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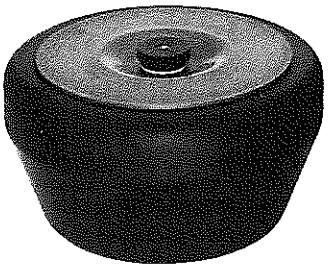
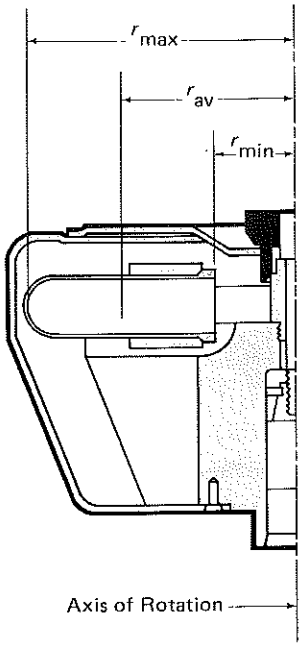
BECKMAN

INSTRUCTIONS FOR USING THE JS-13.1 SWINGING BUCKET ROTOR

in Beckman J-21 and J-6 Series Centrifuges





U.S. Patent No. 4,412,830

SPECIFICATIONS (in a J-21 Series Centrifuge)

Maximum speed	13 000 rpm*
Minimum speed	1000 rpm†
Maximum solution density	1.2 g/mL
Maximum allowable imbalance of opposing loads	5 grams
Relative Centrifugal Field‡ at maximum speed	
At r_{max} (140 mm)	26 500 x *g*
At r_{av} (91 mm)	17 200 x *g*
At r_{min} (41 mm)	7 760 x *g*
k factor at maximum speed	1841
Number of buckets	6
Available bottles and tubes	see Table 1
Nominal dimensions of largest tube	29 x 105 mm**
Nominal tube capacity	50 mL
Nominal rotor capacity	300 mL
Approximate acceleration time to maximum speed (fully loaded)	2½ min
Approximate deceleration time from maximum speed (max. brake, fully loaded)	2½ min
Weight of fully loaded rotor	9.1 kg (20 lb)
Rotor material	aluminum
Conditions requiring speed reductions	see Speed Limits

*Or lower, depending upon the type of tube used (see Table 1).

†Buckets are not completely horizontal below this speed.

‡Relative Centrifugal Field (RCF) is the ratio of the centrifugal acceleration at a specified radius and speed ($r\omega^2$) to the standard acceleration of gravity (*g*) according to the following formula:

$$RCF = \frac{r\omega^2}{g}$$

where *r* is the radius in millimeters, ω is the angular velocity of radians per second (2πRPM/60), and *g* is the standard acceleration of gravity (9807 mm/s^2). After substitution:

$$RCF = 1.12\,r\left(\frac{RPM}{1000}\right)^2$$

**May be shorter if certain adapters are used. See Rotor Installation and Loading.

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DESCRIPTION

The JS-13.1 swinging bucket rotor, rated for 13 000 rpm, is designed to hold up to six 50-mL tubes. Used in J-21 and J-6 series centrifuges, the rotor generates centrifugal forces that efficiently process tissue homogenates, cells, and subcellular particles by either pelleting or density gradient separations. Short column methods (i.e., partially filled tubes) may be used to shorten run times.

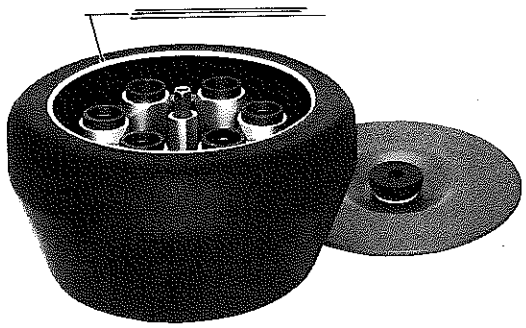

Figure 1. The JS-13.1 Swinging Bucket Rotor. Arrow points to plastic windshield edging.

The rotor and lid are made of anodized aluminum (see Figure 1). A plastic strip fits around the edge of the rotor windshield to protect the edges of the windshield and cover. Pins in the drive hole of the rotor seat into the centrifuge drive spindle and prevent the rotor from slipping. The lid knob acts as a tool for securing the rotor to the drive spindle. Once the rotor is fastened, the lid can simply be lifted off while the rotor remains secured in the centrifuge. The air pressure differential caused by the rotor as it spins keeps the lid in place. The rotor is warranted for 7 years (see the Warranty).

OPERATION

The tubes and bottles listed in Table 1 may be run in the JS-13.1 under the conditions specified (see also Speed Limits). Containers may be centrifuged at most normal operating temperatures but should be tested under simulated conditions if operated below 4°C or above room temperature. For the care, cleaning, sterilization, and chemical resistances of materials, see a J-6 or J-21 series centrifuge instruction manual or bulletin IN-175.

The operating parameters for the JS-13.1 rotor are the same as those for the JS-13. When used in a J2-21M or J-6M centrifuge, the JS-13.1 should be entered as if it were the JS-13, which allows for automatic control of rotor speed, acceleration and deceleration rates, maximum speed limits, and temperature compensation settings.

ROTOR INSTALLATION AND LOADING

Before installing the JS-13.1 rotor in a J-21 or J-6 series centrifuge, lightly coat the centrifuge drive spindle where it will contact the rotor drive hole with Spinkote™. A lifting handle is provided with the rotor. Remove the lid from the rotor and, while holding the hex rotor tie-down bolt with one hand, screw the lifting handle into the threads in the top of the tie-down bolt until it is tight (see Figure 2).

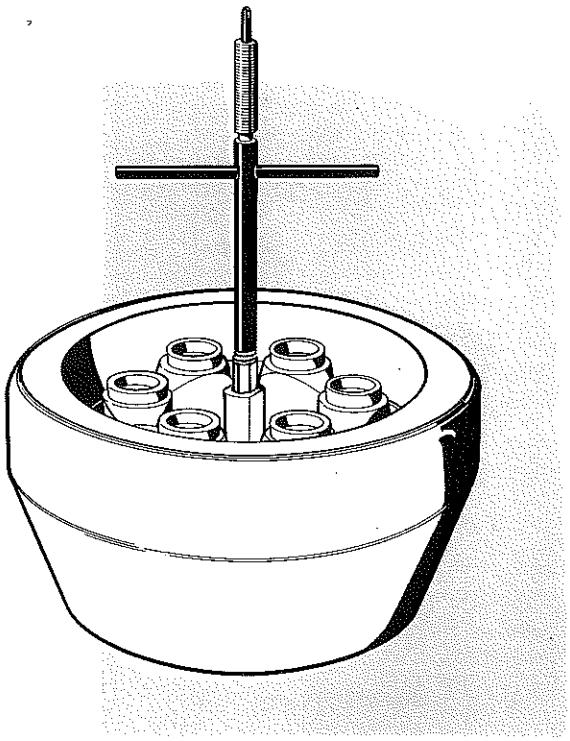

Figure 2. Using the Rotor Lifting Handle

Table 1. Available Bottles and Tubes

Part Number	Description	Nominal Capacity (mL)	Filling Capacity (mL)	Maximum Speed (rpm)	Size (mm)	Adapter Required
355668	Polypropylene* Tube with Snap-on Cap	50	45	13 000	29 x 103	none
355669	Polycarbonate Tube with Snap-on Cap	50	45	13 000	29 x 103	none
355671	Polypropylene* Bottle with Screw-on Cap	50	45	13 000	29 x 104	none
355670	Polycarbonate Bottle with Screw-on Cap	50	45	13 000	29 x 104	none
335431	Corex† Tubes, package of 8	30	32	8 000	25 x 105	870331
335430	Corex Tubes, package of 8	15	16.5	8 500	17 x 100	870329
335432	Pyrex† Tubes, package of 8	15	13	3 000	16 x 100	870329
355630	Polycarbonate Tube	10	9	13 000	16 x 76	342327/ 870329
355672	Polycarbonate Bottle with Screw-on Cap	10	10	13 000	16 x 80	342327/ 870329
340196	Polyethylene Tube	1.8	1.8	13 000	11 x 39	344497
342869	Polyallomer Tube	1.5	1.5	13 000	11 x 39	344497

*Above 20°C, fill polypropylene tubes at least half full.

†Corex and Pyrex are registered trademarks of Corning Glass Works.

Carefully lower the rotor *straight down* onto the centrifuge drive spindle, being sure to align the arrows shown on the label around the rotor drive hole with the grooves in the drive spindle. While holding the tie-down bolt, unscrew the lifting handle and set it aside. Place the lid on the rotor. The lid handle acts as a wrench for the hex hub; turn the handle clockwise to attach the rotor to the drive spindle.

CAUTION

The centrifuge drive spindle can be bent if the rotor is dropped onto it or forced sideways. Always install the rotor by centering it over the spindle and carefully lowering it straight down.

The pins located in the rotor drive hole must be seated in the bottom of the grooves in the drive spindle (see Figure 3). The arrows shown on the label around the rotor drive hole correspond to the location of the pins. When these arrows are aligned with the grooves, the rotor will be seated properly. Running a rotor which is seated incorrectly can result in rotor failure.

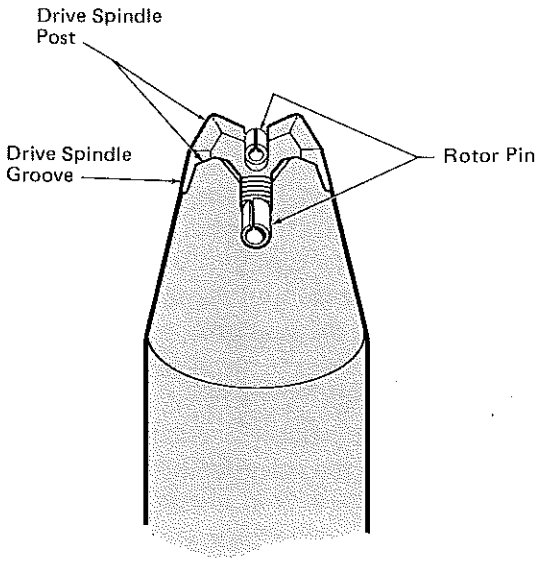

Figure 3. Pins in the Rotor Drive Hole Must Be Seated Properly in the Grooves of the Centrifuge Drive Spindle.

Remove the lid and fill the rotor, making sure all buckets swing freely. Opposing loads should balance to within 5 grams. Replace the lid on the rotor, slipping the knob down firmly over the hex hub. The lid can be slipped on and off the rotor between subsequent runs. No further turning of the lid handle is required as long as the rotor remains firmly tightened to the spindle.

> **NOTE:** All six buckets must always be installed in the rotor during centrifugation, even if not all buckets are loaded with tubes.

> **NOTE:** Bucket collars are numbered 1 through 6, as are the buckets (in sets of six). It is best to load the rotor so that bucket numbers correspond with collar numbers. If additional buckets are purchased, we recommend that you do not mix sets. Buckets are matched within sets by weight and variance exists between sets.

Adapters are required for some containers (see Table 1). When tubes are used with adapters, it is important to check the overall length of the tube and adapter. If the top of a tube should contact either the rotor yoke (when the bucket is fully horizontal) or the lid (when the bucket is vertical), the bucket could be dislodged and could severely damage the rotor.

Do not use rubber adapters in which glass tubes have previously broken because pieces of glass will be embedded in the rubber and will damage or break subsequently used tubes.

> **NOTE:** Consult the appropriate instrument instruction manual for centrifuge operation. Also see Temperature, below.

ROTOR REMOVAL

With the lid in position on the rotor, turn the lid handle counterclockwise to unscrew the rotor from the spindle. If desired, you may use the lifting handle to remove the rotor. Attach it as previously described. Lift the rotor straight up off the drive spindle and out of the chamber.

Should the rotor stick to the drive spindle of the centrifuge, the rotor removal tool (the other end of the lifting handle) may be used to release it (see Figure 4). Remove the lid, and, using an adjustable wrench, unscrew the tie-down bolt assembly from the rotor and set it aside. Screw the rotor removal tool into the threaded opening. As the removal tool tightens down, it will push against the drive spindle, forcing the rotor off of it. Unscrew the removal tool and reassemble the tie-down bolt in the rotor, tightening it securely with the adjustable wrench. You should be able to remove the rotor from the centrifuge. Lubricate the centrifuge drive spindle with Spinkote to prevent the rotor from sticking.

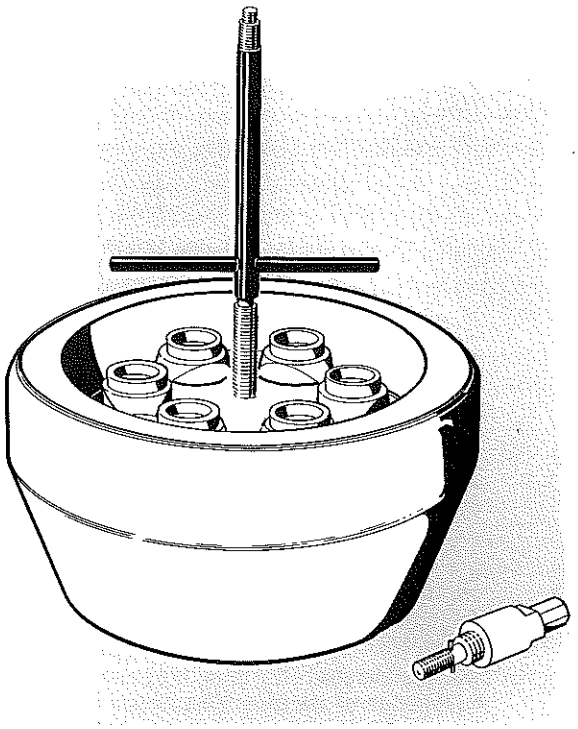

Figure 4. Using the Rotor Removal Tool

RUN CONDITIONS

Time

Run times (t, in hours) for pelleting in the JS-13.1 rotor can be estimated if the sedimentation coefficients (s) of the particles of interest are known. Use the following equations. The k factor of the rotor[1] is 1841 and s is in Svedberg units (S).

$$t = \frac{k}{s} \tag{1}$$

Since listed k factors are calculated for the rotor's maximum speed, the value of k must be adjusted if the rotor is to be run at less than maximum speed as follows:

$$k = 1841 \left(\frac{13\,000 \text{ rpm}}{\text{actual run speed}} \right)^2 \tag{2}$$

Density gradient separation times can be estimated from data established in prior experiments if the k factor of the previous rotor is known.[2] For any two rotors a and b:

$$\frac{t_a}{t_b} = \frac{k_a}{k_b} \tag{3}$$

where k_a and k_b have been adjusted:

$$k_x = k_{rated} \left(\frac{\text{rated speed}}{\text{actual speed}} \right)^2 \tag{4}$$

Temperature

Temperature control compensation settings for this rotor depend on centrifuge model. J2-21M and J-6M settings are automatically controlled. J-6B settings directly reflect chamber temperatures. Table 2 provides information for the J2-21 Model Centrifuge. Temperature compensation settings in the J-6, J-21C, J-21B, and J-21 must be empirically determined.

Table 2. J2-21 Centrifuge Temperature Settings. Turn the SET *knob to the desired sample temperature and set the* COMPENSATE *dial on the appropriate setting given in the table. Interpolate if intermediate values are required.*

Rotor Speed (rpm)	Desired Sample Temperature (°C, green bar)						
	-20°	-10°	2°	5°	10°	20°	40°
13 000	*N*	-10	-10	-10	-10	-10	-9
11 000	*N*	-8	-8	-8	-7	-6	-5
8 000	-6	-5	-4	-4	-3	-3	*N*
5 000	-4	-3	-1	-1	-1	-1	*N*

An *"N"* indicates that the rotor cannot achieve the desired temperature at this speed.

[1] The k factor is based on sedimentation in water at 20° C.

[2] Beckman provides the k factors for all its rotors.

Speed Limits

The centrifugal force at a given radius in a rotor is a function of run speed. Comparisons of forces between different rotors are made by comparing the rotors' relative centrifugal fields (RCF). When rotational speed is selected so that identical samples are subjected to the same RCF in two different rotors, one may then describe the samples as having been subjected to the same force (see Table 3). Rotational speeds may not be selected in excess of the limits provided in Table 1.

When solutions more dense than 1.2 g/mL are centrifuged in this rotor, use equation (5) to calculate the reduced maximum allowable rotor speed.

$$\text{reduced maximum speed} = (13\,000\ \text{rpm}) \sqrt{\frac{1.2\ \text{g/mL}}{\text{density of tube contents}}} \qquad (5)$$

MAINTENANCE

Routinely apply Spinkote to the centrifuge drive spindle to prevent the rotor from sticking. Do not use sharp tools on the rotor, since corrosion begins in scratches and may open fissures in the metal with increased use. If the rotor has been scratched by broken glass tubes or metal tubes, ask your local Beckman office about having the rotor reanodized. To prevent corrosion, store the rotor upside down with the lid off. Buckets should also be stored upside down. Do not store the rotor in the centrifuge. See publication IN-175, *Chemical Resistance Table,* to evaluate your rotor's ability to withstand a given chemical solution.

INSPECTION

Periodically inspect the rotor (especially inside the buckets) for rough spots, pitting, white powder deposits (frequently aluminum oxide), or heavy discoloration. If any of these signs are evident, *do not run the rotor.* Show it to your Beckman Field Service Representative. Your Beckman Representative provides contact with both the Field Rotor Inspection Program and with a rotor repair program.

If the plastic edge strip around the top edge of the rotor body should become worn or lost, it may be replaced with one of the extra strips that accompany the rotor. These strips vary in length and must be trimmed to fit.

Relative Centrifugal Fields. Entries are calculated from the formula RCF - 1.12 r (RPM/1000)^2. Numbers in the table are approximations (to three significant digits).

Rotor Speed (rpm)	Relative Centrifugal Field (x *g*)		
	At r_{max} (140 mm)	At r_{av} (91 mm)	At r_{min} (41 mm)
13 000	26 500	17 200	7 760
12 500	24 500	15 900	7 170
12 000	22 600	14 700	6 610
11 500	20 700	13 500	6 070
11 000	19 000	12 300	5 560
10 500	17 300	11 200	5 060
10 000	15 700	10 200	4 590
9 500	14 200	9 200	4 140
9 000	12 700	8 260	3 720
8 500	11 300	7 360	3 320
8 000	10 000	6 520	2 940
7 500	8 820	5 730	2 580
7 000	7 680	4 990	2 250
6 500	6 620	4 310	1 940
6 000	5 640	3 670	1 650
5 500	4 740	3 080	1 390
5 000	3 920	2 550	1 150
4 500	3 180	2 060	929
4 000	2 510	1 630	734
3 500	1 920	1 250	562
3 000	1 410	917	413
2 500	980	637	287
2 000	627	407	183
1 500	352	229	103
1 000	156	101	45

CLEANING

Under normal use the rotor should be washed at least once a week. Wash the rotor immediately after use if you have run salt solutions or other corrosive materials, or if spillage has occurred. Do not allow corrosive solutions to dry on the rotor. Most laboratory detergents are too harsh for use on aluminum rotors because they attack the anodized surface. Beckman has prepared a detergent (Solution 555™) for use with all rotors and rotor accessories (purchase the Rotor Cleaning Kit). Solution 555 should be diluted 5 or 10 to 1 with water. Rinse a cleaned rotor with distilled water and air-dry both rotor and buckets upside down. DO NOT use acetone to dry the rotor.

A rotor (and/or accessories) contaminated with radioactive material should be decontaminated using a solution that will not damage its anodized surface. Beckman has tested a number of solutions and found two which do not harm anodized aluminum: RAD-CON (Nuclear Associates, Carle Place, New York 11514) and RADIACWASH (Atomic Products Corp., Center Moriches, New York 11934). Beckman does not, however, warrant the performance of these products with respect to their effect on the rotors (and/or accessories) or their ability to decontaminate these parts.

CAUTION

Strongly alkaline solutions will damage the rotor.

STERILIZATION

Sterilize all rotor components by autoclaving at 121°C for one hour (autoclave the rotor and the buckets upside down with the lid off). *Do not* autoclave the nylon edging around the rotor windshield—remove the nylon before autoclaving the rotor. Rotor components may be disinfected with 70% ethanol.[3] Tubes, adapters, and the nylon trim may be sterilized using cold methods.

SUPPLY LIST

REPLACEMENT ROTOR PARTS

Lid assembly	346964
Bucket set	346976
Lifting handle	346965
Plastic windshield trim	346979

SUPPLIES

Bottles, tubes, adapters	see Table 1
Rotor Cleaning Kit	339558
Silicone vacuum grease	335148
Spinkote™ lubricant	306812

[3] Flammability hazard. Do not use in or near operating centrifuges.