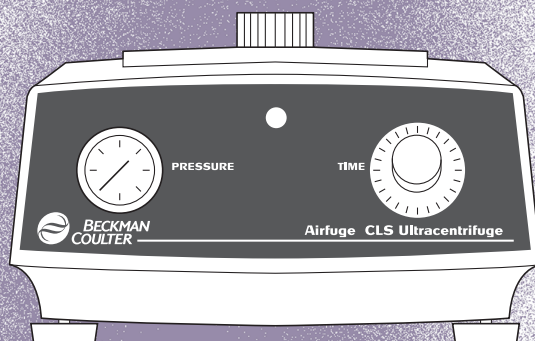


Airfuge®

Air-Driven Ultracentrifuge



Instruction Manual

Symbol Symbol Symbole Símbolo	Simbolo 記号 符号	Title / Titel / Titre / Titolo / Titolo / 名称 / 名称
		Dangerous voltage Gefährliche elektrische Spannung Courant haute tension Voltaje peligroso Pericolo: alta tensione 危険電圧 危险电压
		Attention, consult accompanying documents Achtung! Begleitpapiere beachten! Attention, consulter les documents joints Atención, consulte los documentos adjuntos Attenzione: consultare le informazioni allegate 注意、添付資料を参照のこと 注意，请参阅附带的文件
		On (power) Ein (Netzverbindung) Marche (mise sous tension) Encendido Acceso (sotto tensione) 入（電源） 开（电源）
		Off (power) Aus (Netzverbindung) Arrêt (mise hors tension) Apagado Spento (fuori tensione) 切（電源） 关（电源）
		Protective earth (ground) Schutzleiteranschluß Liaison à la terre Puesta a tierra de protección Collegamento di protezione a terra 保護アース（接地） 保护接地
		Earth (ground) Erde Terre Tierra Scarica a terra アース（接地） 接地



SAFETY NOTICE

This safety notice summarizes information basic to the safe operation of the equipment described in this manual. The international symbol displayed above is a reminder that all safety instructions should be read and understood before installation, operation, maintenance, or repair of this instrument. When you see the symbol on other pages, pay special attention to the safety information presented. Observance of safety precautions will also help to avoid actions that could damage or adversely affect the performance of the equipment.

Safety During Installation and/or Maintenance

Locate the ultracentrifuge in a clean, safe, uncluttered environment.

Any servicing of this equipment that requires removal of any covers can expose parts which involve the risk of electric shock or personal injury. Make sure that the power switch is off and the ultracentrifuge is disconnected from the main power source, and refer such servicing to qualified personnel.

Do not replace any ultracentrifuge components with parts not specified for use on this instrument.

Electrical Safety

To reduce the risk of electrical shock, this instrument uses a three-wire electrical cord and plug to connect this equipment to earth-ground. To preserve this safety feature:

- Make sure that the matching wall outlet receptacle is properly wired and earth-grounded. Check that the line voltage agrees with the voltage listed on the name-rating plate affixed to the instrument.
- Never use a three-to-two wire plug adapter.
- Never use a two-wire extension cord or a two-wire non-grounding type of multiple-outlet receptacle strip.

Do not place containers holding liquid on or near the chamber door. If they spill, liquid may get into the instrument and damage electrical or mechanical components.

Safety Against Risk of Fire

Fuses protect certain electrical circuits within this instrument against overcurrent conditions. For continued protection against the risk of fire, replace only with the same type and rating specified.

This instrument is not designed for use with materials capable of developing flammable or explosive vapors. Do not centrifuge such materials (such as chloroform or ethyl alcohol) in this instrument nor handle or store them within the required 30-cm (1-ft) area surrounding the ultracentrifuge.

Mechanical Safety

For safe operation of the equipment, observe the following:

- Use only the rotors and accessories designed for use in this ultracentrifuge.
- Never operate the instrument without a rotor cap or lid installed on the rotor.
- Do not exceed the maximum rated speed of the rotor in use.
- NEVER attempt to slow or stop the rotor by hand.
- Do not lift or move the ultracentrifuge while the rotor is spinning.
- NEVER open the chamber door while the rotor is spinning. The instrument has a protective window to allow safe observation of rotor motion.
- Maintain a 7.6-cm (3-in.) clearance envelope around the ultracentrifuge while it is running. During operation you should come within the envelope only to adjust instrument controls, if necessary. Never bring any flammable substances within the 30-cm (1-ft) area surrounding the ultracentrifuge. Never lean on the instrument or place items on the ultracentrifuge while it is operating.

Chemical and Biological Safety

Normal operation may involve the use of solutions and test samples that are pathogenic, toxic, or radioactive. Such materials should not be used in this ultracentrifuge, however, unless *all necessary safety precautions are taken*.

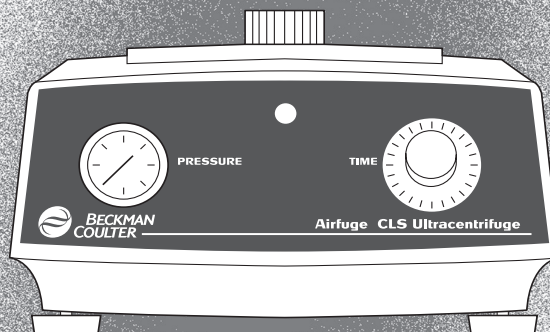
- Observe all cautionary information printed on the original solution containers prior to their use.
- Handle body fluids with care because they can transmit disease. No known test offers complete assurance that they are free of micro-organisms. Some of the most virulent—Hepatitis (B and C) and HIV (I–V) viruses, atypical mycobacteria, and certain systemic fungi—further emphasize the need for aerosol protection. Handle other infectious samples according to good laboratory procedures and methods to prevent spread of disease. Because spills may generate aerosols, observe proper safety precautions for aerosol containment. Do not run toxic, pathogenic, or radioactive materials in this instrument without taking appropriate safety precautions. Biosafe containment should be used when Risk Group II materials (as identified in the World Health Organization *Laboratory Biosafety Manual*) are handled; materials of a higher group require more than one level of protection.
- Dispose of all waste solutions according to appropriate environmental health and safety guidelines.

It is your responsibility to decontaminate the instrument and accessories before requesting service by a Beckman Coulter representative.



Airfuge®

Air-Driven Ultracentrifuge



Instruction Manual

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CERTIFICATION

To ensure full system quality, Beckman Coulter Airfuge® ultracentrifuges are manufactured in a registered ISO 9001 or 13485 facility. They have been designed and tested to be compliant (when used with Beckman Coulter rotors) with the laboratory equipment requirements of applicable regulatory agencies. Declarations of conformity and certificates of compliance are available at www.beckmancoulter.com.

SCOPE OF MANUAL

This manual is designed to familiarize you with the Airfuge ultracentrifuge, its functions, specifications, operation, and routine operator care and maintenance. We recommend that you read this entire manual, especially the SAFETY NOTICE and all safety-related information, before operating the ultracentrifuge or performing instrument maintenance.

- Section 1 contains system specifications and a brief physical and functional description of the ultracentrifuge, including the operating controls and indicators.
- Section 2 provides information about space and power requirements for installing and connecting the ultracentrifuge.
- Section 3 contains ultracentrifuge operating procedures.
- Section 4 lists possible malfunctions, together with probable causes and suggested corrective actions.
- Section 5 contains procedures for routine operator care and maintenance, as well as a brief list of supplies and replacement parts.

 NOTE

If the ultracentrifuge is used in a manner other than specified in this manual, the safety and performance of this equipment could be impaired. Further, the use of any equipment other than that recommended by Beckman Coulter has not been evaluated for safety. Use of any equipment not specifically recommended in this manual and/or the appropriate rotor manual is the sole responsibility of the user.

CONVENTIONS

Certain symbols are used in this manual to call out safety-related and other important information. These international symbols may also be displayed on the ultracentrifuge and are reproduced and described below and on the inside of the front cover.

NOTES, CAUTIONS, AND WARNINGS

 NOTE

Used to call attention to important information that should be followed during installation, use, or servicing of this equipment.



CAUTION

Used to indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury and/or mechanical damage. It is also used to alert against unsafe practices.

**WARNING**

Used whenever an action or condition may potentially cause personal injury or loss of life. Mechanical damage may also result.

**WARNING**

Indicates high voltage or risk of electric shock. Refer servicing of all areas displaying either symbol to service personnel.

CFC-FREE CENTRIFUGATION



To ensure minimal environmental impact, no CFCs are used in the manufacture or operation of Airfuge ultracentrifuges.

RADIO INTERFERENCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference, in which case the user will be required to correct the interference at his own expense.

CANADIAN REGULATIONS

This equipment does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe A prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

RECYCLING LABEL



Note: On the instrument, the triangle background is yellow rather than gray.

This symbol is required in accordance with the Waste Electrical and Electronic Equipment (WEEE) Directive of the European Union. The presence of this marking on the product indicates:

- 1) the device was put on the European market after August 13, 2005 and
- 2) the device is not to be disposed via the municipal waste collection system of any member state of the European Union.

It is very important that customers understand and follow all laws regarding the proper decontamination and safe disposal of electrical equipment. For Beckman Coulter products bearing this label please contact your dealer or local Beckman Coulter office for details on the take back program that will facilitate the proper collection, treatment, recovery, recycling and safe disposal of the device.



FUNCTIONAL DESCRIPTION

The Beckman Coulter Airfuge® (see Figure 1-1) is a benchtop air-driven ultracentrifuge capable of accelerating rotors up to 110 000 rpm (revolutions per minute) in as little as 30 seconds. The instrument uses no vacuum or high-speed bearings; the rotor is supported and turned by streams of air. Rotor speed can be determined by conversion of the applied air pressure, as displayed on the PRESSURE gauge, to rpm.¹

An available Digital Speed Readout Accessory (347592), which attaches to the top of the chamber door, continuously displays actual rotor speed. Installation and use of the accessory are described in publication AF-TB-013.

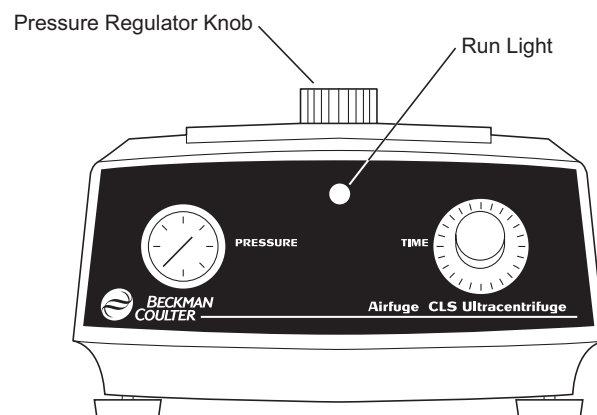


Figure 1-1. The Airfuge Ultracentrifuge

¹ This conversion is different for each type of rotor (see the graph in the applicable rotor manual).

SAFETY FEATURES

The Airfuge ultracentrifuge has been designed and tested to operate safely indoors at altitudes up to 2 000 m (6 562 ft).

The Airfuge is an exceptionally safe ultracentrifuge because the rotor is held in place by a pressure differential created during centrifugation. An air pressure limitation of 35 psig (240 kPa) is factory set. However, do not operate the instrument at more than 30 psig (207 kPa).

CONTROLS AND INDICATORS

PRESSURE REGULATOR KNOB

The pressure regulator knob controls the driving air pressure. Pressing down on the knob and turning to the right (clockwise) closes the door. Turning the knob further brings up the air pressure and accelerates the rotor to speed.

PRESSURE GAUGE

Operating air pressure is displayed on this gauge. Recommended operating air pressure is 30 psig (207 kPa).

RUN LIGHT

The run light comes on when the timer is set and remains lit until the braking system is engaged.

TIME-DELAY KNOB

This knob, located on the ultracentrifuge bottom panel (see Figure 1-2), is used to set a time-delay period that allows the rotor to coast after the timer reaches zero at the end of a run. The run light goes out and a brake pin is released at the end of the set delay period. A setting of 120 seconds on the knob (or about 3.5 on older instruments) represents the 2-minute delay period.

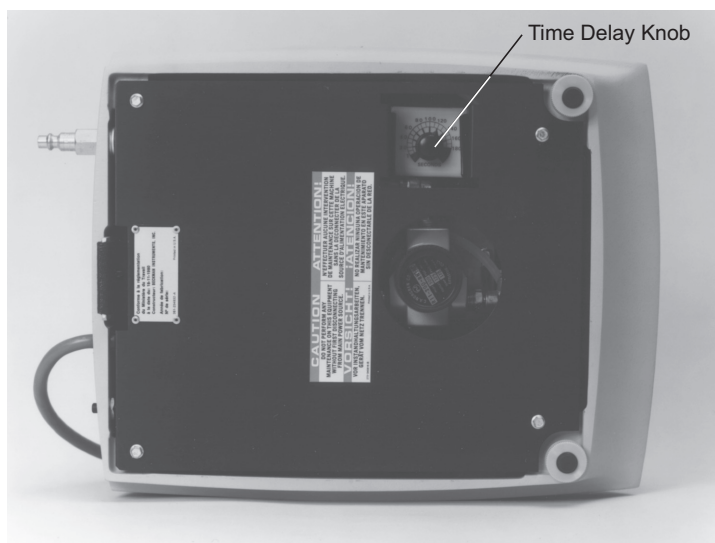


Figure 1-2. Bottom Panel

BRAKE TENSION SCREW

The brake spring wire (see Figure 1-3) forces the brake pin up into the rotor bottom during braking. Occasional adjustment of the spring tension, using the BRAKE TENSION adjusting screw located on the back panel (see Figure 1-4), may be necessary.

LEVITATION AIR SCREW

When the timer reaches zero at the end of a run, the driving air is turned off and levitation air supports the rotor during its deceleration. If the flow of levitation air is too high and the rotor fails to stop completely, or too low and the rotor stops too fast, adjustment of the LEVITATION AIR screw located on the rear panel may be necessary.

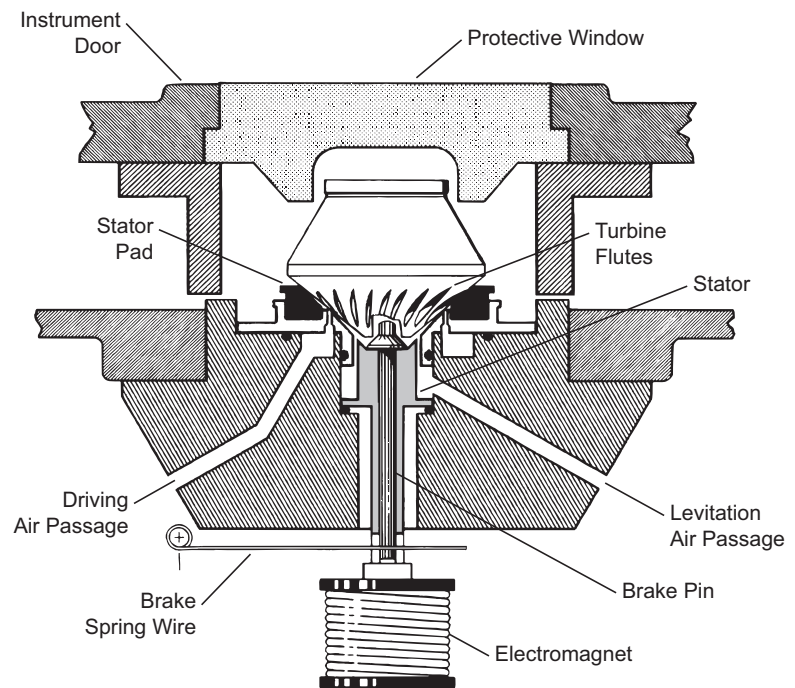


Figure 1-3. Cross-section View of the Airfuge



Figure 1-4. Rear View

CHAMBER COMPONENTS

STATOR

The brass stator (see Figure 1-3) contains the driving air jets that control the rotor speed and the air jets that levitate the rotor during deceleration. Levitation air operates automatically during deceleration.

STATOR PAD

The black stator pad (see Figure 1-5) rests on the channel of the stator and cushions the rotor during a run and when the rotor is at rest.



Figure 1-5. Airfuge Components and Accessories

BRAKE PIN

Braking action is provided by a movable brake pin (see Figure 1-5) set vertically on a spring in the shaft of the stator (see Figure 1-3). An electromagnet holds the pin down during a run and releases it 2 minutes after the timer reaches zero. When released, the pin engages the rotor bottom, stabilizing the rotor as it gradually decelerates to a stop.

DOOR LATCH

The door-latch mechanism secures the door during centrifugation. This prevents premature door opening, which would result in damage to the rotor and stator pad.

FILTER

A filter is supplied with the ultracentrifuge for water and oil removal from the air supply. The filter element turns red when it is saturated and needs to be replaced.

NAME RATING PLATE

A name rating plate is affixed to the rear of the instrument. Always mention the serial number and model number when contacting Beckman Coulter regarding your Airfuge ultracentrifuge.

SPECIFICATIONS

Only values with tolerances or limits are guaranteed data. Values without tolerances are informative data, without guarantee.

Speed range	80 000 to 110 000 (±5 000) rpm
Maximum relative centrifugal field*	199 000 × g
Air pressure:	
Air pressure at ultracentrifuge for	
routine operation	30 psig (207 kPa)
Air pressure at filter for routine operation	42 psig (290 kPa)
Air pressure drop across filter	12 psig (83 kPa)
Maximum air pressure at ultracentrifuge	75 psig (517 kPa)
Minimum air pressure at ultracentrifuge	
for operation	20 psig (138 kPa) [†]
Maximum air flow rate at 30 psig (207 kPa)	0.0015 m ³ /s (3.5 cfm)
Time	to 5 hours in 5-minute increments
.	or continuous (hold)
Approximate acceleration time	30 to 60 seconds
Approximate deceleration time	2 1/2 to 5 1/2 minutes
Rotor temperature	rotor temperature is always a few degrees above
.	ambient temperature; the instrument can be run
.	in a cold room for lower temperatures
Dimensions	
Width	28 cm (11 in.)
Depth	38 cm (15 in.)
Height	20 cm (8 in.)
Weight	10.4 kg (23 lb)
Finishes	
Control panel	coated polycarbonate
Top surface	urethane paint
Other surfaces	general purpose paint
Electrical requirements	
60-Hz instrument	120 VAC
50-Hz instrument	100 or 220–240 VAC
Electrical supply	Class I
Installation (overvoltage) category	II
Pollution degree	2 [‡]

* 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:

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

where r is the radius in millimeters, ω is the angular velocity in radians per second ($2\pi \text{ RPM} / 60$), and g is the standard acceleration of gravity (9807 mm/s^2). After substitution:

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

[†] Instrument operation at gauge pressures below 20 psig (138 kPa) may cause rotor instability.

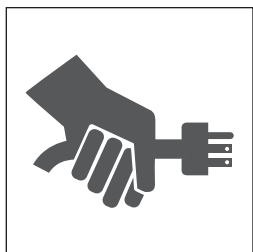
[‡] Normally only nonconductive pollution occurs; occasionally, however, a temporary conductivity caused by condensation must be expected.

AVAILABLE ROTORS

Airfuge rotors are made of anodized aluminum and have turbine flutes on the bottom that provide the driving surface for the jets of air. Pressurized air impinges on the rotor bottom and lifts and turns the rotor. A white plastic bushing fitted in the rotor bottom is engaged by the brake pin during braking.

Rotors are designed to meet specific needs. Detailed information about each rotor is contained in the applicable rotor manual.

- The A-110 fixed angle rotor holds up to six 180- μ L tubes at a tube angle of 18 degrees from the axis of rotation, and is ideal for the rapid separation of small sample volumes in a very short time. Maximum operating speed is 110 000 rpm at 30 psig (207 kPa) air pressure.
- The A-100/18 fixed angle rotor holds up to six 175- μ L tubes at a tube angle of 18 degrees from the axis of rotation, and is ideal for the efficient sedimentation of small sample volumes in a very short time. Maximum operating speed is 95 000 rpm at 30 psig (207 kPa) air pressure.
- The A-100/30 fixed angle rotor holds up to six 240- μ L tubes at a tube angle of 30 degrees from the axis of rotation, and is ideal for the efficient sedimentation of small sample volumes in a very short time. Maximum operating speed is 92 000 rpm at 30 psig (207 kPa) air pressure.
- The A-95 fixed angle rotor holds up to four 450- μ L tubes at a tube angle of 30 degrees from the axis of rotation, and is ideal for the rapid separation of small sample volumes in a very short time or to isolate microsomal fractions and plasma membranes. It can also be used to clarify small volumes of lipemic serum by flotation of the chylomicrons. Maximum operating speed is 95 000 rpm at 30 psig (207 kPa) air pressure.
- The ACR-90 rotor uses 3.5-mL and 2.4-mL disposable liners, and is used to clarify lipemic serum. Serum can be clarified by a 10-minute spin at 90 000 rpm at 30 psig (207 kPa) air pressure.
- The EM-90 electron microscopy particle-counting rotor is specifically designed for sedimenting particulates from very small volumes onto supports suitable for insertion into an electron microscope. The rotor is rated for 90 000 rpm at 30 psig (207 kPa) air pressure.
- The Batch rotor can be used to pellet particles from a single large sample. Sample volumes of 2 to 7 mL can be run. The rotor is rated for 90 000 rpm at 30 psig (207 kPa) air pressure.



SPACE AND LOCATION REQUIREMENTS



WARNING

Do not place the ultracentrifuge near areas containing flammable reagents or combustible fluids. Vapors from these materials could enter the ultracentrifuge air system and be ignited by the motor. Maintain a 30-cm (1-ft) clearance envelope around the ultracentrifuge while it is running. No persons or any hazardous materials should be within this clearance boundary while the ultracentrifuge is operating except to change operating controls, if required.

- Select a location away from heat-producing laboratory equipment, with sufficient ventilation to allow for heat dissipation.
- Position the ultracentrifuge on a level surface, such as a sturdy table or laboratory bench, within 4 m (12 ft) of a supply of clean, compressed air at about 42 psig (290 kPa), but not over 75 psig (517 kPa).
- In addition to space for the ultracentrifuge itself, allow 7.6-cm (3-in.) clearances at the sides and back of the ultracentrifuge to ensure sufficient air circulation.

ELECTRICAL REQUIREMENTS

60-Hz instrument	120 VAC
50-Hz instrument	100 or 200–240 VAC

To reduce the risk of electrical shock, this ultracentrifuge uses a three-wire electrical cord and plug to connect the ultracentrifuge to earth-ground. (Contact your local Beckman Coulter office for specific information regarding local requirements.) To preserve this safety feature:

- Make sure that the matching wall outlet receptacle is properly wired and earth-grounded. Check that the line voltage agrees with the voltage listed on the name rating plate affixed to the ultracentrifuge. Then plug in both ends of the ultracentrifuge power cord.
- Never use a three-to-two wire plug adapter.
- Never use a two-wire extension cord or a two-wire non-grounding type of multiple-outlet receptacle strip.
- If there is any question about voltage, have a qualified service person measure it under load while the drive is operating.

To ensure safety the ultracentrifuge should be wired to a remote emergency switch (preferably outside the room where the ultracentrifuge is housed, or adjacent to the exit from that room), in order to disconnect the ultracentrifuge from the main power source in case of a malfunction.

INSTALLATION PROCEDURES

Installation of the ultracentrifuge requires the following steps—in order:

- installing the filter,
- checking the time-delay setting,
- leveling the instrument, and
- installing the brake pin and stator pad.

After installation, perform a trial run to ensure proper operation.

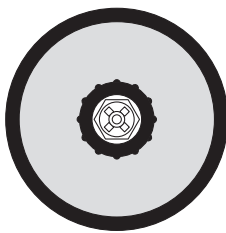
FILTER INSTALLATION

NOTE

If the air source is especially wet or oily, install a second filter as a prefilter. A second filter will cause an additional pressure drop of approximately 5 psig (35 kPa) in the air pressure that reaches the instrument.

Make sure the required operating air pressure is obtainable at the instrument PRESSURE gauge.

1. Pull back the spring-loaded sleeve of the quick-disconnect at the filter outlet and push the fitting of the quick-disconnect hose into the sleeve until they snap together (see Figure 2-1).



Filter Bottom

NOTE

Do not install the filter upside down. The filter bottom has a valve that distinguishes it from the top. Escaping air can be heard if the filter is installed upside down.

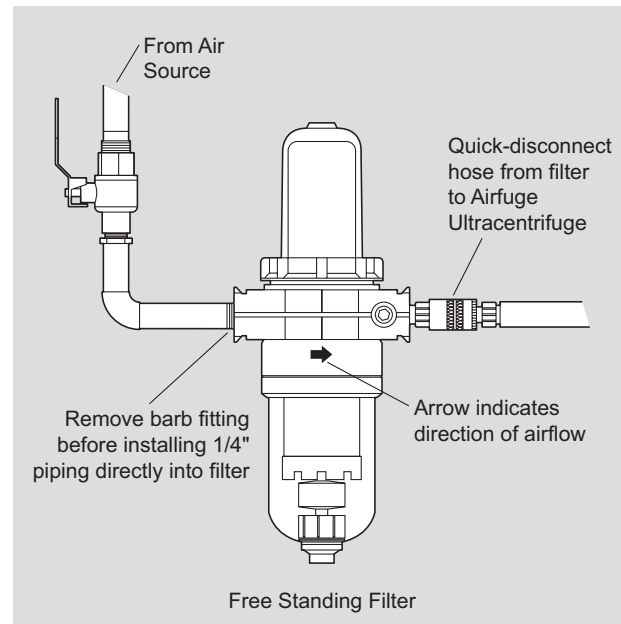
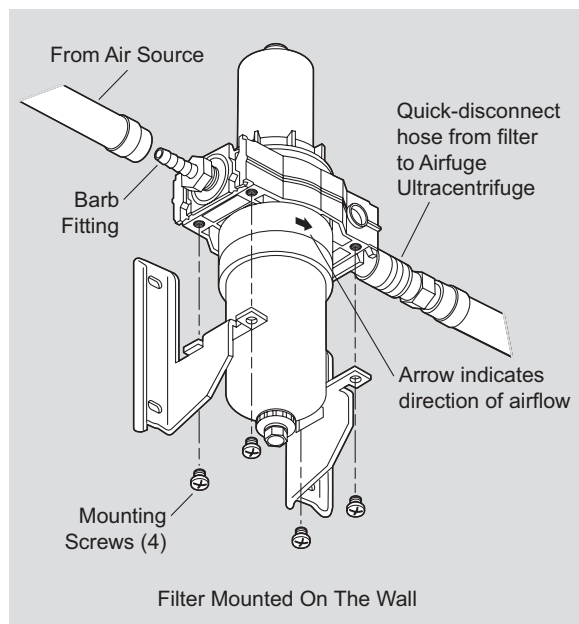


Figure 2-1. Filter Installation

2. *If non-rigid piping leads from the air source*, mount the filter on a ring stand or on the wall. Clamp the filter to a ring stand, or use the supplied mounting brackets (see Figure 2-1) to mount the filter to the wall. Attach the brackets to the assembled filter with the mounting screws, then attach the brackets to the wall. The air flow arrow *must* point toward the ultracentrifuge. Add hose clamps to the plain high-pressure hose. Clamp one end of the hose to the barb fitting of the filter inlet and one end to the air source.

If rigid piping (standard 1/4-in. pipe thread) leads from the air source, the filter can be free-standing. Remove the barb fitting from the filter inlet to the air source. The air flow arrow *must* point toward the ultracentrifuge.

3. Connect the quick-disconnect hose to the fitting at the rear of the instrument. Place a beaker or other container under the filter to collect water and oil.

If the air source does not supply sufficient air pressure to close the filter's automatic drain valve you will hear air escaping from the filter. Routine operation at 30 psig (207 kPa) on the instrument PRESSURE gauge requires 290 kPa (42 psig) air pressure supplied to the filter.

TIME-DELAY SETTING CHECK

The time-delay knob (on the ultracentrifuge bottom plate) is factory set for a 2-minute delay period. Make sure that the knob is still set at about 120 seconds (or 3.5 on older instruments).

LEVELING THE AIRFUGE

The Airfuge must be leveled before use.

1. Place the supplied liquid level on the center of the stator.
2. Adjust the instrument front feet until the bubble of the level is centered.

INSTALLING THE BRAKE PIN AND STATOR PAD

1. Place the brake pin in the hole at the center of the stator (see Figure 2-2). Make sure that the slot in the pin bottom straddles the brake spring wire as shown in the figure.
2. Lightly touch the pin. It should bounce back freely to about 3 mm ($\frac{1}{8}$ in.) above the stator. If the pin is too high (approximately 6 mm above the stator), gently turn the pin so that it drops down to straddle the spring wire.
3. Install the black ring-shaped stator pad in the channel of the stator.

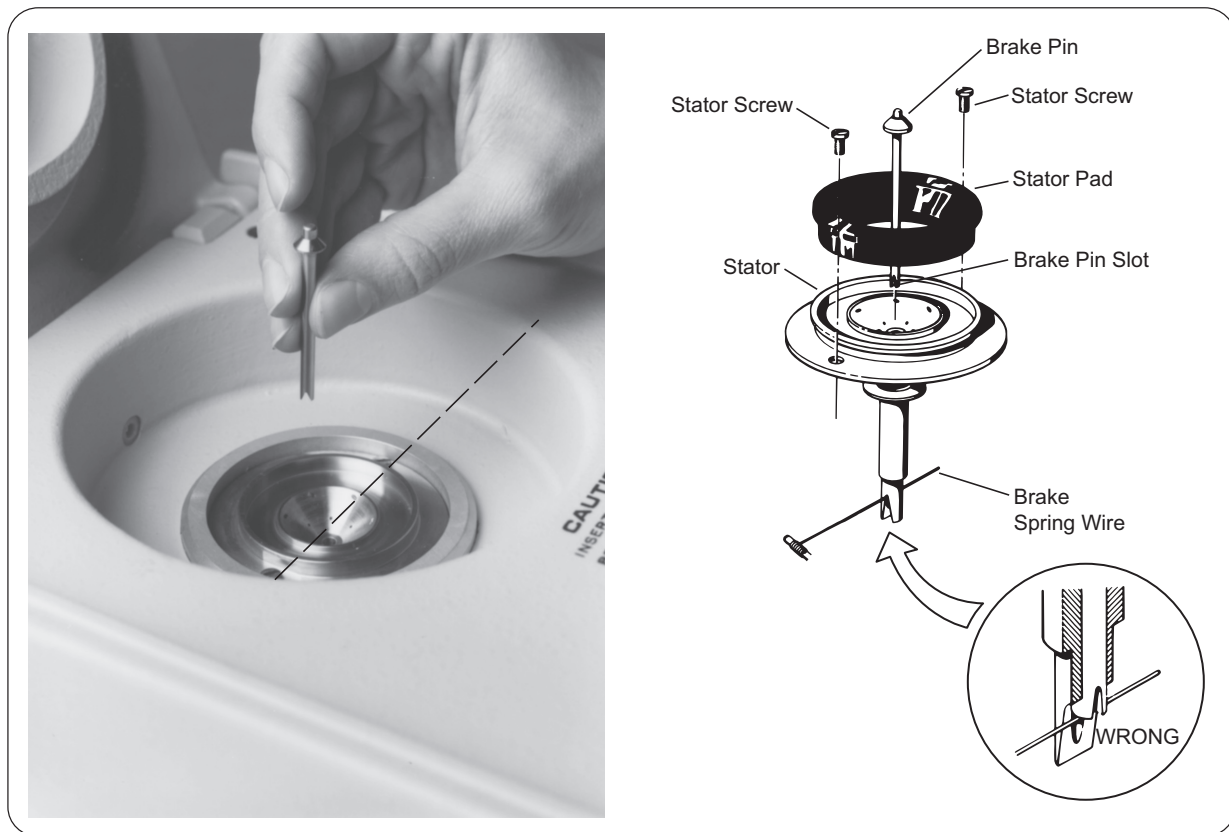


Figure 2-2. Aligning the Brake Pin in the Stator. The slot on the end of the pin straddles the brake spring wire. The broken line shows the wire direction (aligned with the screws). If the tip of the pin slot stands on the wire instead of straddling it, the pin will be too high above the stator.

TRIAL RUN

When installation is complete, perform a trial run to confirm proper ultracentrifuge operation. Refer to Section 3 for operating instructions. Time the rotor deceleration as follows.

1. After the rotor runs for a few minutes, turn the TIME dial to zero and begin timing. The run light should go out approximately 2 minutes after the TIME dial is turned off.
2. Observe rotor motion through the window. Fixed angle rotors should stop within about 2 minutes after the run light goes out. Other rotors should stop within about 3-1/2 minutes.

NOTE

If a fixed angle rotor stops in less than 45 seconds, sample stirring may result; adjust the brake or levitation air to provide a longer stopping time. If a rotor takes too long to stop, the brake, pin tension, or levitation air needs adjusting. See Section 5 for adjustment procedures.

COLD ROOM INSTALLATION

If rotor temperatures below room temperature are required, the Airfuge can be operated in a cold room. A typical cold room set-up is shown in Figure 2-3. In addition to the installation procedures above, the following variations are required.

- Because large amounts of water may condense in the airstream as it passes through the lower temperatures of the cold room, a second filter is required to remove the additional water. Install the second filter as close as possible to the ultracentrifuge. The maximum distance between the filter and the instrument should be 0.6 m (2 ft).
- The second filter will cause a pressure drop of about 5 psig (35 kPa) in the air pressure that reaches the instrument. Make sure that the required operating air pressure is obtainable at the instrument pressure gauge.

- Approximately 3 m (10 ft) of finned copper tubing ($3/8$ -in. ID recommended) must be added to the air supply line (see Figure 2-3) to allow the air to cool to cold-room temperature.
- The operating temperature of the instrument will be a few degrees higher than the cold-room temperature; the rotor will typically be operating at approximately 8 to 10°C.

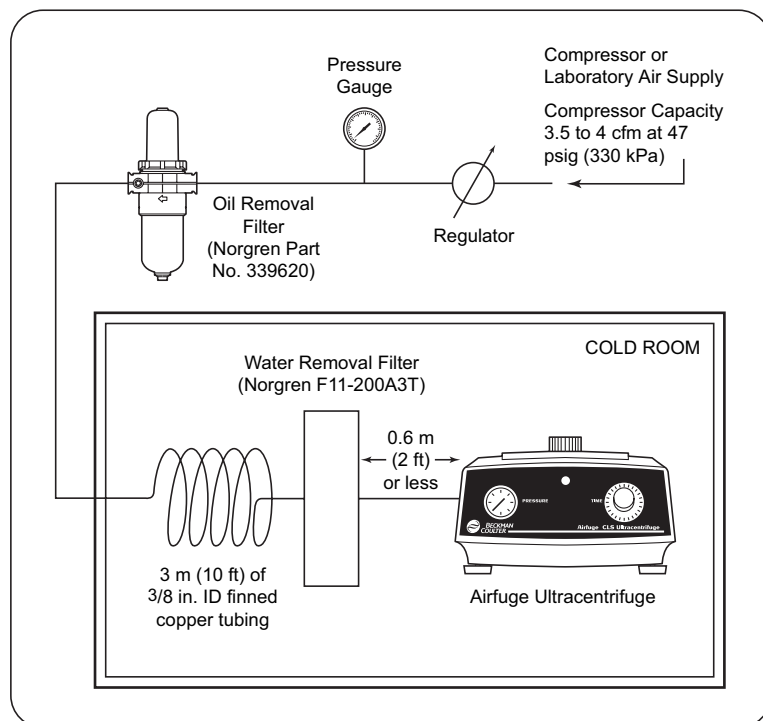
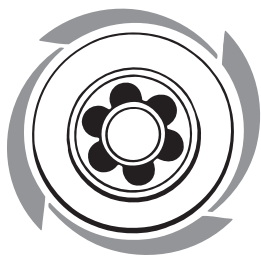


Figure 2-3. Cold Room Set-up



Refer to individual rotor manuals for detailed information on each rotor.



WARNING

Normal operation may involve the use of solutions and test samples that are pathogenic, toxic, or radioactive. Handle body fluids with care because they can transmit disease. No known test offers complete assurance that they are free of micro-organisms. Some of the most virulent—Hepatitis (B and C) and HIV (I–V) viruses, atypical mycobacteria, and certain systemic fungi—further emphasize the need for aerosol protection. Handle other infectious samples according to good laboratory procedures and methods to prevent spread of disease. Because spills may generate aerosols, observe proper safety precautions for aerosol containment. Do not run toxic, pathogenic, or radioactive materials in this ultracentrifuge without taking appropriate safety precautions. Biosafe containment should be used when Risk Group II materials (as identified in the World Health Organization *Laboratory Biosafety Manual*) are handled; materials of a higher group require more than one level of protection.



WARNING

Do not use the ultracentrifuge in the vicinity of flammable liquids or vapors, and do not run such materials in the instrument. Do not lean on the instrument or place items on it while it is operating.

STARTING THE RUN

1. Connect the power cord and turn the air supply on.



CAUTION

Never operate the ultracentrifuge without a rotor cap or lid installed on the rotor.

2. Load the rotor and secure the rotor lid or cap as described in the applicable rotor manual. Tubes should be symmetrically loaded in a fixed angle rotor; rotor liners should be full and evenly seated in their rotor base.



NOTE

If you are using an Airfuge with the digital speed readout accessory installed, use a flat black marker to color half of the rotor lid or cap flat black. If the black surface is shiny, inaccurate speed readings will be displayed.

3. Lightly touch the brake pin to be sure it operates freely.
4. Check the stator pad; it must be clean and in good condition. A worn stator pad is smooth and shiny on the inside surface (see Figure 3-1). Replace a worn stator pad.



NOTE

Stator pads—especially the white circles on the bottom—should be kept clean with alcohol.

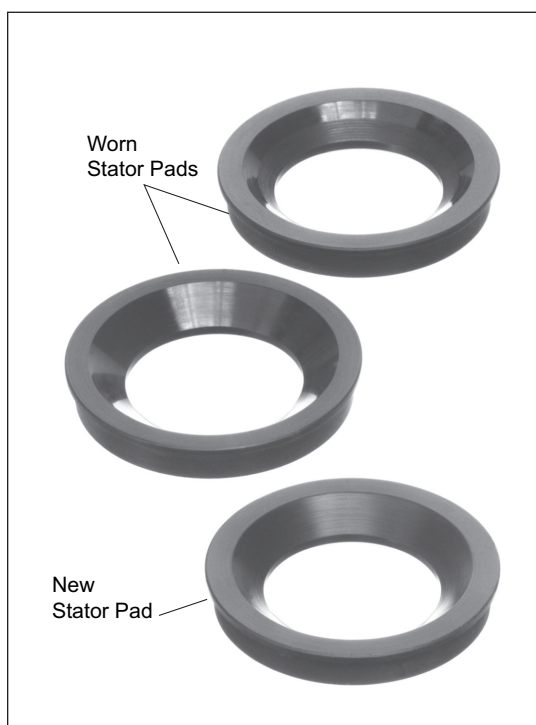


Figure 3-1. Worn and New Stator Pads

5. Place the rotor on the stator pad and shut the instrument door.
6. Set the TIME dial for the required run time. The dial indicates up to 5 hours of run time in 5-minute increments. (In some models, the dial indicates 5 minutes of run time in 5-second increments.) For longer runs, set the timer to HOLD. For runs shorter than 30 minutes, turn the dial past the 30-minute point, then back to the required time. (*ACR-90 rotor*—set the run time for 10 minutes to prevent significant evaporative loss.)
7. Secure the instrument door by turning the pressure regulator knob to the right (clockwise), pushing down, until the air pressure indicated on the PRESSURE gauge brings the rotor to the required speed. Optimal run speed is achieved at 30 psig (207 kPa). (This is the only recommended operating air pressure for the *ACR-90 rotor*.) Note that some low-speed rotor vibration is normal at the beginning of the run.



CAUTION

If the rotor makes an unusual noise, turn the timer to zero. When the rotor stops, open the chamber door and remove the rotor. Check to make sure the rotor is loaded correctly. Correct the problem before restarting the run (see Table 4-1).

ENDING THE RUN

1. When the timer reaches or is turned to zero, the rotor will coast for about 2 minutes. After the 2-minute delay period, the run light goes out and the brake pin engages the rotor. The rotor will stop about 1 to 3 minutes later, depending on the rotor.



NOTE

If the coasting time is too short—45 seconds or less—check the time-delay relay setting and/or adjust the flow of levitation air as described in Section 5.

2. *After the rotor has stopped*, turn the pressure regulator knob to the left (counterclockwise) until the PRESSURE gauge reading is zero.
3. Open the chamber door. Refer to the applicable rotor manual for instructions on unloading and cleaning the rotor.



NOTE

Do not tighten the pressure regulator knob between runs.



Troubleshooting

This section lists possible malfunctions, together with probable causes and corrective actions. Maintenance procedures are in Section 5. For any problems not covered here, contact Beckman Coulter Field Service for assistance.

NOTE

It is your responsibility to decontaminate the instrument, as well as any rotors and/or accessories, before requesting service by Beckman Coulter Field Service representatives.

Possible malfunctions are described in Table 4-1, along with possible causes—listed in the probable order of occurrence—and corrective actions. Perform the recommended corrective action in sequence, as listed. If you are unable to correct the problem, call Beckman Coulter Field Service. To help diagnose and correct the problem, provide as much information as possible:

- Note the operating situation when the error occurred (rotor in use, speed, load type, and so forth).
- Note any unusual environmental and/or operating conditions (ambient temperature, voltage fluctuations, and so forth).
- Include any other useful information.

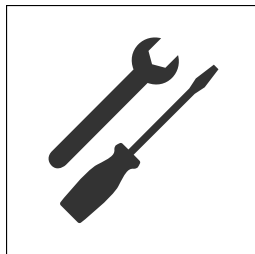
Table 4-1. Troubleshooting. If the problem persists call Beckman Coulter Field Service.

Problem	Possible Cause	Recommended Action
Brake pin falls flat on stator surface	Brake spring wire not centered	Adjust the brake spring wire.
	Brake spring tension too low	Adjust the brake spring tension.
Brake pin not actuating	Brake spring tension too low	Adjust the brake spring tension.
	Stator shaft oily	Clean the stator shaft and pin.
	Brake pin damaged	Replace the brake pin.
Rotor will not spin	Air supply or power disconnected	Check air and power connections.
	Circuit breaker tripped	Reset the circuit breaker.
	Filter saturated	Replace the filter element.
	Stator pad worn or damaged	Replace the stator pad.
	Stator screws loose	Check stator screws; tighten as required.
Rotor runs erratically or makes unusual noise	Stator pad damaged	Replace the stator pad.
	Dirty air jets	Clean the stator assembly.
	Missing or damaged rotor cap	Check the rotor cap.
	Rotor improperly loaded	Check placement of tubes or liner in rotor.
Rotor fails to stop	Brake pin shaft oily	Clean the pin and shaft.
	Levitation air flow too high	Adjust levitation air.
	Brake spring tension too low	Adjust the brake spring tension.
Rotor stops too fast	Levitation air flow too low	Adjust levitation air.
	Time-delay period too short	Check the time-delay setting.
	Stator pad worn or damaged	Replace the stator pad.
	Brake pin shaft oily	Clean the stator assembly and shaft.
	Brake malfunction	Adjust brake spring tension and levitation air.
Oil visibly collecting in instrument	Filter element saturated	Replace the filter element.
Filter element turns red	Filter element saturated	Replace the filter element.
Pressure at instrument will no longer read 30 psig	Filter element saturated	Replace the filter element.

Continued —

Table 4-1. Troubleshooting (continued)

Problem	Possible Cause	Recommended Action
Run light fails to come on	Light burned out	Replace the lamp.
	Circuit breaker tripped	Reset the circuit breaker.
	Time delay faulty	Call Beckman Coulter Field Service.
Rotor crashes	Stator pad worn	Order Repair Kit 1.
	Missing rotor lid or cap	Refer to the applicable rotor manual.
Circuit breaker trips repeatedly	Various	Call Beckman Coulter Field Service.
	 CAUTION _____ <i>Repeated tripping of the circuit breaker may cause instrument damage.</i> _____	



This section contains care and maintenance procedures that should be performed regularly. For maintenance not covered in this manual, contact Beckman Coulter Field Service for assistance. Refer to the applicable rotor manual for instructions on the care of rotors and their accessories.

INSTRUMENT CARE

NOTE

It is your responsibility to decontaminate the instrument, as well as any rotors and/or accessories, before requesting service by Beckman Coulter Field Service representatives.



WARNING

Any maintenance procedure requiring removal of a panel exposes the operator to the possibility of electrical shock and/or mechanical injury. Therefore, turn the power OFF and disconnect the instrument from the main power source, and refer such maintenance to service personnel.

GENERAL MAINTENANCE

Perform the following procedures regularly to ensure satisfactory performance and long service life of the ultracentrifuge.

- At least once a week (depending on usage) inspect the interior of the rotor chamber for accumulations of foreign matter. Clean as required (see CLEANING, below), as these accumulations can result in rotor vibrations.
- Regularly check the stator pad for ease of rotation. Rotate it on the stator, using light finger pressure, to ensure it moves easily. Also check for dirt or oil; clean with alcohol* (especially the white circles on the bottom).
- Regularly check the stator pad for wear; a worn pad is smooth and shiny on the upper half of the inside surface. A shiny pad has lost its cushioning effect and will eventually cause rotor failure. Replace a worn pad.

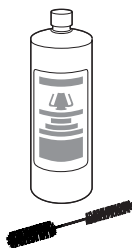
NOTE

Proper deceleration of the rotor (that is, allowing the rotor to come to a complete stop before opening the door) will increase pad life.

CLEANING

NOTE

Before using any cleaning or decontamination methods except those recommended by the manufacturer, users should check with the manufacturer that the proposed method will not damage the equipment.



Frequent cleaning will ensure proper operation and prolong the life of the ultracentrifuge. Always clean up spills when they occur to prevent corrosives or contaminants from drying on component surfaces. (Be careful not to spill liquid on the instrument where electrical or mechanical components could become damaged.) Refer to *Chemical Resistances* (publication IN-175) for chemical compatibilities of cleaning materials.

* Flammability hazard. Do not use in or near operating ultracentrifuges.

INSTRUMENT INTERIOR AND EXTERIOR

- Clean the instrument exterior surfaces by wiping with a damp cloth or washing with Beckman Solution 555™ (339555). Dilute the detergent 10 to 1 with water. Do not use acetone or other solvents.
- To prevent accumulations of sample, dust, oil, dirt, or other foreign matter, regularly wipe the channel of the stator, the air jets, and the brake pin with isopropyl alcohol.*

STATOR ASSEMBLY

Clean the stator assembly when the filter element is replaced, or if the rotor runs erratically.



WARNING

Disconnect the power cord and the air supply.

1. Disconnect the air supply at the rear of the instrument by pulling back the quick-disconnect hose sleeve. The hose may be disconnected while it is under pressure, but be careful not to damage surrounding objects.
2. Remove the stator pad and the brake pin. (Lift the pin out with a forceps.)
3. Unscrew the two stator screws, then pry the stator off, using the tools supplied. See Figures 5-1 and 5-2. Note that the slots on the stator outside rim are used to provide a leverage point for the stator tools.
4. Remove the three stator O-rings, shown in Figure 5-3. Use a pointed wooden or plastic tool to avoid scratching the stator.
5. Clean the stator, including the air jets and shaft, with acetone.*
6. Lightly coat the O-rings with silicone vacuum grease (335148) and reposition them.

* Flammability hazard. Do not use in or near operating ultracentrifuges.

7. Clean the brake pin and install it in the shaft at the center of the stator. The pin should move freely up and down in the stator shaft.
8. To reassemble the stator and pin, align the screw holes then lower the stator and pin into place. The slot on the end of the stator must straddle the brake spring in the hole as shown in Figure 5-4. (The wire direction is indicated by an imaginary line between the stator screws.) Press the stator down firmly. The brake pin will bounce up about 3 mm (1/8 in.) above the stator. Lightly touch the pin to test its motion.
9. Replace the screws. Firmly tighten the screws, alternating until both are tight.
10. Place the stator pad on the channel of the stator.
11. Reconnect the power cord.
12. To reconnect the air supply, pull back the spring-loaded sleeve of the quick-disconnect hose and push the sleeve over the fitting at the rear of the instrument.

LUBRICATION

- Periodically lubricate the threads of the pressure regulator knob with Spinkote lubricant (306812).
- Lightly coat the three stator O-rings with silicone vacuum grease (335148) when removed for stator cleaning.

FILTER ELEMENT REPLACEMENT

Expected service life of the filter element is approximately 1400 hours of run time, if the air supply is not excessively oily. Replace the element when it turns red or when there is an additional drop of about 67 kPa (10 psig) in the air pressure that reaches the Airfuge. Instructions for replacing the element are in the Filter Element Kit (878587).



Figure 5-1. Prying Up the Stator



Figure 5-2. Lifting Out the Stator.
Keep the stator level to prevent binding.

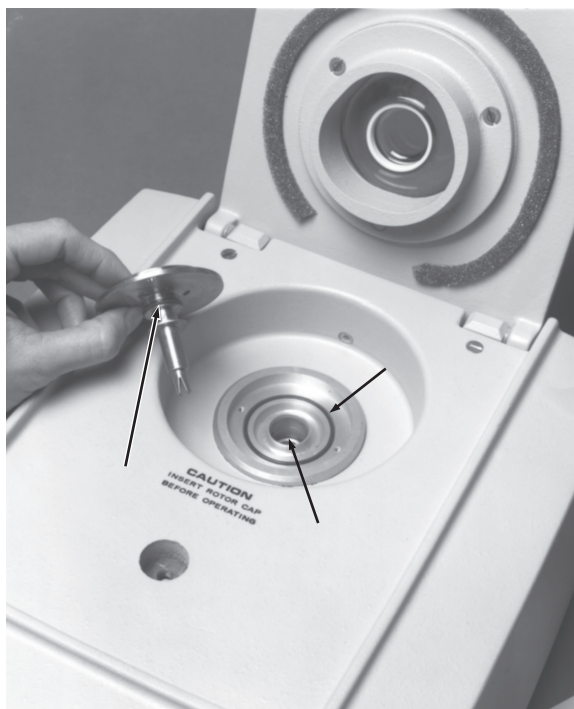


Figure 5-3. Stator O-Ring Positions

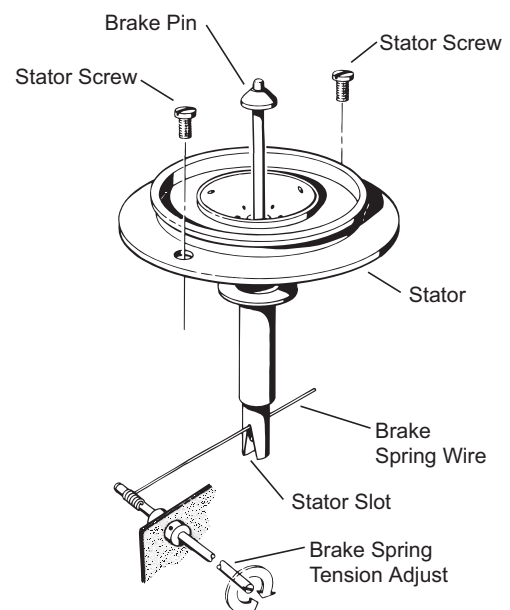


Figure 5-4. Reassembling the Stator and Pin

BRAKE SPRING WIRE ADJUSTMENT

If the brake pin is flat on the stator surface, either the brake spring wire is out of position or the brake spring tension is too low.



WARNING

Disconnect the power cord and the air supply.

1. Remove the stator pad and brake pin. Lift the pin out with a forceps.
2. Using a flashlight, look straight down the shaft in the center of the stator. The wire should extend across the center. If the wire is centered, go to BRAKE SPRING WIRE TENSION ADJUSTMENT, below. If the wire is not positioned correctly or you do not see the wire, go on to Step 3.
3. Unscrew the two stator screws, then pry the stator off, using the tools supplied. See Figures 5-1 and 5-2. Note that the slots on the stator outside rim are used to provide a leverage point for the stator tools.
4. Gently push the wire to the center, using a screwdriver blade. If the wire is too far off center to be engaged by a tool, or if it will not stay centered, reposition it as follows:



WARNING

Any maintenance procedure requiring removal of a panel exposes the operator to the possibility of electrical shock and/or mechanical injury. Therefore, disconnect the power cord and the air supply, and refer such maintenance to trained and qualified service personnel.

- a. Ensure that the power cord and air supply are disconnected, then turn the instrument on its side and remove the bottom plate.
- b. Position the wire from underneath (see Figure 5-5) so that it extends across the center of the hole. It may be necessary to raise the stator slightly so the wire can pass between the stator and the electromagnet (buzzer). Check the position of the wire by looking down the hole from the top.
- c. Replace the bottom plate. Turn the instrument upright.

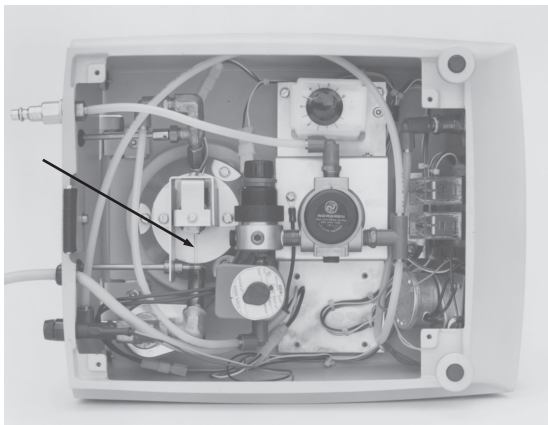


Figure 5-5. Location of the Brake Spring Wire from the Ultracentrifuge Bottom

5. Reinstall the stator and brake pin as described under CLEANING, (Steps 8 through 11 of STATOR ASSEMBLY), above.

BRAKE SPRING WIRE TENSION ADJUSTMENT

If the brake spring wire is centered but the brake pin drops flat on the stator, the brake spring wire tension requires adjustment. Adjustment may also be required if the rotor fails to stop.

1. Remove the brake pin and clean it with alcohol, then reinstall it.
2. Turn the BRAKE TENSION screw (see Figure 5-6) clockwise (decrease), as viewed from the instrument back, until the brake pin drops to the stator surface.
3. Turn the screw counterclockwise (increase) one-quarter to one-half turn until the brake pin pops up to its 3-mm (1/8-in.) position above the stator. (The adjusting screw will turn slightly less than one full revolution from the fully decreased position.) Stop turning the screw as soon as the brake pin pops up.
4. Lightly touch the pin. If it bounces freely, the brake is in operating condition. If the pin motion is sticky, remove it and clean the pin and shaft with alcohol.



Figure 5-6. Location of Rear Controls

LEVITATION AIR ADJUSTMENT

If the rotor fails to stop completely or stops too fast, the levitation air flow may require adjustment.

NOTE

Refer to publication AF-TB-013 for levitation air adjustment procedures on an instrument equipped with a digital speed readout accessory.

1. Remove the stator pad and clean it with alcohol,* especially the white circles on the bottom. Place it on the channel of the stator.
2. Turn the timer on, then back to zero. This will engage the braking system and hold the brake pin down for 2 minutes while you complete this adjustment.
3. Place a rotor on the stator pad. Be sure rotor caps or lids are properly installed. (The rotor does not need to be loaded.)
4. Close the Airfuge door and turn the pressure regulator knob on the door clockwise until the PRESSURE gauge indicates 30 psig (207 kPa). The rotor will wobble.
5. Turn the LEVITATION AIR screw on the back panel (see Figure 5-6) clockwise (decrease) until the rotor stops wobbling. Then turn the screw slowly counterclockwise (increase) until the rotor wobbles slightly. Note the position of the screw, then turn it

* Flammability hazard. Do not use in or near operating ultracentrifuges.

one-quarter turn further counterclockwise. The rotor will be wobbling and may be turning in either direction. Leave the LEVITATION AIR screw at this setting; this is the correct adjustment.

6. Turn the pressure regulator knob counterclockwise and open the door. Remove the rotor.

At the end of the 2-minute period, the run light will go out and a clicking sound can be heard when the brake pin is released.

TIME-DELAY PERIOD ADJUSTMENT

The delay period between the time the timer reaches zero and the run light goes out may be lengthened or shortened, using the time-delay knob on the instrument bottom (see Figure 5-7). A setting of about 120 seconds (or 3.5 on older instruments) is optimal.



WARNING

Disconnect the power cord and the air supply.

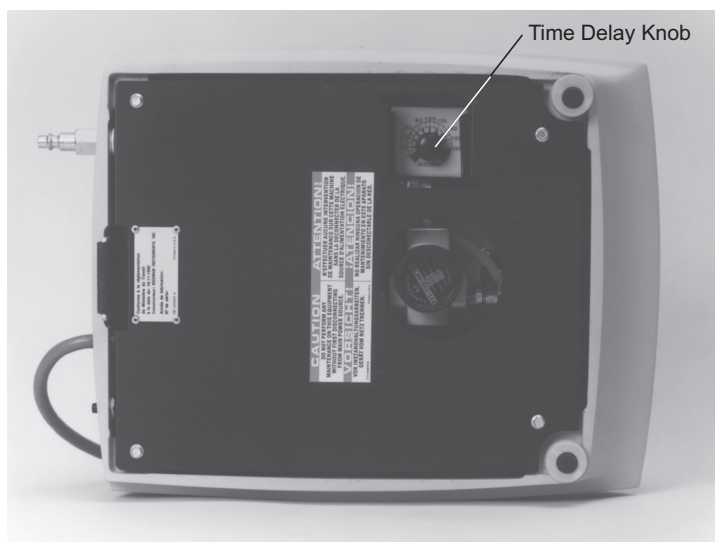


Figure 5-7. Location of Time-Delay Knob

1. Close the Airfuge door and turn the instrument on its side.
2. Turn the time-delay knob counterclockwise to shorten the delay time, or clockwise to lengthen the delay time.
3. Reconnect the power cord and the air supply and perform a trial run to check the new setting.

DECONTAMINATION



If the instrument and/or accessories are contaminated with radioactive or pathogenic solutions, follow appropriate decontamination procedures as determined by your laboratory safety officer. Refer to *Chemical Resistances* (publication IN-175) or contact Beckman Coulter Field Service to ensure that the decontamination method does not damage any part of the instrument (or accessories).

STERILIZATION AND DISINFECTION

Instrument surfaces are finished with vinyl paint, the window is made of polycarbonate, and the front panel is acrylic. Ethanol (70%)* may be used on these surfaces. See *Chemical Resistances* for more information regarding chemical resistances of instrument and accessory materials.

While Beckman Coulter has tested these methods and found that they do not damage the instrument, no guarantee of sterility or disinfection is expressed or implied. When sterilization or disinfection is a concern, consult your laboratory safety officer regarding proper methods to use.

*Flammability hazard. Do not use in or near operating ultracentrifuges.

STORAGE AND TRANSPORTATION

To ensure that the instrument does not get damaged, contact Beckman Coulter Field Service for specific instructions and/or assistance in preparing the equipment for transport or long-term storage. Temperature and humidity requirements for storage should meet the environmental requirements described under SPECIFICATIONS in Section 1 of this manual.

SUPPLY LIST

NOTE

Publications referenced in this manual can be obtained by calling Beckman Coulter at 1-800-742-2345 in the United States, or by contacting your local Beckman Coulter office.

Contact Beckman Coulter Sales (1-800-742-2345 in the United States; worldwide offices are listed on the back cover of this manual) for information about ordering parts and supplies. A partial list of supplies is given below for your convenience. See the Beckman Coulter *Ultracentrifuge Rotors, Tubes & Accessories* catalog (BR-8101, available at www.beckmancoulter.com) for detailed information on ordering rotors, tubes, and accessories.

SUPPLIES

Stator pad	339610
Stator assembly	339609
Brake pin	339611
Filter assembly	339620
Filter mounting kit.	979436
Forceps	878446
Level	874303
Stator tools (2).	339641
Filter element kit	878587
Plastic rotor bushing	339639
Digital Speed Readout Accessory (50-Hz instrument)	347592
Neon lamp for run light.	979659
Repair Kit 1	347597
Spinkote lubricant (2 oz).	306812
Silicone vacuum grease (1 oz)	335148
Beckman Solution 555 (1 qt)	339555

WARRANTY FOR THE AIRFUGE® ULTRACENTRIFUGE

Subject to the exceptions and upon the conditions specified below and the warranty clause of the Beckman Coulter terms and conditions of sale in effect at the time of sale, Beckman Coulter agrees to correct, either by repair, or, at its election, by replacement, any defects of material or workmanship which develop within one (1) year after delivery of the Airfuge Ultracentrifuge (the product) to the original Buyer by Beckman Coulter or by an authorized representative, provided that investigation and factory inspection by Beckman Coulter discloses that such defect developed under normal and proper use.

Some components and accessories by their nature are not intended to and will not function for one (1) year. If any such component or accessory fails to give reasonable service for a reasonable period of time, Beckman Coulter will repair or, at its election, replace such component or accessory. What constitutes either reasonable service and a reasonable period of time shall be determined solely by Beckman Coulter.

REPLACEMENT

Any product claimed to be defective must, if requested by Beckman Coulter, be returned to the factory, transportation charges prepaid, and will be returned to Buyer with the transportation charges collect unless the product is found to be defective, in which case Beckman Coulter will pay all transportation charges.

CONDITIONS

Beckman Coulter makes no warranty concerning products or accessories not manufactured by it. In the event of failure of any such product or accessory, Beckman Coulter will give reasonable assistance to the Buyer in obtaining from the respective manufacturer whatever adjustment is reasonable in light of the manufacturer's own warranty.

Beckman Coulter shall be released from all obligations under all warranties, either expressed or implied, if the product covered hereby is repaired or modified by persons other than its own authorized service personnel, unless such repair by others is made with the written consent of Beckman Coulter, or unless such repair is, in the sole opinion of Beckman Coulter, minor, or unless such modification is merely the installation of a new Beckman Coulter plug-in component for such product.

DISCLAIMER

IT IS EXPRESSLY AGREED THAT THE ABOVE WARRANTY SHALL BE IN LIEU OF ALL WARRANTIES OF FITNESS AND OF THE WARRANTY OF MERCHANTABILITY AND THAT BECKMAN COULTER, INC., SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER ARISING OUT OF THE MANUFACTURE, USE, SALE, HANDLING, REPAIR, MAINTENANCE, OR REPLACEMENT OF THE PRODUCT.



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