

CAUTION:

Be sure to set the rotor cover before operation. Running the centrifuge without the rotor cover can cause a serious damage to the centrifuge.

To prevent forgetting about the rotor cover setting, be sure to hang the rotor cover on the cover hanger at the door when the rotor cover is removed.

MARNING:

Check that the rotor lock screw is firmly tightened before operation.

4. Maintenance of Rotor

- Sticking of sample or water drops on buckets may corrode the buckets, especially at the bottom. Be sure to wash and dry the buckets after using and apply the attached silicone grease to prevent corrosion.
- Friction of the sliding portion between the bucket and the rotor pin may cause a faulty bucket swinging. Apply a light coating of the attached teflon coat to the sliding portion of the bucket ("A" portion) once a week. Application of too much teflon coat can cause a faulty bucket swinging. If applied too much, remove teflon coat with thinner or acetone.





Relative centrifugal force (RCF) = $1,118 \times r \times N^2 \times 10^8$ (g) r = Rotation radius (cm) N = speed (rpm)

RCF Table for R5S2 Rotor

Speed	RCF	(×g)
(rpm)	Rmax = 26.1 cm	Rmin = 11.1 cm
1,000	290	120
2,000	1,170	500
3,000	2,630	1,120
4,000	4,670	1,990
4,200	5,150	2,190

R4S2 Swing Rotor

1. Rotor specifications

Rotor model	R4S2 (Rotor No.3)
Max. rotor speed	3,200 rpm
Max. RCF	2,540×g
Quantity of buckets	2
Max. quantity of tubes	168(<i>φ</i> 12×7.5)
Life	7 years from the date of delivery

2. Allowable Rotor Speed When Centrifuging Heavy Sample

In the case of R4S2 rotor, control the weight of contents in each bucket (gross weight of the bases, racks, blood-collecting tubes, etc.) less than 1,500 g to perform centrifugation at the maximum rotor speed 3,200 rpm.

MARNING:

When the weight of contents in a bucket exceeds 1,500 g, be sure to reduce the speed according to the following. Running the centrifuge at an exceeded speed can result in rotor disruption or serious injury.

Allowable speed =
$$3,200 \times$$

1,500(g)

Weight of contents in a bucket (g)

Weight of contents in a bucket and the allowable speed

Weight of contents in a bucket (g)	Allowable speed (rpm)
1,500	3,200
1,600	3,090
1,700	3,000
1,800	2,920
1,900	2,840
2,000	2,770

3. Caution in Handling Rotor

CAUTION:

Do not exceed the allowable imbalance weight 30 g specified for this rotor.

Check that the base for carrying is securely mounted in the bucket. Base for carrying A base for carrying is mounted in the bucket correctly. Bucket Faulty sliding between the bucket and the rotor pin may cause misoperation of the imbalance detector. Apply silicone grease (standard accessory) to the sliding portion between the bucket and the rotor pin once a week. Apply silicone grease. Rotor Rotor pin Bucket CAUTION: Load tubes in the rotor symmetrically in relation to the axis of rotation to keep the balance. NG OK

CAUTION:

Sticking of sample or water drops may corrode the rotor and result in rotor disruption or serious injury. Be sure to wash and dry the rotor after using and apply silicone grease.

4. Calculation of Relative Centrifugal Force



Relation Between Centrifugal Force and Speed

The centrifugal force generated by rotation relates to the speed and the distance from the center of rotation. Centrifugal force (RCF*) is found using the following equation. (Generally Centrifugal force is expressed in comparison with the gravitational acceleration of the earth in units of "G" or "g".)

RCF = $1.118 \times 10^{-6} \times r \times N^{2}(G)$

N: Speed (rpm) r : Rotation radius (mm)

It is possible to calculate the speed (rpm) from the RCF (G) using this equation. *RCF : Relative Centrifugal Force

How to Find The Separation Time

To find the sedimenting time T, which is the time to sediment particles dispersed in the solution from the top (r_t) to the bottom (r_b) , use the following equation. Generally, the characteristic of the sedimentation is expressed with sedimentation coefficient s.

$$T (hr) = \frac{1}{3600 \times s} \cdot \frac{\ln (r_{b}) - \ln (r_{i})}{\omega^{2}}$$

$$\omega : Angular velocity \quad \omega = \frac{2\pi}{60} \cdot N$$

$$N : Speed (rpm)$$

$$r_{t} : Distance from the center of the rotation of the rotor to the top of the solution
$$r_{b} : Distance from the center of the rotation of the rotor to the top of the tube$$

$$Now, if K = \frac{\ln (r_{b}) - \ln (r_{i})}{\omega^{2}} \cdot \frac{10^{13}}{3600} \text{ and } s = s \times 10^{13} \text{ are defined, it becomes}$$

$$T (hr) = \frac{K}{S}$$$$

and it becomes possible to find the time to sediment the particles from r_{t} to r_{b} .

\Rightarrow CALCULATION FOR CENTRIFUGATION

K is called the K factor and it changes depending on the kind of rotor and the speed. For the K factor at the maximum speed, refer to the instruction manual of the rotor. The K factor used at optimum speed is found by calculating the following equation.

$$K_N = K \left(\frac{N}{Nmax} \right)^2$$



Generally, the sedimentation coefficient becomes very small value and $s \times 10^{13}$ may be expressed as S.

The "S" expressed as $s \times 10^{13}$ is called the sedimentation coefficient of Svedberg Unit. However in the field of biochemistry, it may be simply called as sedimentation coefficient. If S is unknown, calculate it using the following equation (Stokes equation).

$$S = \frac{d^2 (p_2 - p_1)}{18 \eta} \times 10^{13}$$

$$d : \text{Diameter of the sedimenting particle (cm)}$$

$$p_1 : \text{Density of the solution around the particle (g/cm^3)}$$

$$p_2 : \text{Density of the e sedimenting particle (g/cm^3)}$$

$$\eta : \text{Viscosity of the solution around the particle}$$

$$(\text{Poise})$$

$$(\text{The viscosity of the 20^{\circ}\text{C water is 0.01 Poise.})}$$

S in 20°C pure water is expressed as $S_{20. W}$,.

ADDITIONAL EXPLANATION FOR CALCULATING RCF

CR7 can read maximum radius of rotor "Rmax" from the rotor number and automatically calculate RCF (Relative Centrifugal Force).

Furthermore, CR7 can automatically calculate rotation radius "r" and then the RCF at "r" by setting the sample height "h". RCF is found by calculating the following equation.

 $RCF = 1.118 \times 10^{-6} \times r \times N^2$ (G) θ N: Speed used (rpm) r: Rotation radius (mm) h h×sin 6 In the case of angle rotor, CR7 can automatically calculate Rmax' the rotation radius "r" by the following equation in Rmax consideration of tube gradient. $r = Rmax' - h \times sin \theta$ (mm) Rmax' : Distance from the center of rotation to the center of the tube bottom (mm) h : Sample height (mm) θ : Angle of tube gradient (deg)

The maximum radius of rotor "Rmax" is used as rotation radius "r" for the calculation when setting 0 for sample height. In this case, RCF is equivalent to maximum RCF.

CAUTION:

Tube bottom are spherical. Accordingly, the result of calculation may have an error if the sample height is very low in the case of an angle rotor.

STANDARD ACCESSORIES

(1) Standard accessories of CR7 centrifuge

Name	Q'ty	Rough Sketch	Remark
Instruction manual	1		CAT No. S999274
Rotor and tube catalog	1		CAT No. 999484
Level	1		CAT No. 403584
Fuse (2A)	1		CAT No. 84333601
Silicone grease (stop cock grease)	1		CAT No. 660557

(2) Standard accessories of R5S2 rotor

Name	Q'ty	Rough Sketch	Remark
Teflon coat	1		CAT No.S403145A
Wrench	1		CAT No. 84850206

(3) Standard accessories of R4S2 rotor

Name	Q'ty	Rough Sketch	Remark
Base	2		CAT No. 330905

Warranty on CR7 centrifuge

CR7 is warranted for one year after delivery so far as it is properly operated and maintained.

The drive unit is warranted for five years after delivery.

(However, the warranty period depends on the using conditions.)

Warranty on rotors

For information on the warranty on rotors, refer to the instruction manuals of each rotor for Hitachi Large Capacity Refrigerated Centrifuge.

CAUTION: In case the following happens during the warranty period, a charge will be levied for repairs.

- (1) Malfunction caused by incorrect installation.
- (2) Malfunction caused by rough handling or errors in operation.
- (3) Malfunction caused by moving or relocation after installation.
- (4) Malfunction caused by attempts to disassemble or remodel the refrigerated centrifuge.
- (5) Malfunction caused by fire, earthquake, or other natural disasters.
- (6) Malfunction of consumable part or part which has another warranty.

AFTER-SALES SERVICE

We would like to recommend periodical checks in order to keep this centrifuge operating safely and efficiently. If the unit does not operate normally, please contact your sales agent or Hitachi High–Technologies Corporation. service personnel without attempting repairs yourself. Also, please contact them for ordering parts or any operation problem.

If the manufacturing of any spare part for the centrifuge is stopped, Hitachi Koki will stock the spare part for a period of seven years following the stoppage of manufacturing.

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