Thermo Scientific

TCF-20 Rotor

for the Thermo Scientific Sorvall LYNX Centrifuge

Instruction Manual

50133975-a • 05 / 2013 • Superspeed Centrifuge

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The pictures published within this manual are for reference only. The values shown on your centrifuge and the size of the shown items might differ.

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Original instruction manual 50133975-a printed in 05 / 2013

Table of Contents

List of Figures

List of Tables

Preface

Before starting to use the rotor, read through this instruction manual carefully and follow the instructions.
Failure to follow the instructions and safety information in this instruction manual will result in the expiration of the seller's warranty.

Items Supplied

Table 1
Zonal Mode
Rotor Package
(75003013)

Article No.	Item	Quantity	Check
49609	Septa	1	❑
75000601	Tube Holder Assembly	1	❑
75000604	Titanium Rotor Body	1	❑
75004012	Rotor Cover	1	❑
75004052	Tool Kit	1	❑
75004051	Zonal Mode Assembly	1	❑

Table 2
Continuous Flow
Rotor Package
(75003012)

Article No.	Item	Quantity	Check
49609	Septa	1	❑
75000601	Tube Holder Assembly	1	❑
75000604	Titanium Rotor Body	1	❑
75004012	Rotor Cover	1	❑
75004052	Tool Kit	1	❑
75000605	Continuos Flow Assembly	1	❑

Intended Use

This rotor is a laboratory product used to seperate substance mixtures of different sizes and densities.
If the rotor is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
This rotor should be operated by trained specialists only.

Precautions

In order to ensure safe operation of the Thermo Scientific TCF-20 rotor, the following general safety regulations must be followed:

- Observe all safety instructions.
- Never exceed maximum rotor speed under any circumstances.
- Always reduce (derate) rotor speed as instructed in this manual whenever:
  - » the rotor speed/temperature combination exceeds the solubility of the gradient material and causes it to precipitate.
  - » the compartment load exceeds the maximum allowable compartment load specified (average fluid density greater than 1.2 g/mL). Failure to reduce rotor speed under these conditions can cause rotor failure.
- Keep surfaces of the rotor and spindle clean. Always clean the rotor with a neutral mild soap or detergent solutions. Never use any abrasive tools to clean the rotor („Maintenance and Care“ on page 57).
- Do not use rotors which show any signs of damage.
- Always lift, carry and handle the rotor with care. Dropping a rotor may render the rotor unusable. If a rotor is dropped, contact Thermo Fisher Scientific for an inspection.
- If any unusual vibrations, sounds or odors occur, turn off the centrifuge immediately and do not operate the centrifuge until the cause of the improper behavior is determined and repaired.
- Use only accessories and parts which have been approved by Thermo Fisher Scientific.

Pay particular attention to the following aspects:

- Do not operate or precool the rotor at the critical speed, as this will have a detrimental effect on centrifuge component life. („Critical Speed“ on page 18).
- Do not operate the rotor unless it has a full fluid load (1350 mL) as described in this manual. Operating the rotor with less than a full fluid load may cause damage to the centrifuge and/or rotor due to the shifting mass of the fluid
- Operating the rotor with the cover not properly seated can cause rotor failure with subsequent damage to the centrifuge.

Centrifugation of hazardous substances:

- Do not centrifuge explosive or flammable materials or substances which could react with one another.
- Do not centrifuge any material capable of producing flammable or explosive vapors or creating extreme exothermic reactions.
- Do not centrifuge toxic or radioactive materials or any pathogenic micro-organisms without suitable safety precautions.
  When centrifuging microbiological samples from the Risk Group II (according to the “Laboratory biosafety manual” of the World Health Organization (WHO), aerosol-tight biological seals have to be used.
  For materials in a higher risk group, extra safety measures have to be taken.
- If toxins or pathogenic substances have gotten into the centrifuge or its parts, appropriate disinfection measures have to be taken („Cleaning and Decontamination“ on page 57).
- If a hazardous situation occurs, turn off the power supply to the centrifuge and leave the area immediately.

Symbols used in this manual

Observe the information contained in the instruction manual to keep yourself and your environment safe.

This symbol refers to genereal hazards.

CAUTION means that material damage could occur.

WARNING means that injuries or material damage or contamination could occur.

This symbol refers to biological hazards.

1

Rotor Specifications

Table 3
Rotor Specifications

Description	Specification in the Thermo Scientific™ Sorvall™ Lynx 6000 Superspeed Centrifuge
Weight of empty rotor	7.80 kg (17.2 lbs)
Total capacity (nominal)	1,350 mL
Maximum speed	20,000 rpm
Critical speed	4,200 rpm
Max. / Min. / Avg. radius	96.0 mm / 36.0 mm / 66.0 mm
Maximum RCF value at r_{max} / r_{min} / r_{avg}	42,931 x g / 16,099 x g / 29,400 xg
Diameter	213 mm (8.40 in)
Design load	1350 mL at 1.2 g/mL
K-factor at maximum speed	620

Parts and Accessories

The rotor body assembly is composed of:

- a rotor
- septa
- rotor cover
- feed device assembly

The rotor body and cover are machined from a titanium forging for strength and corrosion resistance. The Valox™ septa is inserted into the rotor body to divide the chamber into six sector-shaped compartments. The upper, internal surface of the rotor body is threaded to accommodate the circular threaded rotor cover which is sealed to the body by a large O-ring.

To perform all operating instructions included in this manual, it is necessary to have additional assemblies and equipment not supplied with the rotor. Table 1 and Table 2 list the assemblies and equipment required to complete all possible TCF-20 Rotor applications in the Sorvall Lynx 6000 superspeed centrifuge.

Table 4 Parts and Accessories (see „Appendix“ on page 69 for details on Figure Item Numbers)

Figure Item No.	Catalog No.	Item Description
01	75000604	Titanium Rotor Body
02	75004012	Rotor Cover
03	49609	Septa
04	75000601	Tube Holder Assembly
05	75004006	O-Ring Set for Continuous Flow Assembly
06	75004007	O-Ring Set for Zonal Mode Assembly
07	75004008	Screws and small parts
08	75004052	Tool Kit
09	75004050	Bearing Kit
10	75000605	Continuous Flow Assembly
11	75004051	Zonal Mode Assembly
12	75003503	Peristaltic Pump
13	13117	Latex Tubing

Additional equipment and accessories may be needed for the desired application:

- Syringe with Blunt 18 Gauge Needle
- 5 mL Syringe with 20 Gauge Needle
- Peristaltic Pump
- Regulator
- Chiller

Before proceeding, be sure you have all necessary assemblies and equipment for the desired application.

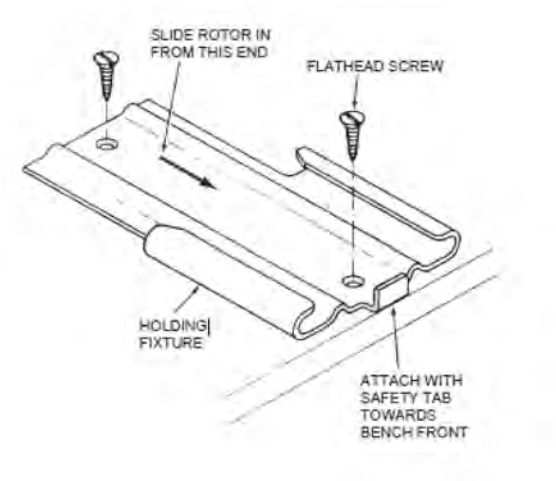
2

Rotor Preparation and Installation

Rotor Holding Fixture

The rotor holding fixture (Catalog No. 52540) is used to hold the rotor during loading and unloading procedures to prevent disturbances of the gradient. Secure the rotor holding fixture to a work bench with the two flathead screws supplied.

Figure 1
Rotor Holding Fixture



Before a Run

To prepare for a run

1. Read the important safety information („Precautions“ on page 10).
2. Level the rotor to ensure equal dispersion of the density gradient.
3. Ensure the rotor spud hole is clean and free.
4. Inspect the O-rings in the rotor assembly for cracks, tears, and abrasions; replace if necessary.
5. Remove any blockage from the feed lines of the septa and the distributor
6. Lubricate the threads of the rotor body with the lubricant (Catalog No. 76003786).
7. Check the compatibility of all materials used („Chemical Compatibility Chart“ on page 75).
8. Make sure all rotor parts and accessories have been cleaned as explained („Maintenance and Care“ on page 57).

Compartment Loads in Excess of Design Mass

There is a recommended design mass established for each rotor representing the maximum mass that can be carried in the rotor. The total mass should not exceed the recommendation unless the rotor speed is reduced proportionately. If the density of the solution is greater than 1.2 g/mL, use the following formula to determine the reduced speed:

$$n_{adm} = n_{max} \sqrt{\frac{1.2\ g/mL}{average\ fluid\ density}}$$

n_{adm} = admissible speed
n_{max} = maximum speed

Critical Speed

The critical speed is that speed at which any rotor imbalance will produce a driving frequency equal to the resonant frequency of the rotating system (that is, the rotor and the centrifuge drive). At this speed, the rotor may produce large amplitude vibrations which can be felt in the instrument frame. Mass imbalance will contribute to increased vibration intensity at the critical speed. Avoid operating the rotor at the critical speed, which is approximately 4,200 rpm for the TCF-20 Rotor in the Sorvall Lynx 6000 superspeed centrifuge.

3

Rotor Installation

Before installing the rotor, make sure that the rotor's center hole and centrifuge spindle are clean and dry, and free of nicks and scratches. Wipe these surfaces clean before installing the rotor.

CAUTION

Unapproved or incorrectly combined accessories can cause serious damage to the centrifuge.

To install the rotor

1. Open the door of the centrifuge and if necessary remove any dust, foreign objects or residue from the chamber.
2. Hold the rotor over the centrifuge spindle and let it slide slowly down the centrifuge spindle.
3. Ensure that the rotor has been correctly identified by the Sorvall LYNX 6000 superspeed centrifuge.

The rotor is now securely in place and ready for operation.

Removing the Rotor

To remove the rotor

1. Open the centrifuge door.
2. Remove part assemblies or cap.
3. Firmly press the rotor unlocking tool (Catalog No. 75000602) into the center of the rotor to engage the release of the rotor from the centrifuge spindle.
4. Lift the rotor off the centrifuge drive spindle and place it in the rotor holding fixture.
5. Open the rotor lid by seating the rotor cover wrench on the rotor cover and turning the clockwise (left-hand thread).

NOTICE

Threads contaminated with dirt, dried lubricant, metal particles, or threads insufficiently lubricated can cause rotor components to stick. Do not use excessive force to loosen components. Routinely clean metal threads and apply lubricant (Catalog No. 70006692). Contact your Thermo Fisher Scientific representative for issues.

4

Zonal Operation

Calculation of Sedimentation Time in Aqueous (Non-gradient) Solutions

The time required to sediment a particle in water at 20 °C through the maximum rotor path length (that is, the distance between r_{min} and r_{max}) can be calculated using the equation:

$$t = \frac{K}{S_{20,W}}$$

where:

t = sedimentation time in hours

K = the clearing factor for the rotor (defined below).

$S_{20,W}$ = the sedimentation coefficient for the particle of interest in water at 20 °C as expressed in Svedbergs*

The clearing (or K) factor (in hours per Svedberg) is defined by the equation:

$$K = (253000)\left[\ln\left(\frac{r_{max}}{r_{min}}\right)\right]\left(\frac{1000}{rotor\ speed}\right)^2$$

Where r_{max} and r_{min} are the maximum and minimum rotor radii, respectively, and rotor speed is expressed in rpm.

Seesee „RCF-Values“ on page 65 for a list of K factors for the TCF-20 Rotor, at speeds from 1,000 rpm to 20,000 rpm (in increments of 500 rpm).

Example: The TCF-20 Rotor has a K factor of 620 at the maximum permitted speed (20,000 rpm). If the particles to be sedimented have a sedimentation coefficient of 10S, the estimated run time required at maximum speed will be:

$$t = \frac{620}{10S} = 62\ hours$$

Note that the calculation assumes particles in water at 20 °C. If the suspending medium is denser or more viscous than water, the sedimentation time will be greater.

*The sedimentation coefficient (S) in seconds, for a particle in a centrifugal field is defined by the equation S = (dx/dt) [1/(ω^2x)]; where dx/dt = sedimentation velocity of the particle in cm/s; ω = rotor speed in rad/s; and x = the distance of the particle from the axis of rotation in centimeters. Conventionally, experimentally determined values of sedimentation coefficients are multiplied by 10^{13} to convert them to Svedberg units (S), so a particle with an experimentally determined sedimentation coefficient of 10^{-11} seconds is usually referred to in the literature as a “100 S particle.” Since the value determined for the sedimentation coefficient is dependent on the density and viscosity of the solution in which centrifugation is performed, values are usually reported for the standard conditions of infinite dilution in water at 20 °C, and designated $S_{20,W}$.

Running Statically Loaded Gradients (Sealed Operation)

To run statically loaded gradients in the TCF-20 Rotor, follow the operating instructions supplied with the rate controller and centrifuge.

Rotor Assembly and Rotor Precooling

NOTICE

If your desired application requires precooling of the rotor and sample, be sure to precool your sample separately. Follow the instructions below to precool your rotor in the centrifuge. If desired, precool your rotor to the required temperature, assemble the rotor following steps 1 through 10 below then proceed to step „Rotor Loading“.
Refer to „Figure 2“ and „Figure 3“, respectively for location and identification of parts and tools required for operation.

To assemble the rotor

1. Place the rotor body into the rotor holding fixture (Catalog No. 52540).
2. Using the dissecting needle (Catalog No. 66026); carefully remove the O-rings in the rotor assembly. Inspect each of the O-rings for cracks, tears or abrasions; replace if necessary. Lubricate each O-ring with a light film of lubricant (Catalog No. 76003500), then reinsert each O-ring into its respective part.

CAUTION

All O-rings used in the rotor assembly should be routinely checked for cracks, tears or abrasions and replaced when necessary. Lubricate the O-rings as directed. Failure to properly maintain the O-rings can result in an incomplete seal.

3. Place the septa (Catalog No. 49609) into the rotor body with a slight twisting motion.
4. Lubricate the threads of the rotor cover at several places around the circumference with lubricant grease (Catalog No. 75003786). Place the cover onto the rotor body, then turn it clockwise until it drops onto the threads of the rotor body. Turn the cover counterclockwise until tight (this will spread the grease over the threads). Use wrench (Catalog No. 49724) to securely tighten the cover.

CAUTION

Before running the TCF-20 Rotor in the centrifuge, make sure the rotor cover is properly seated. Operating the rotor with the cover not properly seated can cause rotor failure with subsequent damage to your centrifuge.

5. Use both hands to remove the rotor assembly from the rotor holding fixture and carefully lower it onto the centrifuge drive spindle.

6. Check that the rotor is level by placing a spirit level on the flat surface of the rotor cover (this will ensure equal dispersion of the gradient during operation). If the rotor is not level, adjust the centrifuge feet accordingly.
7. Place the distributor body (Catalog No. 52425) of the feed device assembly (Catalog No. 49634) in position through the hole in the rotor cover. Slowly rotate the distributor body to engage the guide pins (located on the bottom of the distributor body) with the corresponding holes in the septa.
8. Place the holddown plate (Catalog No. 52416) on the distributor body (the top of the holddown plate can be identified by the three large screw holes). Align the three screw holes of the holddown plate with the corresponding holes in the distributor body. Insert the three socket head screws (Catalog No. 62987) through both parts. Turn the assembly (which includes the holddown plate, distributor body, and septa) while pressing down firmly on one of the screws until it aligns with the corresponding threaded hole of the rotor body spindle and drops into place. Use the T-Wrench to alternately tighten the screws until they are firmly and evenly tightened.
9. Close the centrifuge door. Precool the rotor to the desired temperature by using the pretempering function on the Sorvall Lynx 6000 centrifuge.
10. At the end of centrifugation run, when the rotor has decelerated to 0 rpm, open the centrifuge door.

Rotor Loading

To load the rotor

1. With the rotor at rest and the centrifuge door open, slide the silicone tubing from a peristaltic pump through one of the two inlet ports located on the left back side of the centrifuge (remove the rubber plug).
2. Connect the silicone tubing from the peristaltic pump to the feed adapter (Catalog No. 49007) then insert the feed adapter into the center of the distributor body.
3. Check that all lines are loading gradient properly. Turn the peristaltic pump on, then squeeze the silicone tubing near the feed adapter to create a back pressure. When the tubing is released, the fluid should purge the air from all loading lines resulting in an even flow through all channels. Repeat procedure to be sure all lines flow evenly.
4. Load the gradient into the rotor using the peristaltic pump, light end first. The gradient must flow smoothly through all the loading lines or it will be distributed unevenly between the six compartments of the septa.

CAUTION

Always run the TCF-20 Rotor with a full fluid load (1350 ml). Running the rotor with less than a full fluid load may cause damage to the centrifuge and/or rotor due to the shifting mass of the fluid. If enough sample is not available an overlay should be used to increase the rotor contents to 1350 mL.

5. When all the gradient is loaded, open the centrifuge door and carefully remove the silicone tubing from the feed adapter and from the inlet port. Replace the rubber plug in the inlet port hole.
6. Remove the feed adapter from the distributor body.
7. Use a syringe with a blunt 18 gauge needle to load equal amounts of sample into each of the six small holes of the holddown plate.
8. Place the sealing cover (Catalog No. 52417) over the distributor body. Insert the three socket head screws (Catalog No. 66329) into the sealing cover then align with the distributor body. Use the T-Wrench to alternately tighten the screws until they are firmly and evenly tightened.
9. Close the centrifuge door. Perform the run as explained in the centrifuge instruction manual.

Unloading and Disassembling the Rotor

NOTICE

Once the rotor has stopped spinning, do not bump or jar the centrifuge. Any disturbance may remix the delicate separations.

To unload and disassemble the rotor

1. At the end of the run, open the centrifuge door. Slide the silicone tubing from the peristaltic pump through one of the two inlet ports located on the left back side of the centrifuge (remove the rubber plug).
2. Use the T-Wrench to remove the three socket head screws from the sealing cover. Remove the sealing cover.
3. Lubricate the feed adapter O-ring (Catalog No. 63037) using lubricant (Catalog No. 75003600).
4. Connect the silicone tubing to the feed adapter, insert the feed adapter into the center of the distributor body.
5. Before unloading the rotor, check that all lines unload evenly and smoothly as follows:
    a. Set the speed control of the peristaltic pump to a higher than normal rate.
    b. Turn the peristaltic pump on and squeeze the tubing near the feed adapter to create a vacuum. Release the tubing; when the tubing is released there should be a rush of bubbles up through the adapter as the feed lines clear. No more bubbles should appear in the effluent from the distributor body and all lines should unload at the same time.
    c. Reset the peristaltic pump to its normal unloading rate.

CAUTION

The density gradient being pumped from the rotor must flow smoothly through all feed lines so that the gradient will unload evenly from the six compartments.

NOTICE

Occasionally with very viscous solutions of 55% w/w sucrose or higher, small bubbles will appear in the effluent even after the above procedure is completed. To eliminate this problem, reduce the unloading rate until the viscous end of the gradient (or cushion) has been pumped from the rotor. Then, reset the unloading rate of the peristaltic pump to the normal rate.

6. Close the centrifuge door to maintain temperature within the rotor chamber. Unload the rotor, do not exceed 75 mL/min.
7. After rotor unloading, remove the feed adapter from the distributor body.
8. Disassemble the distributor assembly:
    a. Remove the three socket head screws that secure the holddown plate in place. Remove the holddown plate.
    b. Remove the distributor body.
9. Firmly press the rotor unlocking tool (Catalog No. 75000602) into the center of the rotor to engage the release of the rotor from the centrifuge drive spindle.
10. Lift the rotor off the centrifuge drive spindle and place it in the rotor holding fixture.
11. Remove the rotor cover and the septa.
12. Clean and store the rotor and parts (see „Maintenance and Care“ on page 57).

Rotor Assembly Parts and Accessories for Sealed Operation

To run statically loaded gradients or sealed operation, make sure all parts are clean and in good working order.

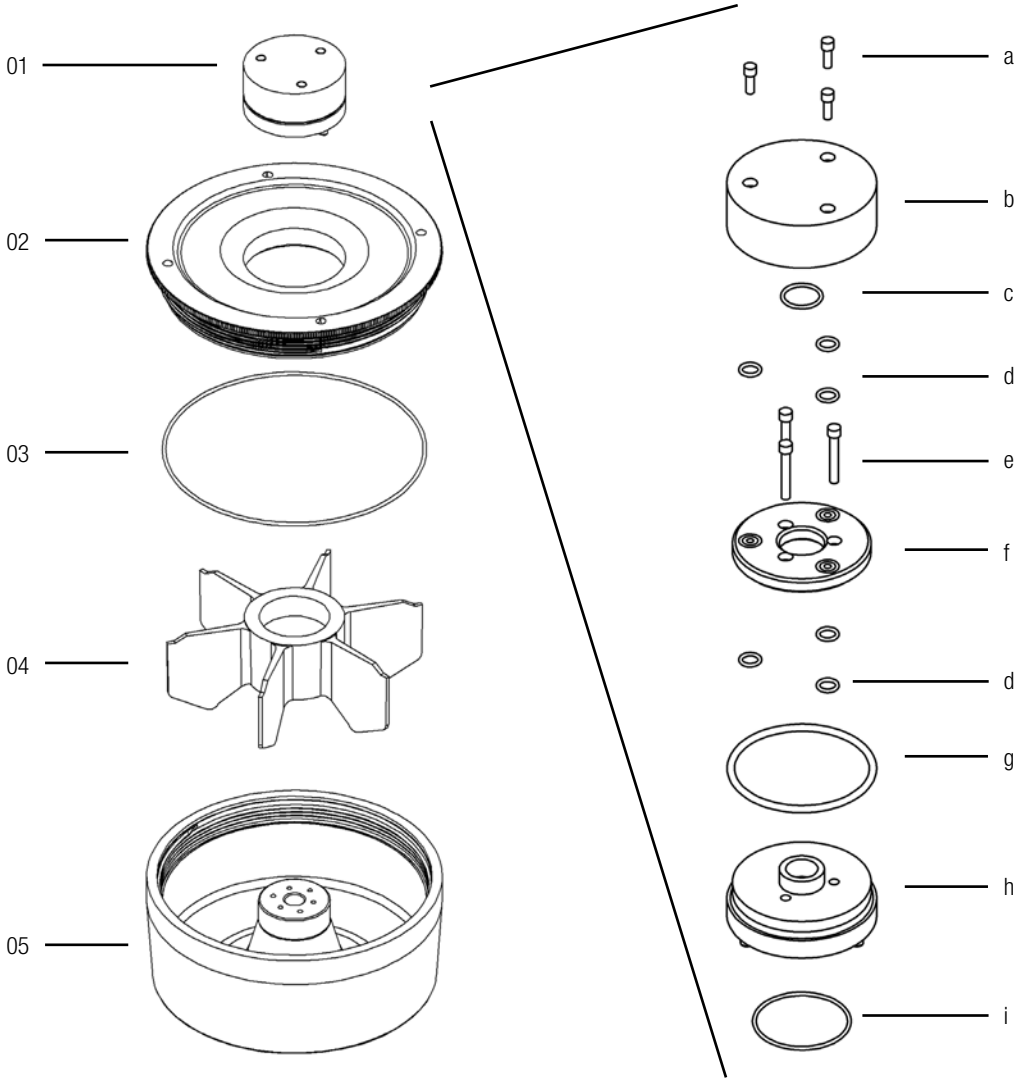


Figure 2
Rotor Assembly for Sealed Operation. See „Table 5“ for description of numbered items

Table 5
Rotor Assembly for Sealed Operation (key to Figure 2)

Figure Item Number	Quantity Supplied	Catalog Number	Description
01		75004051	Sealed Feed Device Assembly
a	3	66329	Hexagon Socket Screw 8/32 x 0.437" VA
b	1	52417	Screw Cap
c	1	66330	O-Ring, 17.2 x 1.8 mm, 75 Shore
d	6	61289	O-Ring, Buna, 7.7 x 11.3 x 1.8 mm, 75 Shore
e	3	62987	Hexagon Socket Screw 8/32 x 1.125" VA
f	1	52416	Holddown Plate
g	1	64578	O-Ring, Viton, 66.3 x 3.6, 75 Shore
h	1	52425	Distributor Body
i	1	66308	O-Ring, Viton, 44.9 x 1.8 mm, 75 Shore
02	1	75004012	Rotot Lid
03	1	90840	O-Ring, 178.8 x 2.6 mm, 75 Shore
04	1	49609	Septa
not shown; used with the septa	6	66193	O-Ring, Viton, 4.5 x 1.8 mm, 75 Shore
05	1	75000604	Rotorbody

Batch Operation (Sealed)

Rotor Precooling

NOTICE

If your desired application requires precooling of the rotor and sample, be sure to precool your sample separately. Follow the instructions below to precool your rotor in the centrifuge. If desired, precool your rotor refrigerating it to the required temperature, assemble the rotor following steps 1 through 10 below then proceed to step „Rotor Assembly, Loading and Unloading“.
Refer to „Figure 2“ , respectively for location and identification of parts and tools required for operation.

To precool the rotor

1. Place the rotor body into the rotor holding fixture.
2. Using the dissecting needle (Catalog No. 66026); carefully remove the O-rings in the rotor assembly. Inspect each of the O-rings for cracks, tears or abrasions; replace if necessary. Lubricate each O-ring with a light film of lubricant (Catalog No. 76003500), then reinsert each O-ring into its respective part.

CAUTION

All O-rings used in the rotor assembly should be routinely checked for cracks, tears or abrasions and replaced when necessary. Lubricate the O-rings as directed. Failure to properly maintain the O-rings can result in an incomplete seal.

3. Place the septa (Catalog No. 49609) into the rotor body with a slight twisting motion.
4. Lubricate the threads of the rotor cover at several places around the circumference with lubricant grease (Catalog No. 76003786). Place the cover onto the rotor body, then turn it clockwise until it drops onto the threads of the rotor body. Turn the cover counterclockwise until tight (this will spread the grease over the threads). Use wrench (Catalog No. 49724) to securely tighten the cover.

NOTICE

Before running the TCF-20 Rotor in the centrifuge, make sure the rotor cover is properly seated. Clearance between the rotor body and rotor cover should be no greater than 0.64 mm (0.025 inches).
Operating the rotor with the cover not properly seated can cause rotor failure with subsequent damage to your centrifuge.

5. Use both hands to remove the rotor assembly from the rotor holding fixture and carefully lower it onto the centrifuge drive spindle.
6. Check that the rotor is level by placing a spirit level on the flat surface of the rotor cover (this will ensure equal dispersion of the gradient during operation). If the rotor is not level, adjust the centrifuge feet accordingly.
7. Place the distributor body (Catalog No. 52425) of the sealed feed assembly in position through the hole in the rotor cover. Slowly rotate the distributor body to engage the guide pins (located on the bottom of the distributor body) with the corresponding holes in the septa.
8. Place the holddown plate (Catalog No. 52416) on the distributor body (the top of the holddown plate can be identified by the three large screw holes). Align the three screw holes of the holddown plate with the corresponding holes in the distributor body. Insert the three socket head screws (Catalog No. 62987) through both parts. Turn the assembly (which includes the holddown plate, distributor body, and septa) while pressing down firmly on one of the screws until it aligns with the corresponding threaded hole of the rotor body spindle and drops into place. Use the T-Wrench to alternately tighten the screws until they are firmly and evenly tightened.
9. Close the centrifuge door. If neccessary, precool the rotor.
10. At the end of the centrifugation run, when the rotor has decelerated to 0 rpm, open the centrifuge door.
11. Disassemble the distributor assembly as follows:
    a. Remove the three socket head screws that secure the holddown plate in place. Remove the holddown plate.
    b. Remove the distributor body.
12. Firmly press the rotor unlocking tool (Catalog No. 75000602) into the center of the rotor to engage the release of the rotor from the spindle.
13. Lift the rotor off the centrifuge drive spindle and place it in the rotor holding fixture.
14. Remove the rotor cover.

Rotor Assembly, Loading and Unloading

To assemble, load and unload the rotor

1. With the rotor placed in the rotor holding fixture, use the dissecting needle (Catalog No. 66026) supplied to carefully remove the O-rings in the rotor assembly. Inspect each of the O-rings for cracks, tears or abrasions; replace if necessary. Lubricate each O-ring with a light film of lubricant (Catalog No. 76003500), then reinsert each O-ring into its respective part.

CAUTION

All O-rings used in the rotor assembly should be routinely checked for cracks, tears or abrasions and replaced when necessary. Lubricate the O-rings as directed. Failure to properly maintain the O-rings can result in an incomplete seal.

2. Fill the rotor body with the sample to be processed (making sure that all six sector-shaped compartments have equal fluid levels).
3. Lubricate the threads of the rotor cover at several places around the circumference with lubricant grease (Catalog No. 76003786). Place the cover onto the rotor body, then turn it clockwise until it drops onto the threads of the rotor body. Turn the cover counterclockwise until tight (this will spread the grease over the threads). Use wrench assembly (Catalog No. 49724) to securely tighten the cover.

CAUTION

Before running the TCF-20 Rotor in the centrifuge, make sure the rotor cover is properly seated. Clearance between the rotor body and rotor cover should be no greater than 0.64 mm (0.025 inches). Operating the rotor with the cover not properly seated can cause rotor failure with subsequent damage to your centrifuge.

4. Using both hands remove the rotor assembly from the rotor holding fixture and carefully lower it onto the centrifuge drive spindle.
5. Check that the rotor is level by placing a spirit level on the flat surface of the rotor cover (this will ensure equal dispersion of the gradient during operation). If the rotor is not level, adjust the centrifuge feet accordingly.
6. Place the distributor body (Catalog No. 52425) in position through the hole in the rotor cover. Rotate the distributor body slowly to engage the guide pins (located on the bottom of the distributor body) with the corresponding holes in the septa.
7. Place the holddown plate (Catalog No. 52416) on the distributor body (the top of the holddown plate can be identified by the three large screw holes). Align the three screw holes of the holddown plate with the corresponding holes in the distributor body. Insert the three socket head screws (Catalog No. 62987) through both parts. Turn the assembly (which includes the holddown plate, distributor body, and septa) while pressing down firmly on the head of one screw until it aligns with the corresponding threaded hole of the rotor body spindle and drops into place. Use the T-Wrench to alternately tighten the three socket head screws until they are firmly and evenly tightened.

8. Place the sealing cover over the distributor body. Insert the three socket head screws (Catalog No. 66329) into the sealing cover, then turn the sealing cover until the screws drops into place. Use the T-Wrench to alternately tighten the screws until they are firmly and evenly tightened.
9. Close the centrifuge door and perform the run as explained in the centrifuge instruction manual.
10. At the end of the run and the rotor decelerated to zero rpm, open the centrifuge door.
11. Remove the three socket head screws that secure the sealing cover. Remove the sealing cover.
12. Disassemble the distributor assembly:
    a. Remove the three socket head screws that secure the holddown plate in place. Remove the holddown plate.
    b. Remove the distributor body.
13. Firmly press the rotor unlocking tool (Catalog No. 75000602) into the center of the rotor to engage the release of the rotor from the spindle.
14. Lift the rotor off the centrifuge spindle and place it in the rotor holding fixture.
15. Remove the rotor cover.
16. Aspirate any unwanted solution. The sedimented particles will be packed against the wall of the rotor.
17. Remove the septa.
18. Use a rubber, wooden or Teflon® coated spatula to remove the sedimented particles from the wall of the rotor.
19. Clean and store the rotor and parts (see „Maintenance and Care“ on page 57).

Batch Operation (Unsealed)

Rotor Precooling

NOTICE

If your desired application requires precooling of the rotor and sample, be sure to precool your sample separately. Follow the instructions below to precool your rotor in the centrifuge. If desired, precool your rotor refrigerating it to the required temperature, assemble the rotor following steps 1 through 10 below then proceed to step „Rotor Assembly, Loading and Unloading“.
Refer to „Figure 3“, respectively for location and identification of parts and tools required for operation.

To precool the rotor

1. Place the rotor body into the rotor holding fixture.
2. Using the dissecting needle (Catalog No. 66026); carefully remove the O-rings in the rotor assembly. Inspect each of the O-rings for cracks, tears or abrasions; replace if necessary. Lubricate each O-ring with a light film of lubricant (Catalog No. 76003500), then reinsert each O-ring into its respective part.

CAUTION

All O-rings used in the rotor assembly should be routinely checked for cracks, tears or abrasions and replaced when necessary. Lubricate the O-rings as directed. Failure to properly maintain the O-rings can result in an incomplete seal.

3. Place the septa (Catalog No. 49609) into the rotor body with a slight twisting motion.
4. Lubricate the threads of the rotor cover at several places around the circumference with lubricant grease (Catalog No. 75003786). Place the cover onto the rotor body, then turn it clockwise until it drops onto the threads of the rotor body. Turn the cover counterclockwise until tight (this will spread the grease over the threads). Use wrench (Catalog No. 49724) to securely tighten the cover.

CAUTION

Before running the TCF-20 Rotor in the centrifuge, make sure the rotor cover is properly seated. Clearance between the rotor body and rotor cover should be no greater than 0.64 mm (0.025 inches). Operating the rotor with the cover not properly seated can cause rotor failure with subsequent damage to your centrifuge.

5. Use both hands to remove the rotor assembly from the rotor holding fixture and carefully lower it onto the centrifuge drive spindle.
6. Check that the rotor is level by placing a spirit level on the flat surface of the rotor cover (this will ensure equal dispersion of the gradient during operation). If the rotor is not level, adjust the centrifuge feet accordingly.
7. Place the unsealed distributor feed device assembly (Catalog No. 49635) in position through the hole in the rotor cover. Slowly rotate the unsealed distributor feed device assembly to engage the guide pins in the corresponding holes in the septa.
8. Place the three cap screws (Catalog No. 62987) in the distributor feed device assembly. Turn the rotor body and distributor/septa in opposite directions until the cap screws align with the drive adapter and drop into place (apply light pressure to one screw to locate the holes). Use the T-Wrench to alternately tighten the screws until they are firmly and evenly tightened.

CAUTION

Do not overtighten the cap screws. The cap screws must be evenly tightened to properly seal the distributor feed device assembly.

9. Close the centrifuge door. If neccessary, precool the rotor.
10. At the end of the centrifugation run, when the rotor has decelerated to 0 rpm, open the centrifuge door.
11. Use the T-Wrench to loosen the three cap screws securing the distributor feed device assembly in place. Then, remove the screws.

12. Remove the distributor feed device assembly by pulling upward; turn clockwise if necessary.
13. Firmly press the rotor unlocking tool (Catalog No. 75000602) into the center of the rotor to engage the release of the rotor from the spindle.
14. Lift the rotor off the centrifuge drive spindle and place it in the rotor holding fixture.
15. Remove the rotor cover turning it clockwise; use wrench assembly (Catalog No. 49724) if necessary.

Rotor Assembly, Loading and Unloading

To assemble, load and unload the rotor

1. With the rotor placed in the rotor holding fixture, use the dissecting needle (Catalog No. 66026) supplied to carefully remove the O-rings in the rotor assembly. Inspect each of the O-rings for cracks, tears or abrasions; replace if necessary. Lubricate each O-ring with a light film of lubricant (Catalog No. 75003600), then reinsert each O-ring into its respective part.

CAUTION

All O-rings used in the rotor assembly should be routinely checked for cracks, tears or abrasions and replaced when necessary. Lubricate the O-rings as directed. Failure to properly maintain the O-rings can result in an incomplete seal.

2. Fill the rotor body with the sample to be processed (making sure that all six sector-shaped compartments have equal fluid levels).
3. Lubricate the threads of the rotor cover at several places around the circumference with lubricant grease (Catalog No. 75003786). Place the cover onto the rotor body, then turn it clockwise until it drops onto the threads of the rotor body. Turn the cover counterclockwise until tight (this will spread the grease over the threads). Use wrench assembly (Catalog No. 49724) to securely tighten the cover.

CAUTION

Before running the TCF-20 Rotor in the centrifuge, make sure the rotor cover is properly seated. Clearance between the rotor body and rotor cover should be no greater than 0.64 mm (0.025 inches). Operating the rotor with the cover not properly seated can cause rotor failure with subsequent damage to your centrifuge.

4. Using both hands remove the rotor assembly from the rotor holding fixture and carefully lower it onto the centrifuge drive spindle.
5. Check that the rotor is level by placing a spirit level on the flat surface of the rotor cover (this will ensure equal dispersion of the gradient during operation). If the rotor is not level, adjust the centrifuge feet accordingly.
6. Place the distributor feed device assembly (Catalog No. 49635) in position through the hole in the rotor cover. Rotate the distributor slowly to engage the guide pins into the corresponding holes of the septa.

7. Place the three cap screws (Catalog No. 62987) in the distributor feed device assembly. Turn the rotor and distributor/septa in opposite directions until the screws align with the centrifuge drive adapter and drop into place (apply light pressure to one screw to locate the holes). Use the T-Wrench to alternately tighten the three cap screws until they are firmly and evenly tightened.
8. Close the centrifuge door and perform the run.
9. At the end of the run and with the rotor decelerated to 0 rpm, open the centrifuge door.
10. Use the T-Wrench to loosen the three cap screws securing the distributor feed device assembly in place. Remove the cap screws.
11. Remove the distributor feed device assembly by pulling upward; turn clockwise if necessary.
12. Firmly press the rotor unlocking tool (Catalog No. 75000602) into the center of the rotor to engage the release of the rotor from the centrifuge spindle.
13. Lift the rotor off the centrifuge drive spindle and place it in the rotor holding fixture.
14. Remove the rotor cover.
15. Aspirate any unwanted solution. The sedimented particles will be packed against the wall of the rotor.
16. Remove the septa.
17. Use a rubber, wooden or Teflon™ coated spatula to remove the sedimented particles from the wall of the rotor.
18. Clean and store the rotor and parts (see „Maintenance and Care“ on page 57).

Rotor Assembly Parts and Accessories for Unsealed Operation

To run statically loaded gradients, make sure all parts are clean and in good working order.

Figure 3
Rotor Assembly for Unsealed Operation.
See „Table 6“ for desctription of numbered items

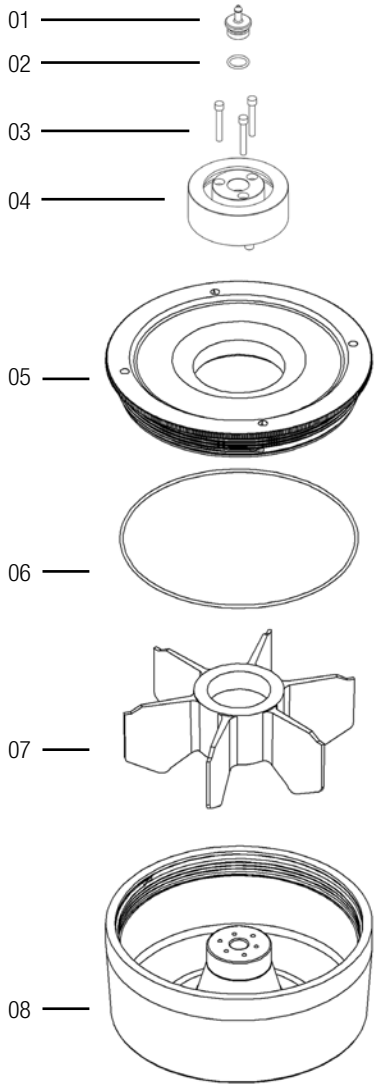


Table 6
Rotor Assembly for Unsealed Operation.
(key to Figure 3)

Figure Item Number	Quantity Supplied	Catalog Number	Description
01	1	49007	Feed Adapter
02	1	63037	O-Ring, Viton, 12.7 x 1.8 mm, 75 Shore
03	3	62987	Hexagon Socket Screw 8/32 x 1.125“ VA
04	1	49635	Unsealed Distributor Feed Assembly
05	1	75004012	Rotor Lid
06	1	90840	O-Ring, 178.8 x 2.6 mm, 75Shore
07	1	49609	Septa
not shown; *used with the septa*	6	66193	O-Ring, Viton, 4.5 x 1.8 mm, 75 Shore
08	1	75000604	Rotorbody

5

Continuous Flow Operation

Pre-run Safety Check

Performing a safety check

1. Secure the rotor holding fixture to a workbench or table as shown in Figure 1 to prepare the TCF-20 Rotor for operation when using continuous flow applications.
2. Follow all precautions („Precautions“ on page 10)
3. Inspect the rotor cover O-ring, the seven O-rings in the continuous flow system and the six O-rings in the septa for cracks, tears or abrasions; replace if necessary.
4. Inspect the feed lines in the septa, adapter and the feed device assembly for blockage („Figure 11“ on page 45).
5. Lubricate the threads of the inlet/outlet assembly with lubricant grease (Catalog No. 75003786).
6. Ensure that all rotor parts, continuous flow parts, and accessories are free of encrusted material and have been cleaned („Maintenance and Care“ on page 57).

Derating for Sediment Build Up

If a suspension having a sediment specific gravity (ρ) greater than 1.2 g/mL is to be separated using the continuous flow system, the depth of the sediment must be limited for safe operation.

To derate for sediment build up

1. Select the graph („Figure 4“ through „Figure 10“) which corresponds to your desired operating speed.
2. Select the supernatant (ρ) specific gravity on the abscissa of the graph.
3. Select the proper sediment specific gravity curve and read the maximum allowable SEDIMENT DEPTH on the ordinate of the graph.
4. If the sediment depth is too small, go to a lower operating speed until sediment depth requirements are satisfied. The rotor must not be operated above this speed.

With the sediment depth determined from the derating curves, the depth can be converted to a collection volume using „RCF-Values“ on page 65.
Knowing the suspension concentration and collection volume, the maximum volume of suspension that can be run through the rotor can be calculated.
EXAMPLE: If the sediment depth is 1.5 cm, this results in a collection volume of 450 mL. If the suspension concentration is 50 mL of sediment per liter of solution, 9 liters of suspension can be run through the rotor and sediment removed before running any additional solution through the rotor.

Derating Charts for Sediment Specific Gravities (ρ)

Figure 4
TCF-20 Derating Chart for Sediment Specific Gravities (ρ) higher than 1.2 g/mL, 20,000 rpm

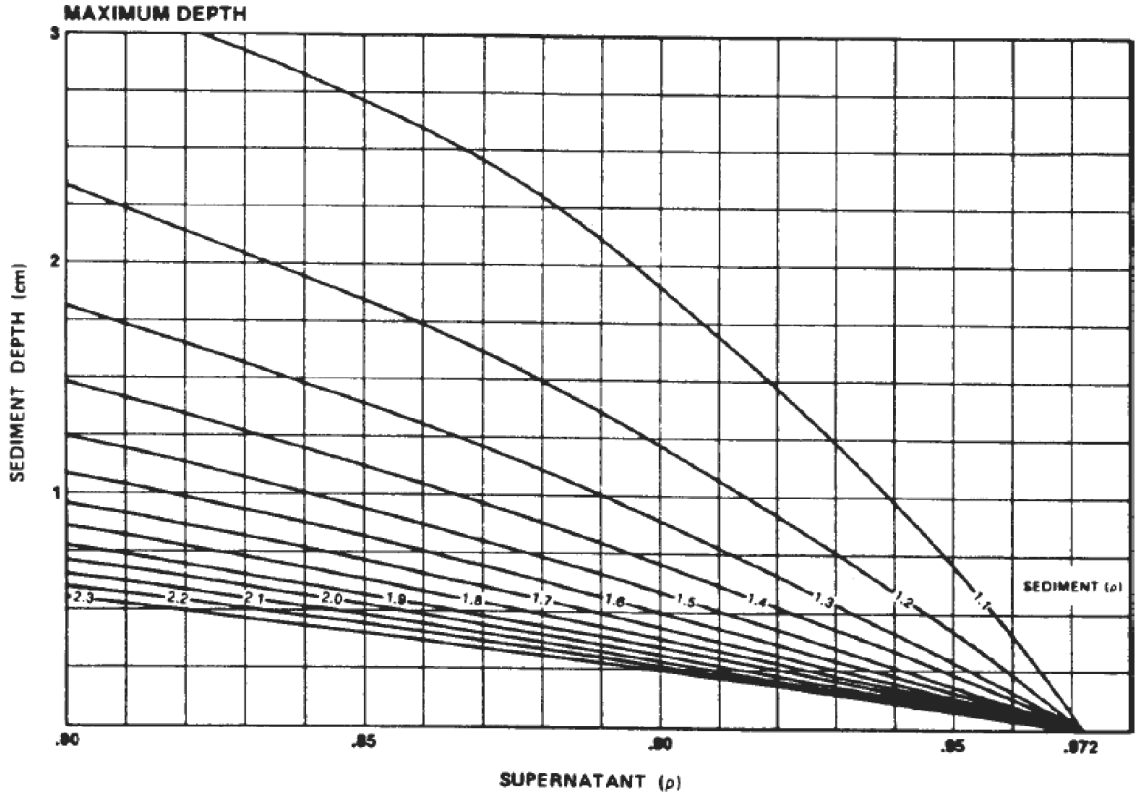


Figure 5
TCF-20 Derating Chart for Sediment Specific Gravities (ρ) higher than 1.2 g/mL, 19,000 rpm

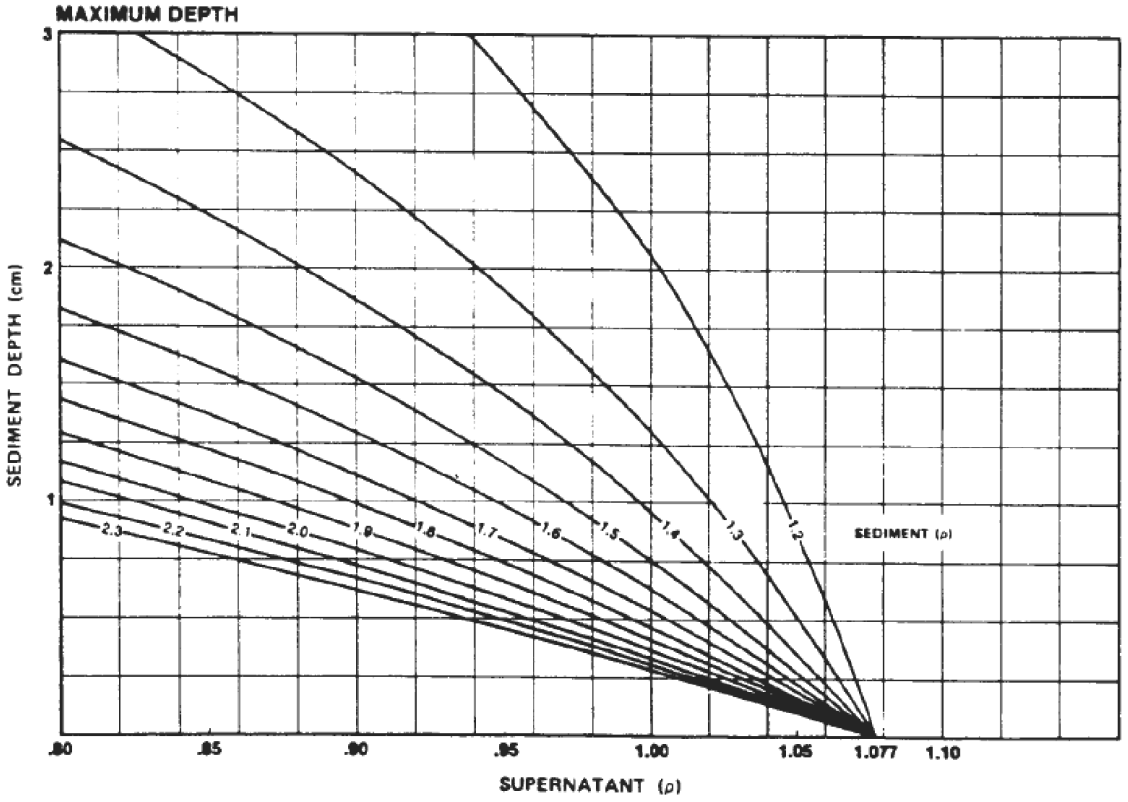


Figure 6
TCF-20 Derating Chart for Sediment Specific Gravities (ρ) higher than 1.2 g/mL, 18,000 rpm

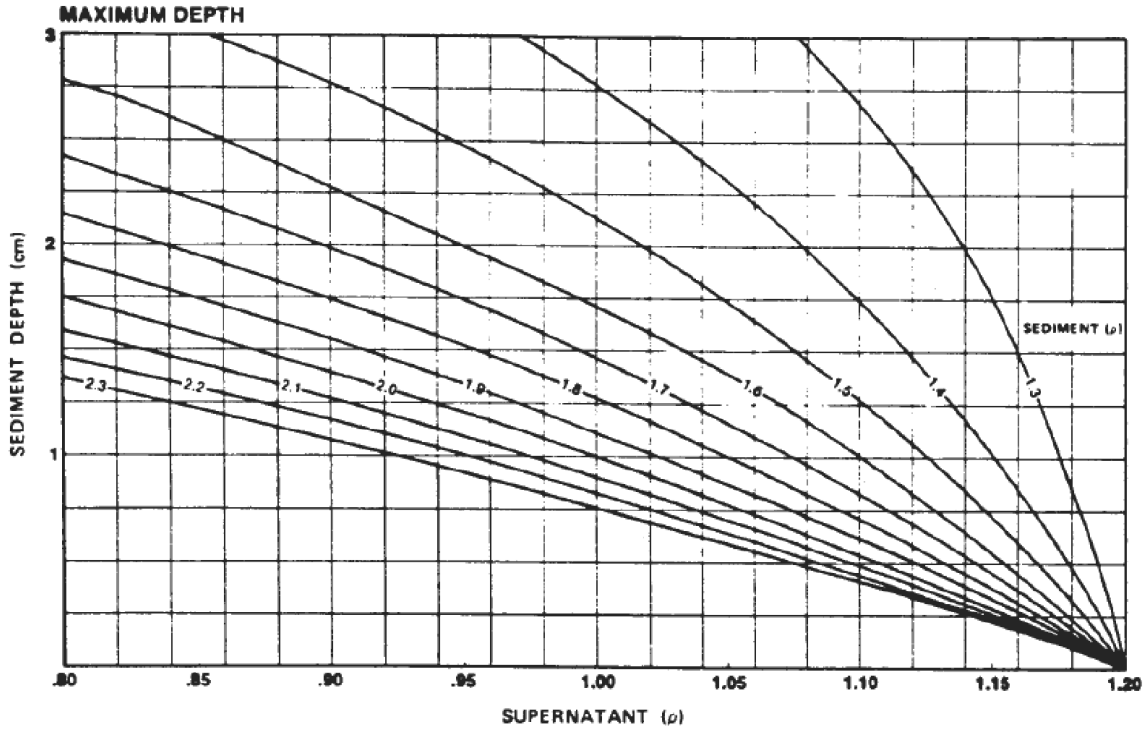


Figure 7
TCF-20 Derating Chart for Sediment Specific Gravities (ρ) higher than 1.2 g/mL, 17,000 rpm

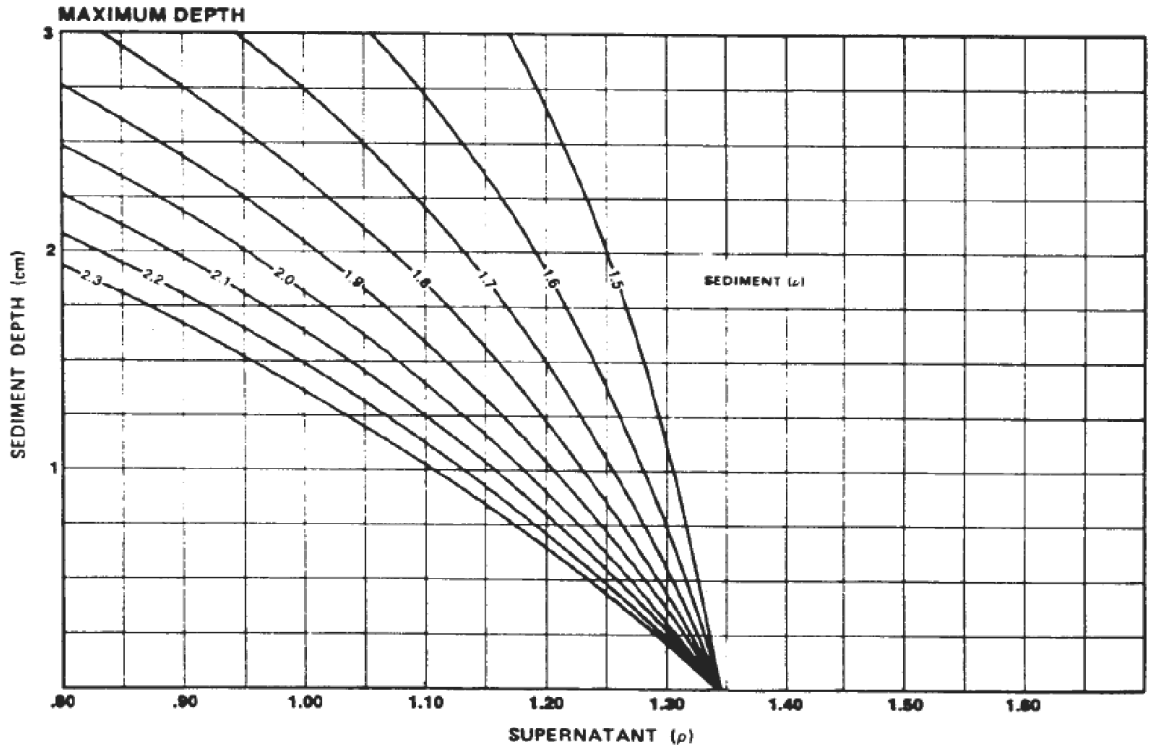


Figure 8
TCF-20 Derating Chart for Sediment Specific Gravities (ρ) higher than 1.2 g/mL, 16,000 rpm

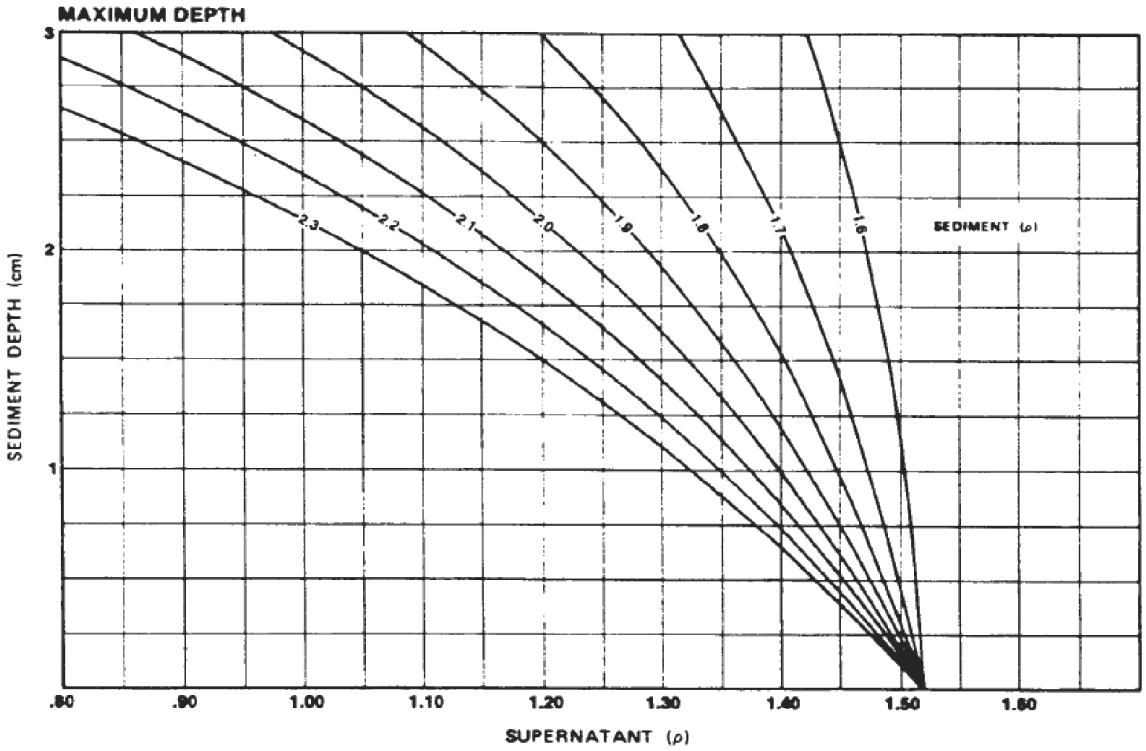


Figure 9
TCF-20 Derating Chart for Sediment Specific Gravities (ρ) higher than 1.2 g/mL, 15,000 rpm

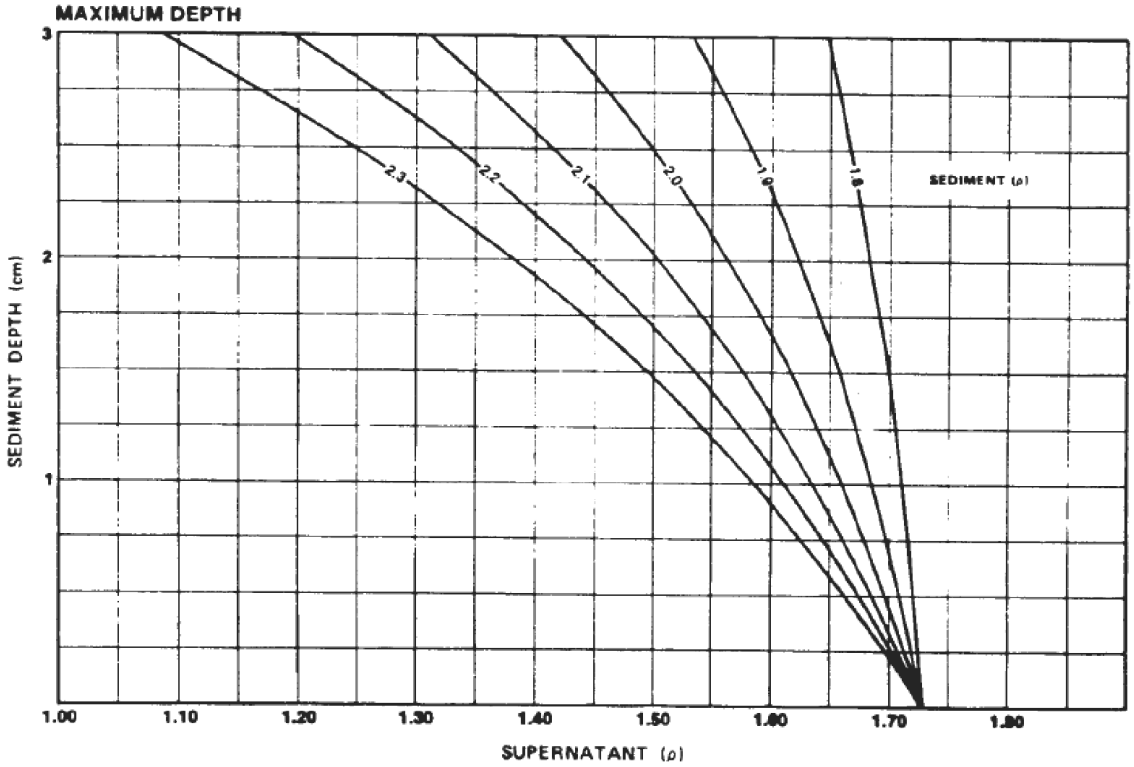
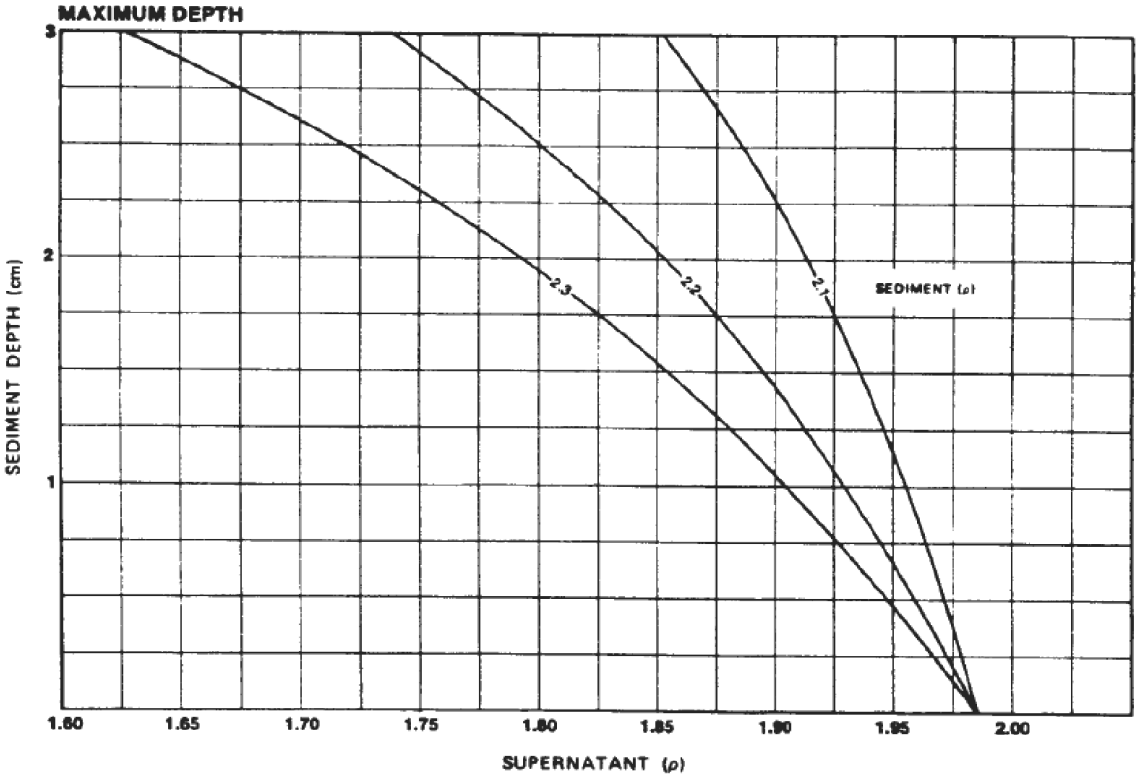


Figure 10
TCF-20 Derating Chart for Sediment Specific Gravities (ρ) higher than 1.2 g/mL, 14,000 rpm



Assembling the TCF-20 Continuous Flow System

Inlet/Outlet Assembly

To assemble the Inlet/OutleAssembly

NOTICE

All threads of the continuous flow assembly are left handed. Refer to „Figure 11“, respectively, for location and identification of parts and tools required for operation.

1. Use the dissecting needle (Catalog No. 66026) supplied to carefully remove the rotor cover O-rings and O-rings in the septa. Inspect the O-rings for cracks, tears or abrasions; replace if necessary. Lubricate each O-ring with a light film of lubricant (Catalog No. 76003500) then reinsert each O-ring into its respective part.
2. Place the lift assembly (Catalog No. 70063005) into the bottom of the distributor cap (Catalog No. 13004).
3. Place the vapor seal (Catalog No. 13012) over the lift assembly.
4. Position the bearing housing (Catalog No. 13006) over the top of the distributor cap and hand tighten.
5. Lubricate the bearings using the lubricant-filled syringe (Catalog No. 13127) supplied with the bearing assembly. Apply small dots (1-2 mm^2) of lubricant to the inner and outer race of each bearing at the ball points shown in „Figure 15“ on page 58. Rotate each bearing by hand to spread the lubricant evenly through the bearing. If any resistance is felt the bearings are worn and should be replaced.

NOTICE

Step 5 must be done before every run to ensure the proper operating conditions of the bearings.

6. Place the pair of bearing into the bearing housing. Be sure the shielded sides of the bearings face outward.
7. Add the bearing clamp ring (Catalog No. 13007) then hand tighten.
8. Use the lift plate wrench (Catalog No. 75000603) to insert the inlet/outlet connector assembly (Catalog No. 13029) down through the top of the assembly. Tighten securely. Test the assembly by holding the inlet/outlet connector assembly in one hand and rotate the rest of the assembly (it should rotate freely and without interference).

Continuous Flow Adapter Assembly

The continuous flow adapter is comprised of the feed device assembly (Catalog No. 49634) and adapter (Catalog No. 49030).

To assemble the continuous flow adapter assembly

1. Use the dissecting needle (Catalog No. 66026) supplied to carefully remove the O-rings in the continuous flow adapter (Catalog No. 49030) and feed device assembly (Catalog No. 49634). Inspect the O-rings for cracks, tears or abrasions; replace if necessary. Lubricate each O-ring with a light film of lubricant (Catalog No. 76003500), then reinsert each O-ring into its respective part.
2. Slip the Adapter over the Feed Device Assembly and compress to mate the two pieces, forming the continuous flow adapter.

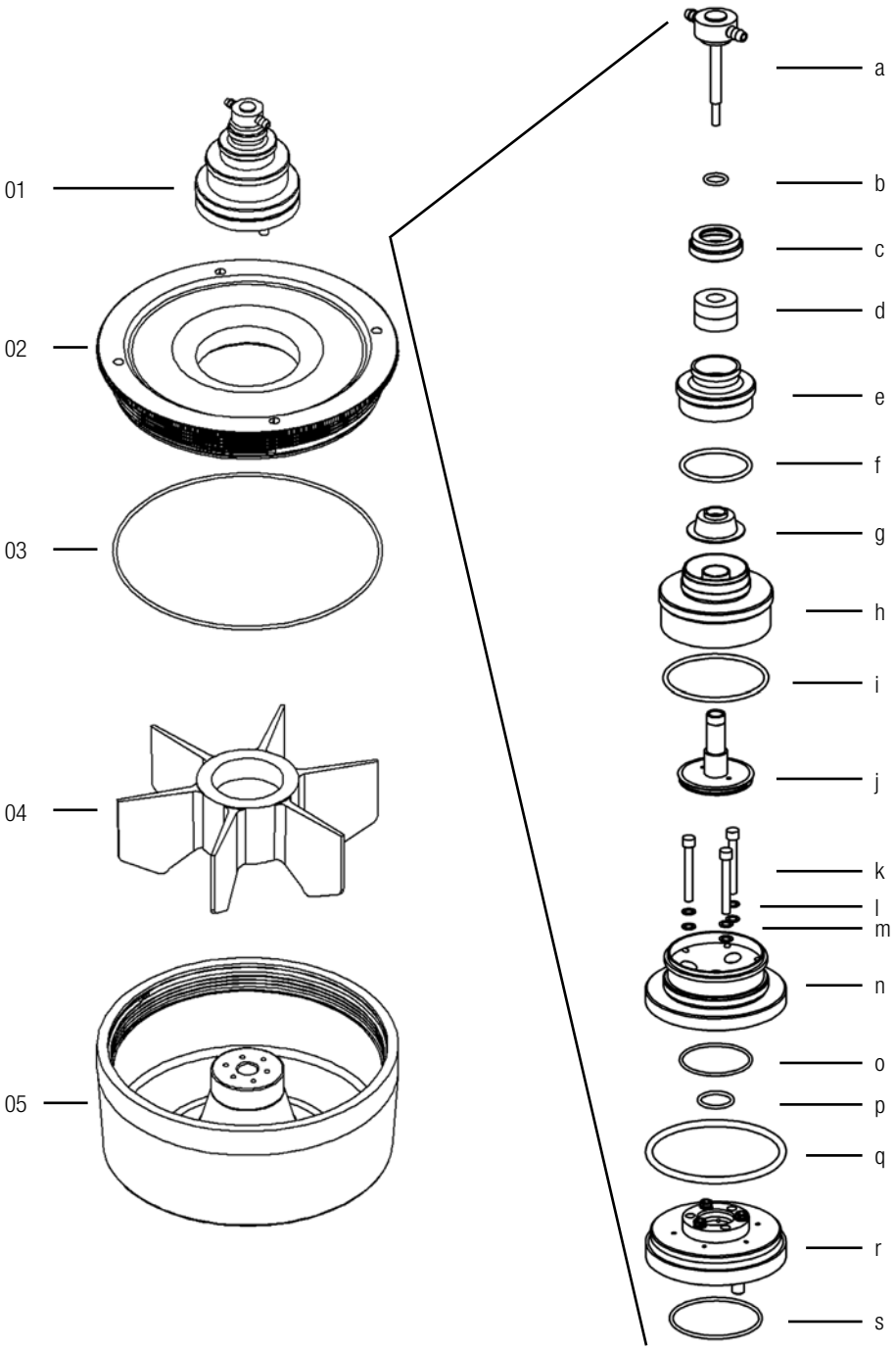


Figure 11
TCF-20 Continuous Flow System. See „Table 7“ for description of numbered items

Table 7
TCF-20 Continuous Flow System (key to Figure 11)

Figure Item Number	Quantity Supplied	Catalog Number	Description
01	1	75000605	Continuous Flow Assembly
a	1	13029	Inlet/Outlet Connector Assembly
b	1	60737	O-Ring, 0.375 x 0.063
c	1	13007	Bearing Clamp Ring
d	2	68085	Bearing Lifter
e	1	13006	Bearing Housing
f	1	60738	O-Ring, 1.313 x 0.094
g	1	13012	Vapor Seal
h	1	13004	Distributor Cap
i	1	60739	O-Ring, Viton, 50.8 x 2.4 mm, 75 Shore
j	1	70063005	Lift Assembly
k	3	62988	Hexagon Socket Screw
l	3	49056	Washer, Stainless Steel
m	3	13081	Washer, Nylon
n	1	49030	Adapter
o	1	62343	O-Ring, 35 x 1.6 mm
p	1	64576	O-Ring, 15.6 x 1.8 mm
q	1	64578	O-Ring, Viton, 66.3 x 3.6 mm, 75 Shore
r	1	49634	Rotor Lid
s	1	66308	O-Ring, 17.2 x 1.8 mm, 75 Shore
02	1	75004012	Rotor Cover
03	1	90840	O-Ring, 178.8 x 2.6 mm, 75 Shore
04	1	49609	Septa
not shown; used with the septa	6	66193	O-Ring, Viton, 4.5 x 1.8 mm, 75 Shore
05	1	75000604	Titanium Rotor Body

Final Assembly

To assemble the continuous flow rotor

1. Slide the rotor body into the rotor holding fixture.
2. Place the septa (Catalog No. 49609) in the rotor body using a slight twisting motion.
3. Fill the rotor body with 1350 mL of desired sample.

CAUTION

Always run the TCF-20 Rotor with a full fluid load (1350 mL). Running the rotor with less than a full fluid load can cause damage to the centrifuge and/or rotor due to the shifting mass of the fluid. If enough sample is not available, an overlay should be used to increase the rotor contents to 1350 mL.

4. Place the rotor cover on the rotor body. Turn the cover clockwise until it drops onto the threads of the rotor body; then turn counterclockwise until tight. Use the wrench handle assembly to securely tighten the cover.

CAUTION

Before running the TCF-20 Rotor in the centrifuge, make sure the rotor cover is properly seated. Clearance between the rotor body and rotor cover („Figure 16“ on page 65) should be no greater than 0.64 mm (0.025 inches). Operating the rotor with the cover not properly seated can cause rotor failure with subsequent damage to your centrifuge.

5. Use both hands to remove the rotor assembly from the rotor holding fixture and carefully lower it onto the centrifuge drive spindle.
6. Check that the rotor is level by placing a spirit level on the flat surface of the rotor cover. If the rotor is not level, adjust the centrifuge feet accordingly.
7. Place the assembled continuous flow adapter („Continuous Flow Adapter Assembly“ on page 45) through the rotor cover. Slowly rotate the adapter to engage the guide pins into the corresponding holes of the septa. When fully seated, the surface of the continuous flow adapter assembly will be flush with the rotor cover.

CAUTION

Failure to properly seat the continuous flow adapter assembly may cause damage to the guide pins.

8. Onto each cap screw (Catalog No. 62988, 3 each), place a stainless steel washer (Catalog No. 49056) and a nylon washer (Catalog No. 13081). The stainless steel washer should be placed closest to the head of the cap screw.
9. Place the three cap screws through the holes of the continuous flow adapter assembly. While turning the rotor in one direction, rotate the continuous flow adapter assembly/septa in the opposite direction until the screws align with the holes in the centrifuge adapter and drop into place (apply light pressure to one of the screws to locate the holes). Use the T-wrench to alternately tighten the three cap screws.
10. Precool the rotor, if necessary, to the desired temperature by using the pretempering function on the Sorvall Lynx 6000 centrifuge with the centrifuge door closed.
11. At the end of the precooling run when the rotor has stopped spinning, open the centrifuge door and attach the inlet/outlet assembly („Figure 11“ on page 45) to the continuous flow adapter assembly. Tighten the left-handed threaded cap securely.

NOTICE

Use glycerin or mineral oil as a sealing fluid. Add the oil through one of the small holes in the bearing housing using a 20 gauge hypodermic needle (2.5 ml to 3.0 ml of fluid is required for an adequate seal)

12. Prepare and connect the latex tubing (Catalog No. 13117) to the Inlet/Outlet Connector Assembly as follows („Figure 12“):
    a. Place the center of the latex tubing over a block of wood. Hold the tubing in place with the sharp end of the tube slotter (Catalog No. 13042) supplied. Tap the tube slotter with a hammer to pierce both sides of tubing (this will form a slot in the tubing).
    b. Hold the tubing tightly against the nipples of the Inlet/Outlet Connector Assembly; place one end of the slotted section of tubing over one nipple, then stretch the tubing over the other nipple.

CAUTION

Never use two separate pieces of latex tubing on the inlet/outlet assembly. To do so can result in loss of sample and/or damage to the centrifuge should the tubing become detached from the inlet/outlet assembly. Always use the tube slotter to prepare the latex tubing for use as explained above.

13. Position the remaining portion of tubing through the two inlet ports located on the right side of the centrifuge chamber. Be sure to leave some slack in the tubing remaining in the chamber.
14. Install the tube holder assembly (Catalog No. 75000601), see „Tube Holder Assembly“ on page 51.
15. Loosen the upper thumbscrew and slide the tubing holder so that the crossbar is above the center of the rotor.
16. Fasten the upper thumbscrew securely.
17. Place the latex tubing in the tubing holder assembly as follows („Figure 13“):

a. Loosen the Inner thumbscrew on the tubing holder crossbar, then thread the tubing in the guides provided on the crossbar (from both sides of the inlet/outlet assembly). Be sure the tubing shows no kinks or sharp bends.

b. Adjust the height of the crossbar.

NOTICE

There should be no more than 4 to 6 cm (1.575 to 2.362 inches) clearance between the lower end of the rubber gasket of the rotorchamber and the top of the continuous flow ring; if necessary, reposition the continuous flow ring.

CAUTION

Make sure there is enough clearance between the top of the Tube Holder Assembly (Catalog No. 75000601) and the centrifuge door to allow for safe closing of the centrifuge door without bending or pinching of the tubing.

c. Tighten the Inner thumbscrew.

d. Thread the tubing over the top of the tubing holder assembly through the guides located on top of the holder. Eliminate excess slack in the tubing.

Figure 12
Attaching the tubing to the Inlet/ Outlet Connector Assembly

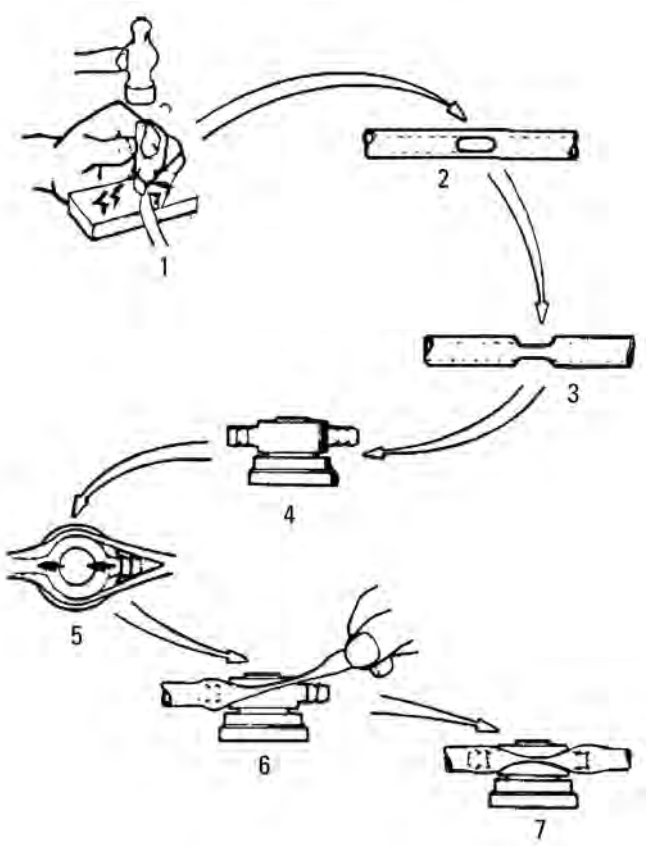
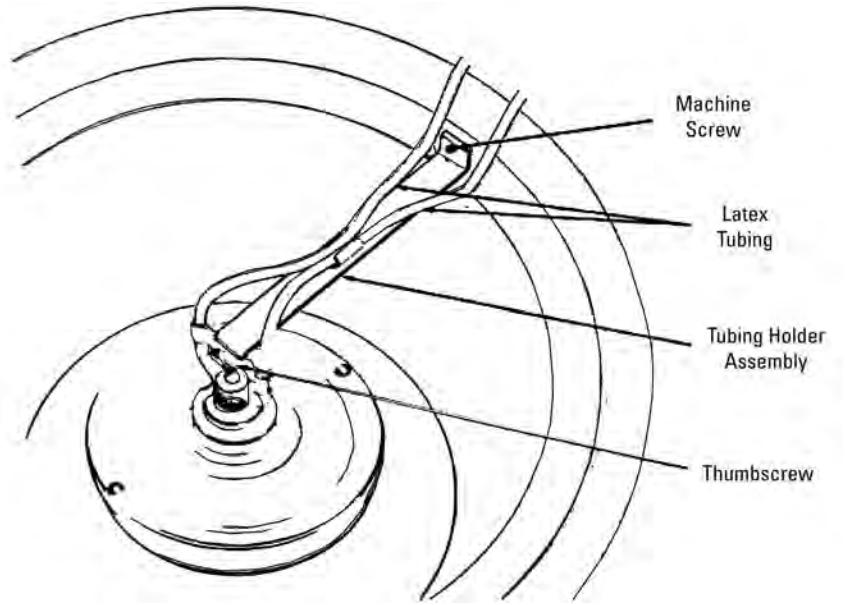


Figure 13
Tube Holder Assembly Attachment



Tube Holder Assembly

To assemble the tube holder in the Sorvall LYNX 6000 superspeed centrifuge

NOTICE

Refer to „Figure 14“ for identification of parts of the tube holder assembly.

1. Open the centrifuge lid.

WARNING

Remove the continuous flow ring when using rotors other than the TCF-20 Continuous Flow Rotor.

2. Remove the rubber plug located at the left side of the rubber gasket at the top of the rotor chamber in the Sorvall LYNX 6000 centrifuge.
3. Install the continuous flow ring (Catalog No. 20900500)
   a. Loosen the upper thumbscrew (Catalog No. 20430313) and slide the tube holder assembly to one side.
   b. Fasten the upper thumbscrew, making sure the tubing holder assembly will not move during installation of the kit and the rotor.
   c. Position the continuous flow ring in the chamber and securely tighten the setscrew (Catalog No. 20420230). If you encounter difficulties, use a pair of pliers to tighten the setscrew.

CAUTION

Make sure there is enough clearance between the top of the tube holder assembly (Catalog No. 75000601) and the centrifuge door to allow for safe closing of the centrifuge door without bending or pinching of the tubing.

NOTICE

There should be no more than 4 to 6 cm (1.575 to 2.362 inches) clearance between the lower end of the rubber gasket of the rotorchamber and the top of the continuous flow ring; if necessary, reposition the continuous flow ring.

4. Assembly and install the TCF-20 continuous rotor in the centrifuge („Assembling the TCF-20 Continuous Flow System“ on page 44).

Figure 14
Tube Holder Assembly. See „Table 8“ for description of numbered items

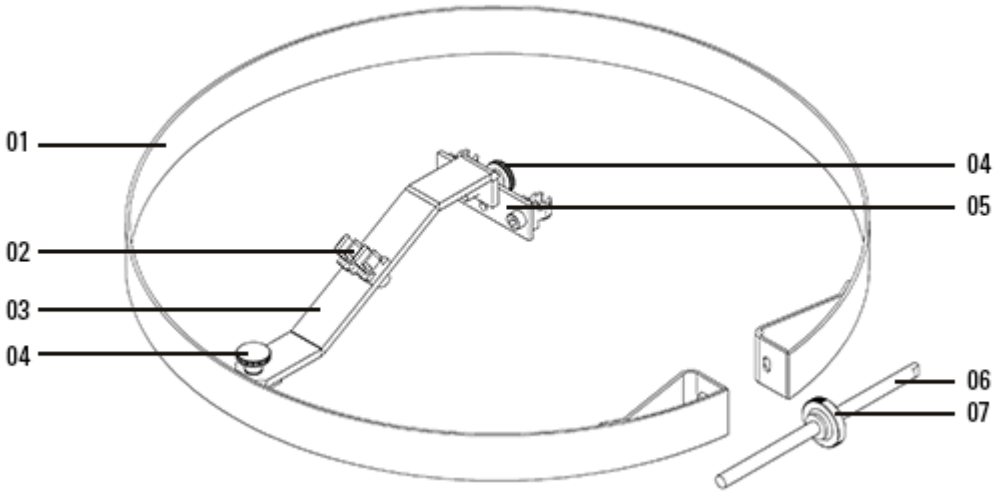


Table 8
Tube Holder Assembly (key to Figure 14)

Figure Item Number	Quantity Supllied	Catalog Number	Description
01	1	20900500	Continuous Flow Ring
02	4	20220624	Tubing Guides
	4	20510279	Hexagon Socket Screw
03	1	70063004	Tube Holder
04	2	20430313	Thumbscrew
	2	20480135	Washer, VA
	2	20480167	Nut
05	1	20058286	Crossbar
06	1	70063003	Threaded Rod
07	1	20420230	Set Screw
	2	20220416	Cable Clip

Operating the TCF-20 Continuous Flow System

To operate the TCF-20 continuous flow system

NOTICE

During a centrifuge run, the timer of the centrifuge should be set to HOLD to prevent shut-off at the end of a timed period if the run is not completed

1. Connect the inlet tubing to the reservoir containing the particle suspension (an arrow stamped on the top of the inlet/outlet assembly indicates the direction of flow through the rotor) and direct the outlet tubing into a collecting vessel.
2. Close the centrifuge door and perform the run as explained in the centrifuge instruction manual.

NOTICE

The minimum operating speed for the continuous flow system is 8000 rpm. When processing small or hard-to-sediment particles, top speed should be reached and maintained for several minutes before beginning sample flow through the rotor.

3. Begin sample flow through the rotor when the desired operating speed is reached. Flow through the rotor should begin after approximately 150 mL of solution has been introduced. If flow rate does not begin, increase the inlet pressure. Maximum flow rate cannot be attained unless the reservoir containing the particle suspension is between 61 cm to 76 cm (24 to 30 inches) above the rotor. If desired a peristaltic pump may be used to accelerate the flow rate.

End of Run

In order to “pack” the residual particles remaining in the rotor body, continue centrifugation for several minutes after all the suspension has been processed. If desired, pass several hundred milliliters of water or saline through the rotor before you begin to decelerate the rotor.

To end the continuous flow run

1. Stop the sample flow.
2. Decelerate the rotor.
3. As soon as deceleration begins, insert the tip of the polyethylene bottle (Catalog No. 60753) supplied into the end of the outlet tubing and aspirate until the rotor stops spinning (this will prevent leakage of excess fluid produced during deceleration. If desired, a peristalic pump may be used to extract excess fluid from both the inlet and outlet tubing. Pumping of excess fluid is more efficiently performed before the rotor deceleration. Excess fluid is produced during acceleration; as the rotor body expands it takes in additional fluid, then as the rotor decelerates it contracts and this fluid is released resulting in excess fluid in the rotor).
4. When the rotor stops spinning, open the centrifuge door and remove the latex tubing from the tubing holder assembly then remove the tubing holder.

5. Disconnect the latex tubing from the nipples of the Inlet/Outlet Connector Assembly.
6. Loosen the inlet/outlet assembly, if necessary using the strap wrench (Catalog No. 75000606) supplied. Remove the inlet/outlet assembly from the rotor.
7. Use a plastic pipette to withdraw the liquid.
8. Use the T-Wrench to loosen the three cap screws.
9. Carefully remove the continuous flow adapter by pulling it in a straight upward motion. If the Adapter becomes detached from the feed device assembly remove the feed device assembly with the lifting wrench (Catalog No. 49058) supplied.
10. Disassemble the inlet/outlet assembly and the continuous flow assembly. Clean all parts („Cleaning and Decontamination“ on page 57).
11. Firmly press the rotor unlocking tool (Catalog No. 75000602) into the center of the rotor to engage the release of the rotor from the spindle
12. Carefully lift the rotor off the drive spindle and place it in the rotor holding fixture.
13. Remove the rotor cover.
14. Remove the residual supernatant remaining in the center of the rotor body by aspiration.
15. Remove the sediment from the rotor using a rubber, wooden or Teflon™-coated spatula.
16. Clean the rotor assembly („Cleaning and Decontamination“ on page 57).

6

Maintenance and Care

Cleaning and Decontamination

Cleaning

> **CAUTION**
>
> These procedures are for general cleaning purposes only. If the rotor or any of its parts are exposed to a contaminate, they must be decontaminated first, then washed.

Cleaning the TCF-20 Rotor

1. Wash the rotor body and rotor cover:

   Wash the rotor body and rotor cover with warm water and a mild, pH neutral, non-alkaline detergent after each use. It is particularly important to wash the rotor and cover immediately after any spills have occurred. Most laboratory chemicals can be removed with lukewarm, 1% solution of a mild, pH neutral, non-alkaline detergent. Rinse the rotor and cover well, inside and out. After rinsing, dry thoroughly with a soft absorbent cloth.

2. Wash the septa, distributor, adapter, feed device assembly, distributor body, and holddown plate:

   To prevent clogging of all feed lines and ports, fill the polyethylene bottle with water then place the tip of the bottle into each feed line and port then flush clean.

3. Wash the bearings:

   Place the bearings in a beaker containing 50 mL of Toluene solvent. Put the beaker into an ultrasonic cleaner and let the bearings soak for three to five minutes. If you do not have an ultrasonic cleaner, stir the solvent periodically. If necessary repeat this step using fresh solvent until all lubricant has been removed. When the bearings are clean, remove them from the solvent and dry the bearings as follows:

   i. Lay the bearings on a clean absorbent cloth with their shielded sides facing up; leave them there until all of the solvent has drained out and bearings are completely dry.

   or

   ii. Dry the bearings with an air blast, but make sure the bearings do not rotate while beingdried.

Decontamination

All parts except the continuous flow system bearings may be autoclaved at temperatures up to 121 °C (250 °F) at 15 psi for 15 minutes. Ethylene oxide, a 2% glutaraldehyde solution, or ultraviolet radiation are also recommended methods of sterilization.

⚠	**CAUTION**
Do not autoclave the continuous flow system bearings.	

To decontaminate the TCF-20 rotor

1. For general radioactive decontamination, use a solution of equal parts of 70% ethanol, 10% SDS, and water.
2. Follow this with ethanol rinses, then deionized water rinses, and dry with a soft absorbent cloth.
3. Dispose of all wash solutions in proper radioactive waste containers.

⚠	**CAUTION**
Before using any cleaning, disinfecting, or decontaminating methods except those recommended, users should check with Thermo Fisher Scientific that the proposed method will not damage the equipment.	

Bearing Lubrication

Before every continuous flow run, lubricate the bearings of the TCF-20 rotor system.

To lubricate the bearings

1. Use the lubricant-filled syringe, supplied with the bearings, and apply small dots (1-2 mm^2) of lubricant to the inner and outer race of each bearing at the ball locations („Figure 15“).
2. Rotate each bearing by hand to spread the lubricant evenly through the bearing.

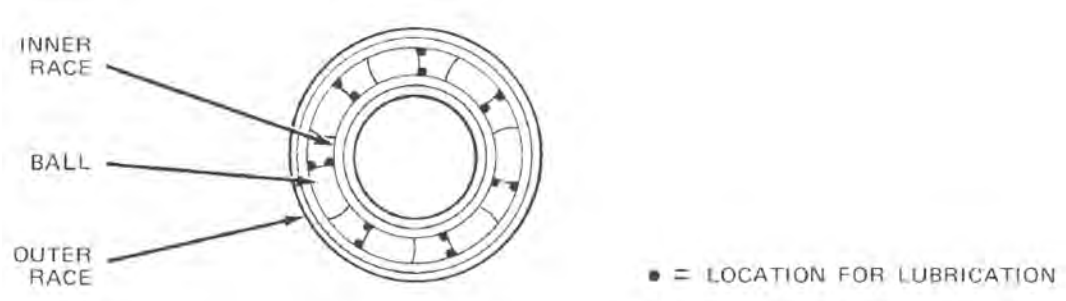


Figure 15
Lubrication Points of the Bearings

Service Decontamination Policy

WARNING

Because of the characteristics of the samples likely to be processed in this rotor, biological or radioactive contamination may occur. Always be aware of this possibility and take normal precautions. Use appropriate decontamination procedures should exposure occur.

If a centrifuge or rotor that has been used with radioactive or pathogenic material requires servicing by Thermo Fisher Scientific personnel, either at the customer's laboratory or at a Thermo Fisher Scientific facility, comply with the described procedure to ensure the safety of all personnel.

To comply with the service decontamination policy

1. Clean the centrifuge or rotor to be serviced of all encrusted material and decontaminate it („Cleaning and Decontamination“ on page 57) prior to servicing by the Thermo Fisher Scientific representative or returning it to the Thermo Fisher Scientific facility. There must be no radioactivity detectable by survey equipment.

   Clean and decontaminate your centrifuge or rotor as follows:

   a. Remove rotor from the rotor chamber.

   b. Remove, wash, and decontaminate motor sealing gasket and pad.

   c. Decontaminate lid, rotor chamber, and drive using an appropriate method.

   d. Remove all encrusted material from around the motor and drive assemblies.

   For rotor:

   Decontaminate rotor using an appropriate method. If any assembled part, or the rotor cover is stuck, notify Thermo Fisher Scientific representative. Be prepared with the name and nature of the sample so the Thermo Fisher Scientific Chemical Hazards Officer can decide whether to authorize the rotor's return to a Thermo Fisher Scientific facility.

2. Complete and attach Decontamination Information Certificate to the centrifuge or rotor before servicing or returning to a Thermo Fisher Scientific facility. If Certificate is not available, attach a written statement verifying decontamination (what was contaminant and what decontamination method was used).

   If the centrifuge or rotor must be returned to a Thermo Fisher Scientific facility:

1. Contact your Thermo Fisher Scientific representative to obtain a Return Service Order Number (RSO No.). Be prepared with the name and serial number of the centrifuge or rotor and the repairs required.
2. Send item(s) with the RSO No. clearly marked on the outside of packaging to the address obtained from your Thermo Fisher Scientific representative.

NOTICE

United States federal regulations require that parts and instruments must be decontaminated before being transported. Outside the United States, check local regulations.

If a centrifuge or rotor to be serviced does not have a Decontamination Information Certificate attached and, in Thermo Fisher Scientific's opinion presents a potential radioactive or biological hazard, the Thermo Fisher Scientific representative will not service the equipment until proper decontamination and certification is complete. If Thermo Fisher Scientific receives a centrifuge or rotor at its Service facilities which, in its opinion, is a radioactive or biological hazard, the sender will be contacted for instructions as to disposition of the equipment. All disposition costs will be borne by the sender.

7

Disposal

WARNING

When removing the centrifuge and accessories from use for disposal you have to clean and if necessary disinfect or decontaminate the entire system. In doubt contact the Thermo Fisher Scientific customer service.

For the disposal of the rotor mind the regulations in your country. In doubt contact the Thermo Fisher Scientific Customer Service for the disposal of the centrifuge.
For the countries of the European Union the disposal is regulated by the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC.
Mind the information on transport and shipping within the centrifuge instruction manual.

WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Fisher Scientific has contracted with one or more recycling or disposal companies in each European Union (EU) Member State, and these companies should dispose of or recycle this product. See www.thermoscientific.com/rohsweee for further information on Thermo Fisher Scientific's compliance with these Directives and the recyclers in your country.

A

RCF-Values

Relative Centrifugal Force (RCF) refers to the force during centrifugation that moves the particulate outward from the center of rotation. This force is proportional to the radial distance and the square of the rotor speed. The RCF value is determined by the following formula:

$$RCF = 11.18\ (r)(rpm/1000)^2$$

when r = the radius in centimeters from the centerline of the rotor to the point in the tube where RCF value is required

and rpm = the rotor speed in revolutions per minute

„Figure 17“ represents the volume occupied by a liquid within the spinning rotor in relation to the maximum internal radius of the rotor, 9.52 cm (3.75 inches). The points marked A, B, C and D in „Figure 16“ correspond to inflection points on the curve in „Figure 17“ and may be used as reference points.

„Table 9“ may be used in conjunction with „Figure 17“. In „Table 9“, representative volumes are listed along with their inside vertical surface radii. The determination of RCF can be helpful when a cushion is used since the actual forces exerted against the sample can be accurately noted. For example, if a 100 mL cushion and a 900 mL gradient were used, then the sample introduced, the forces developed on the sample at 10,000 rpm will range from 6,600 at the free fluid surface of the gradient to 10,300 at the interface of gradient and cushion.

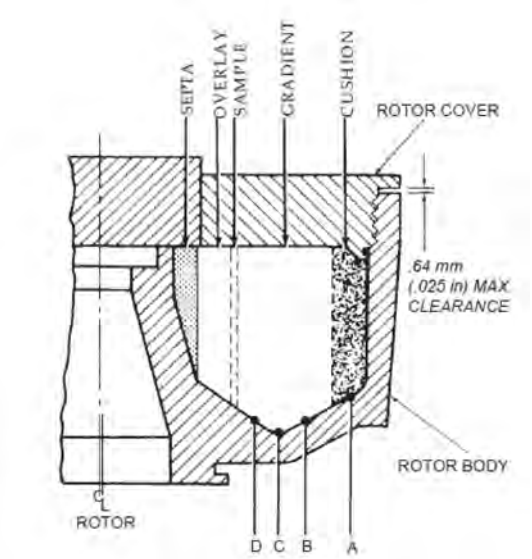


Figure 16
TCF-20 Volume vs. Radius. Clearance between the rotor cover and rotor body is shown.

Figure 17
Graphical Representation of TCF-20 Volume vs. Radius

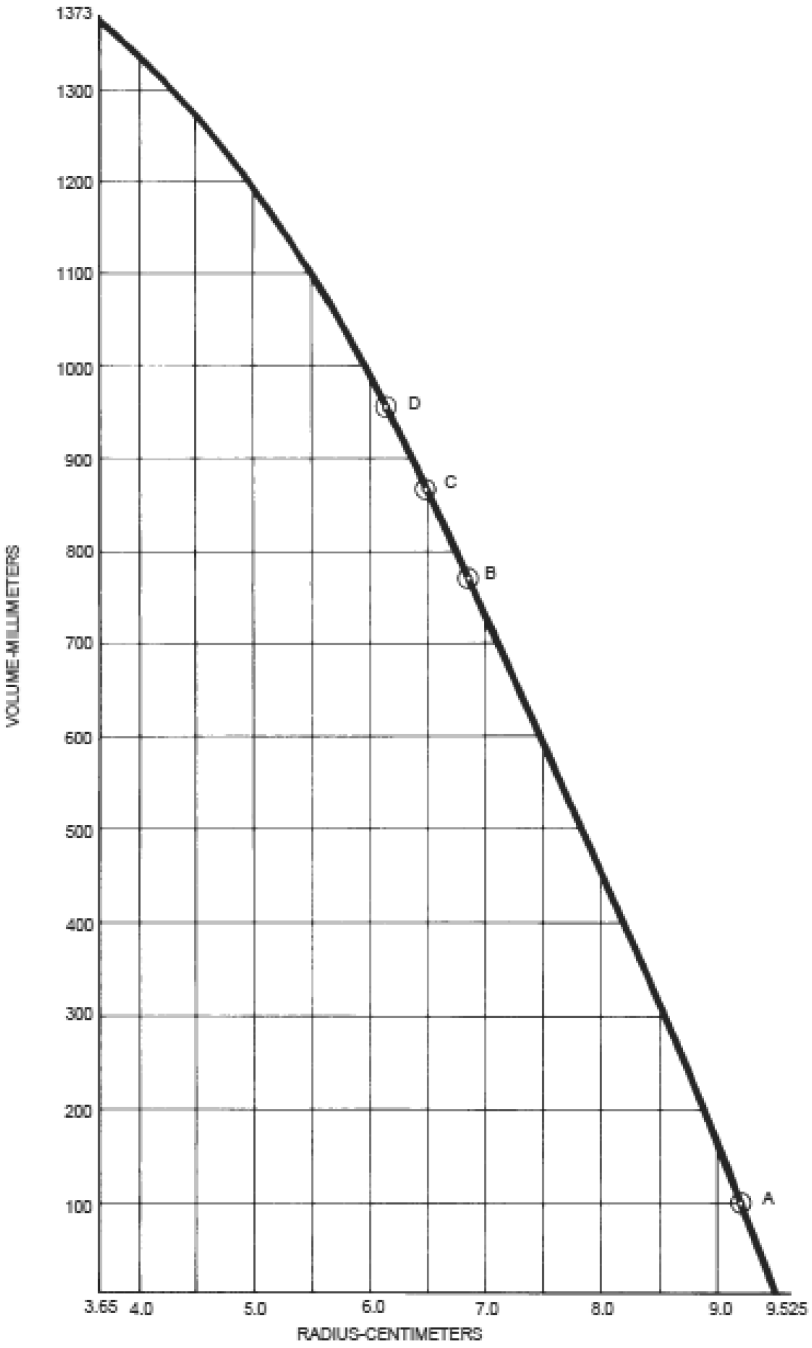


Table 9
TCF-20 Rotor
RCF-values and
K-factors

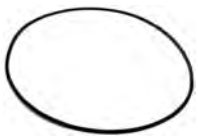
r (cm)	**3,6**	**4,3**	**4,9**	**5,5**	**5,9**	**6,3**	**6,7**	**7,1**	**7,4**	**7,8**	**8,1**	**8,5**	**8,8**	**9,2**	**9,6**	
Vol (mL)	1373	1300	1200	1100	1000	900	800	700	600	500	400	300	200	100	0	
rpm	RCF (x g)															**K-factor**
1000	40	48	55	61	66	70	75	79	83	87	91	95	98	103	107	**248150**
1500	91	108	123	138	148	158	169	179	186	196	204	214	221	231	241	**110289**
2000	161	192	219	246	264	282	300	318	331	349	362	380	394	411	429	**62037**
2500	252	300	342	384	412	440	468	496	517	545	566	594	615	643	671	**39704**
3000	362	433	493	553	594	634	674	714	745	785	815	855	885	926	966	**27572**
3500	493	589	671	753	808	863	918	972	1013	1068	1109	1164	1205	1260	1315	**20257**
4000	644	769	877	984	1055	1127	1198	1270	1324	1395	1449	1520	1574	1646	1717	**15509**
4500	815	973	1109	1245	1336	1426	1517	1607	1675	1766	1834	1924	1992	2083	2173	**12254**
5000	1006	1202	1370	1537	1649	1761	1873	1984	2068	2180	2264	2376	2460	2571	2683	**9926**
5500	1218	1454	1657	1860	1995	2131	2266	2401	2503	2638	2739	2875	2976	3111	3247	**8203**
6000	1449	1731	1972	2214	2375	2536	2697	2858	2978	3139	3260	3421	3542	3703	3864	**6893**
6500	1700	2031	2315	2598	2787	2976	3165	3354	3495	3684	3826	4015	4157	4346	4535	**5873**
7000	1972	2356	2684	3013	3232	3451	3670	3890	4054	4273	4437	4656	4821	5040	5259	**5064**
7500	2264	2704	3081	3459	3710	3962	4213	4465	4654	4905	5094	5345	5534	5786	6037	**4412**
8000	2576	3077	3506	3935	4222	4508	4794	5080	5295	5581	5796	6082	6297	6583	6869	**3877**
8500	2908	3473	3958	4443	4766	5089	5412	5735	5977	6300	6543	6866	7108	7431	7754	**3435**
9000	3260	3894	4437	4981	5343	5705	6067	6430	6701	7064	7335	7697	7969	8331	8694	**3064**
9500	3632	4339	4944	5549	5953	6357	6760	7164	7467	7870	8173	8576	8879	9283	9686	**2750**
10000	4025	4807	5478	6149	6596	7043	7491	7938	8273	8720	9056	9503	9838	10286	10733	**2481**
10500	4437	5300	6040	6779	7272	7765	8258	8751	9121	9614	9984	10477	10847	11340	11833	**2251**
11000	4870	5817	6629	7440	7981	8523	9064	9605	10011	10552	10958	11499	11904	12446	12987	**2051**
11500	5323	6358	7245	8132	8723	9315	9906	10498	10941	11533	11976	12568	13011	13603	14194	**1876**
12000	5796	6923	7889	8855	9499	10142	10786	11430	11913	12557	13040	13684	14167	14811	15455	**1723**
12500	6289	7512	8560	9608	10307	11005	11704	12403	12927	13626	14150	14848	15373	16071	16770	**1588**
13000	6802	8125	9258	10392	11148	11903	12659	13415	13982	14737	15304	16060	16627	17383	18138	**1468**
13500	7335	8761	9984	11207	12022	12837	13652	14467	15078	15893	16504	17319	17930	18746	19561	**1362**
14000	7889	9423	10737	12052	12929	13805	14682	15558	16215	17092	17749	18626	19283	20160	21036	**1266**
14500	8462	10108	11518	12928	13869	14809	15749	16689	17394	18335	19040	19980	20685	21625	22566	**1180**
15000	9056	10817	12326	13835	14841	15848	16854	17860	18615	19621	20376	21382	22136	23143	24149	**1103**
15500	9670	11550	13161	14773	15847	16922	17996	19071	19876	20951	21757	22831	23637	24711	25786	**1033**
16000	10303	12307	14024	15741	16886	18031	19176	20321	21179	22324	23183	24328	25186	26331	27476	**969**
16500	10958	13088	14914	16741	17958	19176	20393	21611	22524	23741	24654	25872	26785	28003	29220	**911**
17000	11632	13893	15832	17771	19063	20355	21648	22940	23910	25202	26171	27464	28433	29725	31018	**859**
17500	12326	14723	16777	18831	20201	21570	22940	24310	25337	26706	27733	29103	30130	31500	32869	**810**
18000	13040	15576	17749	19923	21372	22821	24270	25718	26805	28254	29341	30790	31876	33325	34774	**766**
18500	13775	16453	18749	21045	22575	24106	25637	27167	28315	29846	30993	32524	33672	35202	36733	**725**
19000	14530	17355	19776	22198	23812	25427	27041	28655	29866	31481	32691	34306	35517	37131	38745	**687**
19500	15304	18280	20831	23382	25082	26783	28483	30183	31459	33159	34435	36135	37411	39111	40811	**653**
20000	16099	19230	21913	24596	26385	28174	29962	31751	33093	34882	36223	38012	39354	41142	42931	**620**

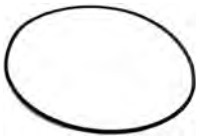
B

Appendix

The shown pictures are just examples. They may differ in color. The size of the shown objects, especially the O-Rings, has to be used with the associated size.

Table 10
Parts and
Accessories

Catalog No.	Item Description	Quantitiy	Picture
75000604	Titanium Rotor Body		
75004012	Rotor Cover		
49609	Septa	1	
75000601	Tube Holder Assembly	1	
75004006	**O-Ring Set Zonal**		
61289	O-Ring, Buna, 7.7 x 11.3 x 1.8 mm, 75 Shore	12	
63037	O-Ring, Viton, 12.7 x 11.3 x 1.8 mm, 75 Shore	2	
64578	O-Ring, Viton, 66.3 x 3.6, 75 Shore	2	
66308	O-Ring, Viton, 44.9 x 1.8 mm, 75 Shore	2	
66330	O-Ring, 17.2 x 1.8 mm, 75 Shore	2	
90840	O-Ring, 178.8 x 2.6 mm, 75 Shore	2	
76003500	Lubricant	1	

Catalog No.	Item Description	Quantitiy	Picture
75004007	**O-Ring Set Continuous Flow**		
60738	O-Ring, 1.313 x 0.094	2	
60739	O-Ring, Viton, 50.8 x 2.4 mm, 75 Shore	2	
62343	O-Ring, 1.375 x 0.063	2	
64576	O-Ring, 0.614 x 0.070	2	
64578	O-Ring, Viton, 66.3 x 3.6, 75 Shore	2	
66308	O-Ring, Viton, 44.9 x 1.8 mm, 75 Shore	2	
90840	O-Ring, 178.8 x 2.6 mm, 75 Shore	2	
60737	O-Ring, 0.375 x 0.063	2	
61289	O-Ring, Buna, 7.7 x 11.3 x 1.8 mm, 75 Shore	12	
76003500	Lubricant	1	
75004008	**Screws and small parts**		
62987	Hexagon Socket Screw 8/32 x 1.125" VA	6	
62988	Hexagon Socket Screw	6	
66329	Hexagon Socket Screw 8/32 x 0.437" VA	6	
70009824	Corrosion Protection Oil	1	
75003786	Lubricant Grease	2	
49056	Washer, Stainless Steel	6	
13081	Washer, Nylon	6	

Catalog No.	Item Description	Quantitiy	Picture
75004052	Tool Kit		
49058	Wrench Lifting	1	
49724	Wrench	1	
52540	Rotor Holding Fixture	1	
66026	Dissecting Needle	1	
92365	Allen Wrench 9/64	1	
92366	Allen Wrench 5/32	1	
75000602	Unlock Tool	1	
75000603	Lift Plate Wrench	1	
75000606	Strap Wrench		
75000634	Tubing Slotter	1	
75004212	Spring Clip	1	
70063016	Adapter Unit	1	

Catalog No.	Item Description	Quantitiy	Picture
75004050	**Bearing Kit**		
13127	Bearing Lubricating Grease	1	
68085	Bearing Lifter	2	
75000605	Continuous Flow Assembly (for details see „TCF-20 Continuous Flow System“ on page 46)		
75004051	Zonal Mode Assembly Sealed (for details see „Rotor Assembly for Sealed Operation.“ on page 28) Unsealed (for details see „Rotor Assembly for Unsealed Operation.“ on page 37)		 
75003503	Peristaltic Pump		
13117	Latex Tubing, diameter 3.75 mm		

C

Chemical Compatibility Chart

CHEMICAL	MATERIAL	ALUMINUM	ANODIC COATING for ALUMINUM	BUNA N	CELLULOSE ACETATE BUTYRATE	POLYURETHANE ROTOR PAINT	COMPOSITE Carbon Fiber/Epoxy	DELRIN™	ETHYLENE PROPYLENE	GLASS	NEOPRENE	NORYL™	NYLON	PET1, POLYCLEAR™,CLEARCRIMP™	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYETHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A™, TEFLON™	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON™	VITON™
2-mercaptoethanol		S	S	U	/	S	M	S	/	S	U	S	S	U	S	S	/	S	S	S	S	U	S	S	S	S	S	S
Acetaldehyde		S	/	U	U	/	/	/	M	/	U	/	/	/	M	U	U	U	M	M	/	M	S	U	/	S	/	U
Acetone		M	S	U	U	S	U	M	S	S	U	U	S	U	S	U	U	U	S	S	U	U	S	M	M	S	U	U
Acetonitrile		S	S	U	/	S	M	S	/	S	S	U	S	U	M	U	U	/	S	M	U	U	S	S	S	S	U	U
Alconox™		U	U	S	/	S	S	S	/	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S	U
Allyl Alcohol		/	/	/	U	/	/	S	/	/	/	/	S	/	S	S	M	S	S	S	/	M	S	/	/	S	/	/
Aluminum Chloride		U	U	S	S	S	S	U	S	S	S	S	M	S	S	S	S	/	S	S	S	S	S	M	U	U	S	S
Formic Acid (100%)		/	S	M	U	/	/	U	/	/	/	/	U	/	S	M	U	U	S	S	/	U	S	/	U	S	/	U
Ammonium Acetate		S	S	U	/	S	S	S	/	S	S	S	S	S	S	S	U	/	S	S	S	S	S	S	S	S	S	S
Ammonium Carbonate		M	S	U	S	S	S	S	S	S	S	S	S	S	S	U	U	/	S	S	S	S	S	S	M	S	S	S
Ammonium Hydroxide (10%)		U	U	S	U	S	S	M	S	S	S	S	S	/	S	U	M	S	S	S	S	S	S	S	S	S	M	S
Ammonium Hydroxide (28%)		U	U	S	U	S	U	M	S	S	S	S	S	U	S	U	M	S	S	S	S	S	S	S	S	S	M	S
Ammonium Hydroxide (conc.)		U	U	U	U	S	U	M	S	/	S	/	S	U	S	U	U	S	S	S	/	M	S	S	S	S	/	U
Ammonium Phosphate		U	/	S	/	S	S	S	S	S	S	S	S	/	S	S	M	/	S	S	S	S	S	S	M	S	S	S
Ammonium Sulfate		U	M	S	/	S	S	U	S	S	S	S	S	S	S	S	S	/	S	S	S	S	S	S	U	S	S	U
Amyl Alcohol		S	/	M	U	/	/	S	S	/	M	/	S	/	M	S	S	S	S	M	/	/	/	U	/	S	/	M
Aniline		S	S	U	U	S	U	S	M	S	U	U	U	U	U	U	U	/	S	M	U	U	S	S	S	S	U	S
Sodium Hydroxide (<1%)		U	/	M	S	S	S	/	/	S	M	S	S	/	S	M	M	S	S	S	S	S	S	M	S	S	/	U
Sodium Hydroxide (10%)		U	/	M	U	/	/	U	/	M	M	S	S	U	S	U	U	S	S	S	S	S	S	M	S	S	/	U
Barium Salts		M	U	S	/	S	S	S	S	S	S	S	S	S	S	S	M	/	S	S	S	S	S	S	M	S	S	S
Benzene		S	S	U	U	S	U	M	U	S	U	U	S	U	U	U	M	U	M	U	U	U	S	U	U	S	U	S
Benzyl Alcohol		S	/	U	U	/	/	M	M	/	M	/	S	U	U	U	U	U	U	U	/	M	S	M	/	S	/	S
Boric Acid		U	S	S	M	S	S	U	S	S	S	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S
Cesium Acetate		M	/	S	/	S	S	S	/	S	S	S	S	/	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Cesium Bromide		M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S

CHEMICAL	MATERIAL	ALUMINUM	ANODIC COATING for ALUMINUM	BUNA N	CELLULOSE ACETATE BUTYRATE	POLYURETHANE ROTOR PAINT	COMPOSITE Carbon Fiber/Epoxy	DELRIN™	ETHYLENE PROPYLENE	GLASS	NEOPRENE	NORYL™	NYLON	PET1, POLYCLEAR™,CLEARCRIMP™	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYETHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A™, TEFLON™	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON™	VITON™
Cesium Chloride		M	S	S	U	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Cesium Formate		M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Cesium Iodide		M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Cesium Sulfate		M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Chloroform		U	U	U	U	S	S	M	U	S	U	U	M	U	M	U	U	U	M	M	U	U	S	U	U	U	M	S
Chromic Acid (10%)		U	/	U	U	S	U	U	/	S	S	S	U	S	S	M	U	M	S	S	U	M	S	M	U	S	S	S
Chromic Acid (50%)		U	/	U	U	/	U	U	/	/	/	S	U	U	S	M	U	M	S	S	U	M	S	/	U	M	/	S
Cresol Mixture		S	S	U	/	/	/	S	/	S	U	U	U	U	U	U	/	/	U	U	/	U	S	S	S	S	U	S
Cyclohexane		S	S	S	/	S	S	S	U	S	U	S	S	U	U	U	M	S	M	U	M	M	S	U	M	M	U	S
Deoxycholate		S	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	S	S	S	S
Distilled Water		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Dextran		M	S	S	S	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Diethyl Ether		S	S	U	U	S	S	S	U	S	U	U	S	U	U	U	U	U	U	U	U	U	S	S	S	S	M	U
Diethyl Ketone		S	/	U	U	/	/	M	/	S	U	/	S	/	M	U	U	U	M	M	/	U	S	/	/	S	U	U
Diethylpyro-carbonate		S	S	U	/	S	S	S	/	S	S	U	S	U	S	U	/	/	S	S	S	M	S	S	S	S	S	S
Dimethylsulfoxide		S	S	U	U	S	S	S	/	S	U	S	S	U	S	U	U	/	S	S	U	U	S	S	S	S	U	U
Dioxane		M	S	U	U	S	S	M	M	S	U	U	S	U	M	U	U	/	M	M	M	U	S	S	S	S	U	U
Ferric Chloride		U	U	S	/	/	/	M	S	/	M	/	S	/	S	/	/	/	S	S	/	/	/	M	U	S	/	S
Acetic Acid (Glacial)		S	S	U	U	S	S	U	M	S	U	S	U	U	U	U	U	M	S	U	M	U	S	U	U	S	/	U
Acetic Acid (5%)		S	S	M	S	S	S	M	S	S	S	S	S	M	S	S	S	S	S	S	S	M	S	S	M	S	S	M
Acetic Acid (60%)		S	S	U	U	S	S	U	/	S	M	S	U	U	M	U	S	M	S	M	S	M	S	M	U	S	M	U
Ethyl Acetate		M	M	U	U	S	S	M	M	S	S	U	S	U	M	U	U	/	S	S	U	U	S	M	M	S	U	U
Ethyl Alcohol (50%)		S	S	S	S	S	S	M	S	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	M	S	M	U
Ethyl Alcohol (95%)		S	S	S	U	S	S	M	S	S	S	S	S	U	S	U	/	S	S	S	M	S	S	S	U	S	M	U
Ethylene Dichloride		S	/	U	U	/	/	S	M	/	U	U	S	U	U	U	U	U	U	U	/	U	S	U	/	S	/	S
Ethylene Glycol		S	S	S	S	S	S	S	S	S	S	S	S	/	S	U	S	S	S	S	S	S	S	S	M	S	M	S
Ethylene Oxide Vapor		S	/	U	/	/	U	/	/	S	U	/	S	/	S	M	/	/	S	S	S	U	S	U	S	S	S	U
Ficoll-Hypaque™		M	S	S	/	S	S	S	/	S	S	S	S	/	S	S	/	S	S	S	S	S	S	S	M	S	S	S
Hydrofluoric Acid (10%)		U	U	U	M	/	/	U	/	/	U	U	S	/	S	M	U	S	S	S	S	M	S	U	U	U	/	/
Hydrofluoric Acid (50%)		U	U	U	U	/	/	U	/	/	U	U	U	U	S	U	U	U	S	S	M	M	S	U	U	U	/	M
Hydrochloric Acid (conc.)		U	U	U	U	/	U	U	M	/	U	M	U	U	M	U	U	U	/	S	/	U	S	U	U	U	/	/
Formaldehyde (40%)		M	M	M	S	S	S	S	M	S	S	S	S	M	S	S	S	U	S	S	M	S	S	S	M	S	M	U
Glutaraldehyde		S	S	S	S	/	/	S	/	S	S	S	S	S	S	S	/	/	S	S	S	/	/	S	S	S	/	/
Glycerol		M	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	/	S	S	S	S	S	S	S	S	S	S
Guanidine Hydrochloride		U	U	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	U	S	S	S
Haemo-Sol™		S	S	S	/	/	/	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	S	S	S	S

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Hexane		S	S	S	/	S	S	S	/	S	S	U	S	U	M	U	S	S	U	S	S	M	S	U	S	S	U	S
Isobutyl Alcohol		/	/	M	U	/	/	S	S	/	U	/	S	U	S	S	M	S	S	S	/	S	S	S	/	S	/	S
Isopropyl Alcohol		M	M	M	U	S	S	S	S	S	U	S	S	U	S	U	M	S	S	S	S	S	S	S	M	M	M	S
Iodoacetic Acid		S	S	M	/	S	S	S	/	S	M	S	S	M	S	S	/	M	S	S	S	S	S	M	S	S	M	M
Potassium Bromide		U	S	S	/	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	/	S	S	S	M	S	S	S
Potassium Carbonate		M	U	S	S	S	S	S	/	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S
Potassium Chloride		U	S	S	/	S	S	S	S	S	S	S	S	S	S	S	/	S	S	S	S	S	S	S	U	S	S	S
Potassium Hydroxide (5%)		U	U	S	S	S	S	M	/	S	S	S	S	/	S	U	S	S	S	S	S	S	S	M	U	M	S	U
Potassium Hydroxide (conc.)		U	U	M	U	/	/	M	/	M	S	S	/	U	M	U	U	U	S	M	/	M	U	/	U	U	/	U
Potassium Permanganate		S	S	S	/	S	S	S	/	S	S	S	U	S	S	S	M	/	S	M	S	U	S	S	M	S	U	S
Calcium Chloride		M	U	S	S	S	S	S	S	S	S	S	S	S	S	M	S	/	S	S	S	S	S	S	M	S	S	S
Calcium Hypochlorite		M	/	U	/	S	M	M	S	/	M	/	S	/	S	M	S	/	S	S	S	M	S	M	U	S	/	S
Kerosene		S	S	S	/	S	S	S	U	S	M	U	S	U	M	M	S	/	M	M	M	S	S	U	S	S	U	S
Sodium Chloride (10%)		S	/	S	S	S	S	S	S	/	/	/	S	S	S	S	S	/	S	S	S	S	/	S	S	M	/	S
Sodium Chloride (sat'd)		U	/	S	U	S	S	S	/	/	/	/	S	S	S	S	S	/	S	S	/	S	/	S	S	M	/	S
Carbon Tetrachloride		U	U	M	S	S	U	M	U	S	U	U	S	U	M	U	S	S	M	M	S	M	M	M	M	U	S	S
Aqua Regia		U	/	U	U	/	/	U	/	/	/	/	/	U	U	U	U	U	U	U	/	/	/	/	/	S	/	M
Solution 555 (20%)		S	S	S	/	/	/	S	/	S	S	S	S	S	S	S	/	/	S	S	S	/	S	S	S	S	S	S
Magnesium Chloride		M	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Mercaptoacetic Acid		U	S	U	/	S	M	S	/	S	M	S	U	U	U	U	/	S	U	U	S	M	S	U	S	S	S	S
Methyl Alcohol		S	S	S	U	S	S	M	S	S	S	S	S	U	S	U	M	S	S	S	S	S	S	S	M	S	M	U
Methylene Chloride		U	U	U	U	M	S	S	U	S	U	U	S	U	U	U	U	U	M	U	U	U	S	S	M	U	S	U
Methyl Ethyl Ketone		S	S	U	U	S	S	M	S	S	U	U	S	U	S	U	U	U	S	S	U	U	S	S	S	S	U	U
Metrizamide™		M	S	S	/	S	S	S	/	S	S	S	S	/	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Lactic Acid (100%)		/	/	S	/	/	/	/	/	/	M	S	U	/	S	S	S	M	S	S	/	M	S	M	S	S	/	S
Lactic Acid (20%)		/	/	S	S	/	/	/	/	/	M	S	M	/	S	S	S	S	S	S	S	M	S	M	S	S	/	S
N/Butyl Alcohol		S	/	S	U	/	/	S	/	/	S	M	/	U	S	M	S	S	S	S	M	M	S	M	/	S	/	S
N/Butyl Phthalate		S	S	U	/	S	S	S	/	S	U	U	S	U	U	U	M	/	U	U	S	U	S	M	M	S	U	S
N, N-Dimethyl-formamide		S	S	S	U	S	M	S	/	S	S	U	S	U	S	U	U	/	S	S	U	U	S	M	S	S	S	U
Sodium Borate		M	S	S	S	S	S	S	S	S	S	S	U	S	S	S	S	/	S	S	S	S	S	S	M	S	S	S
Sodium Bromide		U	S	S	/	S	S	S	/	S	S	S	S	S	S	S	S	/	S	S	S	S	S	S	M	S	S	S
Sodium Carbonate (2%)		M	U	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S

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Sodium Dodecyl Sulfate		S	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S
Sodium Hypochlorite (5%)		U	U	M	S	S	M	U	S	S	M	S	S	S	M	S	S	S	S	M	S	S	S	M	U	S	M	S
Sodium Iodide		M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Sodium Nitrate		S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	/	S	S	S	S	S	U	S	S	S	S
Sodium Sulfate		U	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Sodium Sulfide		S	/	S	S	/	/	/	S	/	/	/	S	S	S	U	U	/	/	S	/	/	/	S	S	M	/	S
Sodium Sulfite		S	S	S	/	S	S	S	S	M	S	S	S	S	S	S	M	/	S	S	S	S	S	S	S	S	S	S
Nickel Salts		U	S	S	S	S	S	/	S	S	S	/	/	S	S	S	S	/	S	S	S	S	S	S	M	S	S	S
Oils (Petroleum)		S	S	S	/	/	/	S	U	S	S	S	S	U	U	M	S	M	U	U	S	S	S	U	S	S	S	S
Oils (Other)		S	/	S	/	/	/	S	M	S	S	S	S	U	S	S	S	S	U	S	S	S	S	/	S	S	M	S
Oleic Acid		S	/	U	S	S	S	U	U	S	U	S	S	M	S	S	S	S	S	S	S	S	S	M	U	S	M	M
Oxalic Acid		U	U	M	S	S	S	U	S	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	U	M	S	S
Perchloric Acid (10%)		U	/	U	/	S	U	U	/	S	M	M	/	/	M	U	M	S	M	M	/	M	S	U	/	S	/	S
Perchloric Acid (70%)		U	U	U	/	/	U	U	/	S	U	M	U	U	M	U	U	U	M	M	U	M	S	U	U	S	U	S
Phenol (5%)		U	S	U	/	S	M	M	/	S	U	M	U	U	S	U	M	S	M	S	U	U	S	U	M	M	M	S
Phenol (50%)		U	S	U	/	S	U	M	/	S	U	M	U	U	U	U	U	S	U	M	U	U	S	U	U	U	M	S
Phosphoric Acid (10%)		U	U	M	S	S	S	U	S	S	S	S	U	/	S	S	S	S	S	S	S	S	S	U	M	U	S	S
Phosphoric Acid (conc.)		U	U	M	M	/	/	U	S	/	M	S	U	U	M	M	S	S	S	M	S	M	S	U	M	U	/	S
Physiologic Media (Serum, Urine)		M	S	S	S	/	/	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Picric Acid		S	S	U	/	S	M	S	S	S	M	S	U	S	S	S	U	S	S	S	S	U	S	U	M	S	M	S
Pyridine (50%)		U	S	U	U	S	U	U	/	U	S	S	U	U	M	U	U	/	U	S	M	U	S	S	U	U	U	U
Rubidium Bromide		M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Rubidium Chloride		M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Sucrose		M	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Sucrose, Alkaline		M	S	S	/	S	S	S	/	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	M	S	S	S
Sulfosalicylic Acid		U	U	S	S	S	S	S	/	S	S	S	U	S	S	S	/	S	S	S	/	S	S	S	U	S	S	S
Nitric Acid (10%)		U	S	U	S	S	U	U	/	S	U	S	U	/	S	S	S	S	S	S	S	S	S	M	S	S	S	S
Nitric Acid (50%)		U	S	U	M	S	U	U	/	S	U	S	U	U	M	M	U	M	M	M	S	S	S	U	S	S	M	S
Nitric Acid (95%)		U	/	U	U	/	U	U	/	/	U	U	U	U	M	U	U	U	U	M	U	U	S	U	S	S	/	S
Hydrochloric Acid (10%)		U	U	M	S	S	S	U	/	S	S	S	U	U	S	U	S	S	S	S	S	S	S	S	U	M	S	S
Hydrochloric Acid (50%)		U	U	U	U	S	U	U	/	S	M	S	U	U	M	U	U	S	S	S	S	M	S	M	U	U	M	M
Sulfuric Acid (10%)		M	U	U	S	S	U	U	/	S	S	M	U	S	S	S	S	S	S	S	S	S	S	U	U	U	S	S
Sulfuric Acid (50%)		M	U	U	U	S	U	U	/	S	S	M	U	U	S	U	U	M	S	S	S	S	S	U	U	U	M	S
Sulfuric Acid (conc.)		M	U	U	U	/	U	U	M	/	/	M	U	U	S	U	U	U	M	S	U	M	S	U	U	U	/	S
Stearic Acid		S	/	S	/	/	/	S	M	S	S	S	S	/	S	S	S	S	S	S	S	S	S	M	M	S	S	S
Tetrahydrofuran		S	S	U	U	S	U	U	M	S	U	U	S	U	U	U	/	M	U	U	U	U	S	U	S	S	U	U

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Toluene		S	S	U	U	S	S	M	U	S	U	U	S	U	U	U	S	U	M	U	U	U	S	U	S	U	U	M
Trichloroacetic Acid		U	U	U	/	S	S	U	M	S	U	S	U	U	S	M	/	M	S	S	U	U	S	U	U	U	M	U
Trichloroethane		S	/	U	/	/	/	M	U	/	U	/	S	U	U	U	U	U	U	U	U	U	S	U	/	S	/	S
Trichloroethylene		/	/	U	U	/	/	/	U	/	U	/	S	U	U	U	U	U	U	U	U	U	S	U	/	U	/	S
Trisodium Phosphate		/	/	/	S	/	/	M	/	/	/	/	/	/	S	/	/	S	S	S	/	/	S	/	/	S	/	S
Tris Buffer (neutral pH)		U	S	S	S	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Triton X/100™		S	S	S	/	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Urea		S	/	U	S	S	S	S	/	/	/	/	S	S	S	M	S	S	S	S	/	S	S	S	M	S	/	S
Hydrogen Peroxide (10%)		U	U	M	S	S	U	U	/	S	S	S	U	S	S	S	M	U	S	S	S	S	S	S	M	S	U	S
Hydrogen Peroxide (3%)		S	M	S	S	S	/	S	/	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
Xylene		S	S	U	S	S	S	M	U	S	U	U	U	U	U	U	M	U	M	U	U	U	S	U	M	S	U	S
Zinc Chloride		U	U	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S
Zinc Sulfate		U	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Citric Acid (10%)		M	S	S	M	S	S	M	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S

[1]Polyethlyeneterephtalate

Key

S – Satisfactory.

M – Moderate attack, may be satisfactory for use in centrifuge depending on length of exposure, speed involved, etc.; suggest testing under actual conditions of use.

U – Unsatisfactory, not recommended.

/ – Performance unknown; suggest testing, using sample to avoid loss of valuable material.

NOTICE

Chemical resistance data is included only as a guide to product use. Because no organized chemical compatibility data exists for materials under the stress of centrifugation, when in doubt we recommend pretesting sample lots.

Index

A

B

C

D

E

F

I

O

P

R

S

T

U

Z

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