Thermo Fisher Scientific

TFT-80.4

Instruction Manual

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Table of contents

This manual is a guide for the use of

Thermo Scientific TFT-80.4 Titanium Fixed-Angle Ultraspeed Centrifuge Rotor

Data herein has been verified and is believed adequate for the intended use of the rotor. Because failure to follow the recommendations set forth in this manual could produce personal injury or property damage, always follow the recommendations set forth herein. Thermo Fisher Scientific does not guarantee results and assumes no obligation for the performance of rotors or other products that are not used in accordance with the instructions provided. This publication is not a license to operate under, nor a recommendation to infringe upon, any process patents.

Publications prior to the Issue Date of this manual may contain data in apparent conflict with that provided herein. Please consider all data in this manual to be the most current.

NOTES, CAUTIONS, and WARNINGS within the text of this manual are used to emphasize important and critical instructions.

WARNING informs the operator of a hazard or unsafe practice that could result in personal injury, affect the operator's health, or contaminate the environment.

CAUTION informs the operator of an unsafe practice that could result in damage of equipment.

NOTE highlights essential information.

CAUTION and WARNING are accompanied by a hazard symbol and appear near the information they correspond to.

Important Safety Information

Certain potentially dangerous conditions are inherent to the use of all centrifuge rotors. To ensure safe operation of this rotor, anyone using it should be aware of all safe practices and take all precautions described below and throughout this manual.

WARNING

When using radioactive, toxic, or pathogenic materials, be aware of all characteristics of the materials and the hazards associated with them in the event leakage occurs during centrifugation. In the event of a rotor failure, neither the centrifuge nor the rotor can protect you from particles dispersed in the air. To protect yourself, we recommend additional precautions be taken to prevent exposure to these materials, for example, use of controlled ventilation or isolation areas.

Always be aware of the possibility of contamination when using radioactive, toxic, or pathogenic materials. Take all necessary precautions and use appropriate decontamination procedures if exposure occurs.

Never use any material capable of producing flammable or explosive vapors or creating extreme exothermic reactions.

Never exceed the maximum rated speed of the installed rotor; to do so can cause rotor failure.

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 is greater than 1.7 g/ml). See Chapter 2, page 2-2.

Failure to reduce rotor speed under these conditions can cause rotor failure.

CAUTION

Do not expose the aluminum rotor components to: strong acids, bases, or alkaline laboratory detergents; liquid chlorine bleach; or salts (chlorides) of heavy metals such as cesium, lead, silver, or mercury. Use of these materials with aluminum can cause a chemical reaction that initiates corrosion.

Do not operate or precool a rotor at the critical speed, as this will have a detrimental effect on centrifuge component life. See Chapter 2, page 2-4.

Do not operate the rotor unless it is symmetrically balanced as described in this manual. Operating the rotor out of balance can cause damage to the centrifuge drive assembly.

Always maintain the rotor in the recommended manner. The rotor accessories must be clean and inspected prior to each run: do not use rotors showing signs of corrosion or cracking. See Chapter 3, Care and Maintenance.

Do not autoclave or expose any aluminum rotor parts to temperatures in excess of 121°C.

DESCRIPTION

This manual provides you with the information you need to operate and maintain your Thermo Fisher Scientific TFT-80.4 Fixed-Angle Ultraspeed Centrifuge Rotor. If you require additional information regarding operation or maintenance, please contact Thermo Fisher Scientific for assistance. In the United States, call Thermo Fisher Scientific toll-free 1-866-9THERMO; outside the United States, contact the nearest Thermo Fisher Scientific office (see back cover) or your local representative for Thermo Fisher Scientific products. Thermo Fisher Scientific product information is available on our internet web site at http:// www.thermo.com/centrifuge .

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Rotor Description

The TFT-80.4 is a ten-place, fixed-angle, ultracentrifuge rotor that can be used at speeds up to 80 000 rpm.[1] The rotor body is made from a titanium forging for strength and corrosion resistance. The aluminum lid and locking nut are given a green anodized finish for surface protection. The rotor is tightly sealed during operation by two O-rings, one that fits inside the rotor lid and another around the bottom of the locking nut. The twelve tube compartments are bored at a 25° angle to the axis of rotation. A disc with alternative black and reflective segments attached to the bottom of the rotor provides overspeed protection.

Rotor Specifications

Table 1-1. Rotor Specifications

Rotor Type	Fixed Angle
Maximum Speed (rpm)	80,000*
Relative Centrifugal Force (RCF) at Max. Speed	
- at $r_{maximum}$ 6.55cm	468 200
- at $r_{average}$ 4.98cm	356 000
- at $r_{minimum}$ 3.41 cm	243 800
K Factor at Maximum Speed	25.8
Critical Speed	
OTD-B	500 rpm
RC	400 rpm
Tube Size (Maximum)	11.6mm x 60.3 mm
Number of Compartment	10
Capacity per Compartment (Nominal)	4.4 ml
Total Rotor Capacity (Nominal)	44 ml
Maximum Compartment Mass	9.4 g
Compartment Angle	25°
Rotor Diameter	13.9 cm (5.47 inches)
Rotor Weight	3.5 kg (7.7 lbs)

*With tubes filled with a homogenous solution having an average density of 1.2 g/ml or less.

[1]Speed in revolutions per minute (rpm) is related to angular velocity, ω, according to the following:

$$\omega = (\text{rpm})\left(\frac{2\pi}{60}\right) = (\text{rpm})(0.10472)$$

Where ω = rad/s. All further references to speed in this manual will be designated as rpm.

Accessories

a. Accessories Supplied

The accessories supplied with the TFT-80.4 Rotor, Catalog No.09202 (rotor with complete accessories), are listed in Table 1-2. Those items indicated by an asterisk (*) are not supplied with Catalog No. 54356, which is a TFT-80.4 Rotor with basic accessories only.

Note In order to seal the ULTRACRIMP® Tubes (supplied with Catalog No. 09202), you must have an ULTRACRIMP® Sealing Tool, Catalog No. 03920.

To order replacement accessories, telephone (800) 522-7746 in the United States. Outside the United States, contact your Thermo Fisher Scientific products distributor or agent. Be sure to provide a description of the part, the catalog number, plus the rotor model and serial number.

Table 1-2. Accessories Supplied

Quantity	Catalog Number	Description
4	03905*	ULTRACRIMP® Tubes, 3.5 ml (50/pkg)**
10	03091*	Rotor Cap
1	03773*	Tube Racks, 4-place (1 pair)
1	12826*	Tube Removal Tool
1	51942	Rotor Stand
1	65937	Vacuum Grease
1	61556	Tube of Lubricant

* Not supplied with Catalog No. 54356 (rotor with basic accessories only).

** Not supplied with Catalog No. 54356 (rotor with basic accessories only).

b. Optional Multipiece Sealing Assembly

If you prefer, you can still use the TFT-80.4 Rotor with the tubes and sealing assemblies previously supplied with the rotor. To do so, you must purchase all items separately: the TFT-80.4 Rotor with basic accessories only, Catalog No. 54356; a Tool Kit, Catalog No. 54380; the tubes; and sealing assemblies. Table 1-2 lists the catalog number and description of the tubes and sealing assembly required, and Table 1-3 lists the parts supplied in the Tool Kit. If you have any of the tools listed, you do not need to purchase the kit; if necessary, any of the tools listed can be ordered separately by the catalog number given in the table.

Table 1-3. Optional Multipiece Sealing Assembly Components

Catalog Number	Description
03955	Tubes, 4.4 ml, Polyallomer (50/pkg)
54366	Sealing Cap Assembly (each); 10 required

Table 1-4. Tool Kit Parts List for use with Optional Multipiece Sealing Assembly

Catalog Number	Description
52176	Tube Cap Vise
54377	Tube Cap Tool
11538	Tube Removal Tool
54376	Adapter Extractor

c. Rotor Cover Removal Tool

The rotor cover of the TFT-80.4 Rotor is designed to fit the rotor body tightly to ensure a positive seal; however, because of this tight fit, it is sometimes difficult to remove. If you have difficulty removing the rotor cover, a removal tool is available, Catalog No. 11538; complete instructions for use of the tool are supplied with it.

OPERATION

This chapter contains the information necessary to prepare the TFT-80.4 Rotor for operation and includes important safety information.

Contents

Prerun Safety Checks

To ensure safe performance of the rotor, before every run you should:

a. read the Important Safety Information on page iii.

b. make sure each tube compartment is clean and that there is no sign of corrosion.

c. be sure the rotor itself is clean and shows no sign of corrosion or cracking. Also, make sure there are no scratches or burrs around the rim of the rotor.

d. check the centrifuge chamber and drive spindle to be sure they are clean and free of scratches and burrs.

e. verify that the proper overspeed decal is firmly attached to the bottom of the rotor; the decal must have 11 black segments (refer to page 3-4 for Overspeed Decal Replacement procedure).

f. check the chemical compatibility of all materials used (see Table in Appendix A).

g. inspect the rotor cover O-rings for cracks, tears, or abrasions and replace if necessary. Be sure the O-rings are properly lubricated (see page 2-9).

h. make sure that the rotor cover is on and properly tightened.

i. be sure the proper environment has been selected for operation; for example, controlled ventilation or isolation, if required.

j. check the top speed capability of the tube or bottle being used; observe the CAUTION.

CAUTION When using a tube or bottle assembly other than those supplied by Thermo Fisher Scientific, be sure to check the top speed capability; when in doubt, do a test run for the desired application. If using a Thermo Scientific tube (or bottle) assembly other than those supplied with the rotor, refer to the Product Guide for the maximum speed. Exceeding the top speed capability of the tube (or bottle) can result in its breakage.

Ultraspeed Centrifuge Modification Requirements

Because the TFT-80.4 Rotor is a light-weight rotor, some Thermo Fisher Scientific Ultraspeed Centrifuges will require modification to ensure proper rotor acceleration and/or deceleration.

OTD-B Ultraspeed Centrifuge

Some OTD-B Ultraspeed Centrifuges will require calibration. Please telephone our Service Department toll free 1-866-9THERMO with the serial number of your centrifuge. Outside the United States, contact the distributor or agent for Thermo Fisher Scientific products. If the modification is required, a Service Representative will arrange a visit to perform the modification at no charge.

RC-Ultraspeed Centrifuge

Some RC-Ultraspeed Centrifuges will require both software and hardware modification. To determine if your centrifuge has already been modified, see figure 2-1; if the drive adapter illustrated is installed in your centrifuge, the modification has been made. If the modification has not been made, please telephone our Service Department toll free 1-866-9THERMO to arrange for a Service Representative to perform the modification at no charge. Outside the United States, contact the

distributor or agent for Thermo Fisher Scientific products. A package containing the parts necessary for the modification should have been shipped to you with your rotor. If it was not, please inform the Service Representative when you schedule the appointment.

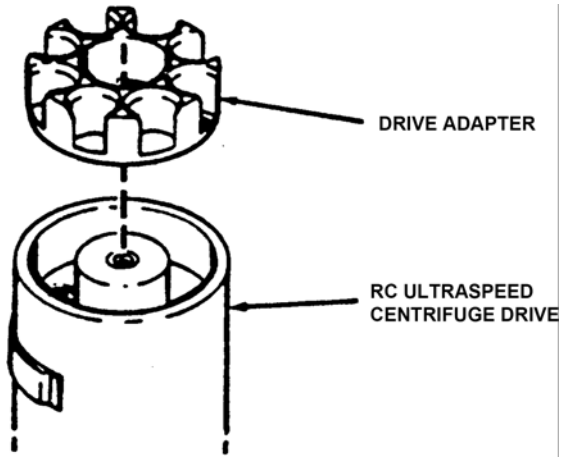

Figure 2-1. Drive Adapter (RC Ultraspeed Centrifuge)

Chemical Compatibility

The critical components of the TFT-80.4 Rotor apt to come in contact with solution are: rotor body (titanium), rotor cover assembly (aluminum), O-rings (Viton®), all sealing assembly components and material of the tubes being used. ULTRACRIMP® sealing assembly components include: rotor caps and tube caps (aluminum), and the tube plugs (Buna N). Optional sealing assembly components include: tube plug (aluminum), seal ring (titanium), post-fill screw (stainless steel), and the material of the tubes being used.

The chemical compatibility of rotor elements and accessory materials is given in the Appendix. Because no organized chemical resistance data exists for materials under the stress of centrifugation, this data is intended to be used only as a guide to the selection of tube materials. When in doubt, we recommend pretesting of sample lots.

Compartment Loads in Excess of Design Mass

A recommended design mass has been established for each ultracentrifuge rotor, representing the maximum mass that each tube compartment can contain during operation. To prevent rotor failure, the total contents, including specimen, tube, rotor cap, tube cap, and tube plug, should not exceed the figure given unless rotor speed is reduced proportionately. (If using the optional multipiece sealing assembly, include the weight of the complete assembly.)

Strict adherence to the maximum allowable compartment mass or reduced speed is required to prevent rotor failure.

The design mass for each compartment of the TFT-80.4 Rotor is 9.4 g at 80 000 rpm. This figure is based on the use of a thinwall polyallomer tube filled with a liquid at 1.2 specific gravity, plus all sealing assembly components.

If the compartment mass is greater than 9.4 g, use the following formula to determine the reduced speed:

$$\text{Reduced Speed} = 80000 \sqrt{\frac{9.4\ \text{g}}{\text{actual weight}}}$$

Critical Speed

CAUTION Do not operate or precool a rotor at the critical speed, as this will have a detrimental effect on centrifuge component life.

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 that can be felt in the centrifuge frame. Mass imbalance contributes to increased vibration intensity at the critical speed. Avoid operating the rotor at the critical speed, which is approximately 400 rpm in a RC Ultracentrifuge and 500 rpm in an OTD-B Ultraspeed Centrifuge. Operation at the critical speed will have a detrimental effect on centrifuge component life.

Rotor Precool

If samples are routinely processed around 4°C or below, the rotor can be stored in a refrigerator or a cold room. If this is not possible, the rotor can be precooled easily in a Thermo Fisher Scientific OTD Ultracentrifuge. Refer to the Ultracentrifuge Instruction Manual for precooling directions. Be careful not to precool the rotor at its critical speed (read paragraph above).

Relative Centrifugal Force (RCF) Determination

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, also known as g force, is determined by the following formula:

$$\text{RCF} = 11.17(r) \left(\frac{\text{rpm}}{1000}\right)^2$$

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

Note The radii values given are the actual rotor cavity specifications; these values do not take the thickness of the tube into consideration.

Figure 2-2 shows the minimum, average, and maximum radii of the TFT-80.4 Rotor. Table 2-1 gives the RCF value at each radius at speeds from 20 000 rpm to 80 000 rpm in increments of 500 rpm. The RCF value at any other speed can be calculated by using the above RCF formula.

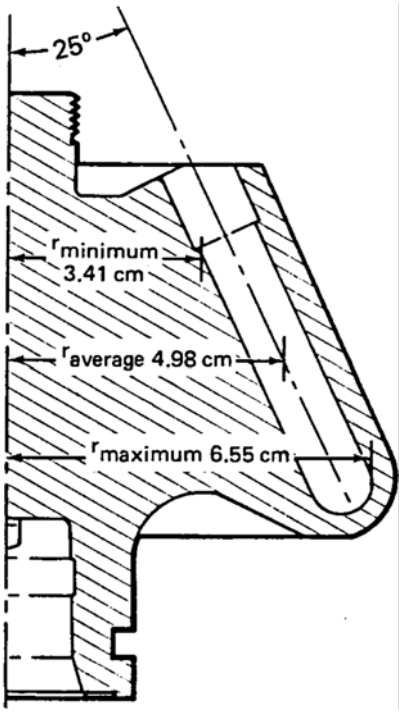

Figure 2-2. TH-641 Rotor Radii

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 $r_{minimum}$ and $r_{maximum}$) 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 on the next page)
S_{20}, w = the sedimentation coefficient for the particle of interest in water at 20°C as expressed in Svedbergs[1]

The clearing (or K) factor is defined by the equation:

$$K = (253000)\left[\ln\left(\frac{r_{maximum}}{r_{minimum}}\right)\right] \div \left(\frac{\text{rotor speed}}{1000}\right)^2$$

[1] 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.

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

K factors for the TFT-80.4 Rotor,at speeds from 20 000 rpm to 80 000 rpm (in increments of 500 rpm), are listed in Table 2-1.

Example: The TFT-80.4 Rotor has a K factor of 25.8 at the maximum permitted speed (80 000 rpm). If the particles to be sedimented have a sedimentation coefficient of 10S, the estimated run time required at maximum speed will be:

$$t = \frac{25.8}{10S} \text{ 2.58 hours } = \text{ 2 hours, 35 minutes}$$

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.

Table 2-5. TH-641 Rotor: RCF Values and K Factors*

Speed (rpm)	RCF $r_{max.}$ 6.55 cm	RCF $r_{avg.}$ 4.98cm	RCF $r_{min.}$ 3.41 cm	K Factors
20,000	29 265	22 251	15 236	413
20,500	30 747	23 377	16 007	393
21,000	32 265	24 531	16 798	374
21,500	33 820	25 713	17 607	357
22,000	35 411	26 923	18 435	341
22,500	37 039	28 161	19 283	326
23,000	38 703	29 426	20 149	312
23,500	40 405	30 720	21 035	299
24,000	42 142	32 041	21 940	287
24,500	43 916	33 390	22 863	275
25,000	45 727	34 767	23 806	264
25,500	47 575	36 171	24 768	254
26,000	49 459	37 604	25 749	244
26,500	51 379	39 064	26 748	235
27,000	53 336	40 552	27 767	227
27,500	55 330	42 068	28 805	218
28,000	57 360	43 611	29 862	211
28,500	59 427	45 183	30 938	204
29,000	61 531	46 782	32 033	196
29,500	63 671	48 409	33 148	190
30,000	66 847	50 064	34 281	184
30,500	68 060	51 747	35 433	178
31,000	70 310	53 457	36 604	172
31,500	72 596	55 195	37 795	166

Table 2-5. TH-641 Rotor: RCF Values and K Factors*

Speed (rpm)	RCF $r_{max.}$ 6.55 cm	RCF $r_{avg.}$ 4.98cm	RCF $r_{min.}$ 3.41 cm	K Factors
32,000	74 919	56 962	39 004	161
32,500	77 279	58 756	40 232	156
33,000	79 675	60 577	41 480	152
33,500	82 108	62 427	42 746	147
34,000	84 577	64 304	44 032	143
34,500	87 083	66 210	45 336	139
35,000	89 625	68 143	46 660	135
35,500	92 204	70 103	48 003	131
36,000	94 820	72 092	49 364	127
36,500	97 472	74 109	50 745	124
37,000	100 161	76 153	52 145	121
37,500	102 886	78 225	53 564	117
38,000	105 648	80 325	55 002	114
38,500	108 447	82 453	56 458	111
39,000	111 282	84 608	57 934	109
39,500	114 153	86 791	59 429	106
40,000	117 062	89 003	60 944	103
40,500	120 006	91 242	62 477	101
41,000	122 988	92 508	64 029	98.2
41 500	126 003	95 803	65 600	95.9
42 000	129 060	98 125	67 190	93.6
42 500	132 152	100 476	68 800	91.4
43 000	135 279	102 854	70 428	89.3
43 500	138 444	105 259	72 075	87.3
44 000	141 645	107 693	73 742	85.3
44 500	144 882	110 155	75 427	83.4
45 000	148 156	112 644	77 132	81.6
45 500	151 467	115 161	78 855	79.8
46 000	154 814	117 706	80 598	78.0
46 500	158 198	120 279	82 359	76.4
47 000	161 618	122 879	84 140	74.8
47 500	165 075	125 508	85 940	73.2
48 000	168 569	128 164	87 759	71.7
48 500	172 099	130 848	89 596	70.2
49 000	175 666	133 559	91 453	68.8

Table 2-5. TH-641 Rotor: RCF Values and K Factors*

Speed (rpm)	RCF $r_{max.}$ 6.55 cm	RCF $r_{avg.}$ 4.98cm	RCF $r_{min.}$ 3.41 cm	K Factors
49 500	179 269	136 299	93 329	67.4
50 000	182 909	139 067	95 224	66.1
50 500	186 585	141 862	97 138	64.8
51 000	190 298	144 685	99 071	63.5
51 500	194 048	147 536	101 536	62.3
52 000	197 834	150 414	102 995	61.1
52 500	201 657	153 321	104 985	59.9
53 000	205 516	156 255	106 994	58.8
53 500	209 412	159 217	109 022	57.7
54 000	213 345	162 207	111 070	56.6
54 500	217 314	165 225	113 136	55.6
55 000	221 320	168 270	115 221	54.6
55 500	225 362	171 344	117 326	53.6
56 000	229 441	177 445	119 449	52.7
56 500	233 556	177 574	121 592	51.7
57 000	237 708	180 731	123 753	50.8
57 500	241 897	183 915	125 934	49.9
58 000	246 122	187 128	128 134	49.1
58 500	250 384	190 368	130 352	48.3
59 000	254 682	193 636	132 590	47.4
59 500	259 017	196 932	134 847	46.6
60 000	263 389	200 256	137 123	45.9
60 500	267 797	203 607	139 418	45.1
61 000	272 241	206 987	141 732	44.4
61 500	276 723	210 394	144 065	43.7
62 000	281 240	213 829	146 417	43.0
62 500	285 795	217 291	148 788	42.3
63 000	290 386	220 782	151 178	41.6
63 500	295 014	224 300	153 587	41.0
64 000	299 678	227 847	156 015	40.3
64 500	304 378	231 421	158 463	39.7
65 000	309 116	235 022	160 929	39.1
65 500	313 890	238 652	163 414	38.5
66 000	318 700	242 309	165 919	37.9
66 500	323 547	245 995	168 442	37.3

Table 2-5. TH-641 Rotor: RCF Values and K Factors*

Speed (rpm)	RCF $r_{max.}$ 6.55 cm	RCF $r_{avg.}$ 4.98cm	RCF $r_{min.}$ 3.41 cm	K Factors
67 000	328 431	249 708	170 985	36.8
67 500	333 351	253 449	173 546	36.2
68 000	338 308	257 217	176 127	35.7
68 500	343 301	261 014	178 726	35.2
69 000	348 331	264 838	181 345	34.7
69 500	353 398	268 690	183 983	34.2
70 000	358 501	272 570	186 640	33.7
70 500	363 641	276 478	189 315	33.2
71 000	368 817	280 414	192 010	32.8
71 500	374 030	284 377	194 724	32.3
72 000	379 280	288 368	197 457	31.9
72 500	384 566	292 387	200 209	31.4
73 000	389 888	296 434	202 980	31.0
73 500	395 248	300 509	205 770	30.6
74 000	400 643	304 611	208 579	30.2
74 500	406 076	308 742	211 407	29.8
75 000	411 545	312 900	214 255	29.4
75 500	417 050	317 086	217 121	29.0
76 000	422 592	321 299	220 006	28.6
76 500	428 171	325 541	222 910	28.2
77 000	433 786	329 810	225 834	27.9
77 500	439 438	334 107	228 776	27.5
78 000	445 127	338 432	231 738	27.1
78 500	450 852	342 785	234 718	26.8
79 000	456 613	347 166	237 718	26.5
79 500	462 412	351 574	240 736	26.1
80 000	468 246	356 010	243 774	25.8

*These values do not take the thickness of the tube into consideration.

Tube Filling and Sealing

ULTRACRIMP® Tubes (PN 03905)

Prepare the ULTRACRIMP® tubes for use by following the tube filling and tube sealing procedures given in the ULTRACRIMP® Tube Sealing System Instruction Manual.

Load the rotor as follows:

1. Gently place filled ULTRACRIMP® tubes in the tube compartments (balancing the rotor as described on page 2-10, Rotor Balancing).
2. Place a rotor cap, PN 03091 into each tube compartment that contains a filled tube. Push the rotor cap into the tube compartment until it is properly seated; when properly seated, the edge of the cap will be positioned slightly below the top of the outer edge of the tube compartment (see figure 2-3).

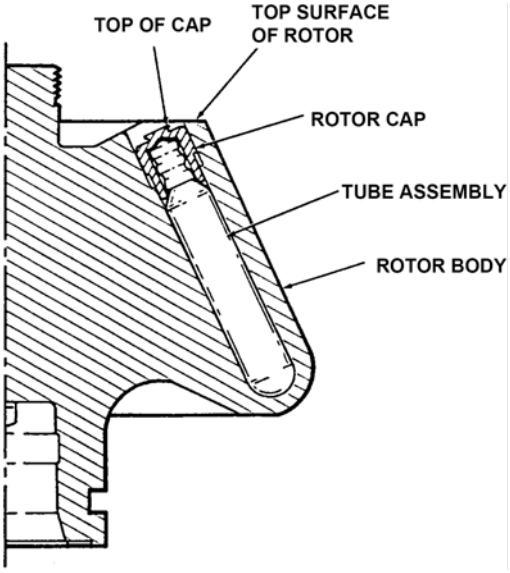

Figure 2-3. Properly Seated Rotor Cap

ULTRACRIMP® Tubes (PN 03905)

Fill and seal the tubes as follows:

1. Before each use:
   a. inspect the tube plugs for signs of cracking and corrosion and replace if necessary.
   b. inspect the titanium seal rings for signs of cracking and replace if necessary.
2. Remove the post-fill screw from the tube plug using the hex end of the tube removal tool, PN 11538.
3. Fill the tube approximately halfway.
4. Screw the threaded end of the tube removal tool into the tube plug. Insert the tube plug into the tube and use a gentle rocking motion to push it in place. The top edge of the tube should seat against the shoulder of the plug (figure 2-4).
5. Insert a syringe and needle or very narrow pipette into the postfill hole of the tube plug and fill the tube until fluid emerges from the post-fill hole.
6. Non-gradient applications only: if any air bubbles larger than 4 mm in diameter are trapped below the seal, withdraw the fluid and reinject it; repeat as many times as necessary until there are no bubbles larger than 4 mm in diameter.

7. Insert the post-fill screw in the post-fill hole of the tube plug. Using the hex end of the tube removal tool, tighten the post-fill screw.

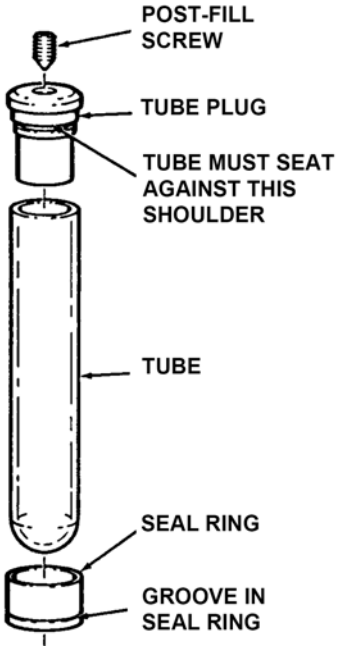

Figure 2-4. Tube and Sealing Assembly

8. Use a syringe of a clean absorbent papertowel to remove any excess fluid from the post-fill hole.
9. Place the tube assembly into the tube vise, PN 52176 from the bottom, as shown in figure 2-5. Tighten the vise securely.
10. Support the filled tube from the bottom; then, using the hex end of the tube removal tool, further tighten the post-fill screw until it is firmly seated against the plastic insert, be careful not to overtighten the screw. The screw will be properly seated when the tube removal tool becomes difficult to turn.
11. Loosen the tube cap vise, and remove the tube assembly..

CAUTION Do not overtighten the postfill screw. To do so moves the plastic insert out of its proper position and can cause it to be completely displaced from the plug during centrifugation, resulting in leakage.

12. Slide the seal ring onto the tube with the groove in the ring towards the bottom of the tube (figure 2-4). Push the ring up as far as it will go. During centrifugation this ring is forced tightly against the plug to form the seal.

13. Insert loaded tubes in tube compartments of the rotor, balancing the rotor as explained on this page, Rotor Balancing.

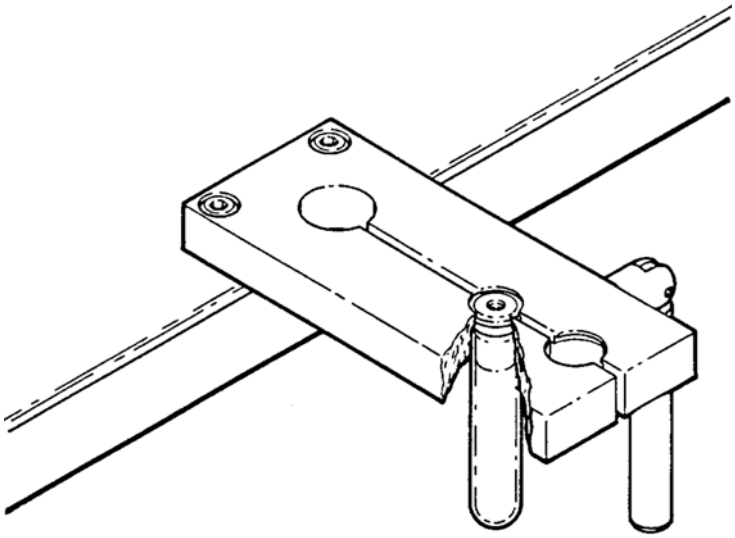

Figure 2-5. Using the Tube Cap Vise (Optional Sealing Assembly)

Rotor Balancing

Always balance the rotor according to the following criteria:

a. balance pairs of tubes containing fluid of identical specific gravity to within 0.5 grams and place them in opposing tube compartments.

b. when using less than a full compliment of ten tubes, the rotor can be operated at maximum allowable speed with groups of two, four, six or eight samples, provided opposing pairs are positioned as shown in figure 2-6.

CAUTION Do not operate the rotor unless it is symmetrically balanced as described in this manual. Operating the rotor out of balance can cause damage to the centrifuge drive assembly.

c. if an odd number of samples are to be run, balance the load as above with a dummy tube that contains a solution having the same specific gravity as the sample in the opposing tube compartment.

d. five samples can be run provided all five tubes are equally balanced and positioned as shown in figure 2-6.

CAUTION Compartments that do not contain a filled tube should be left empty during operation.

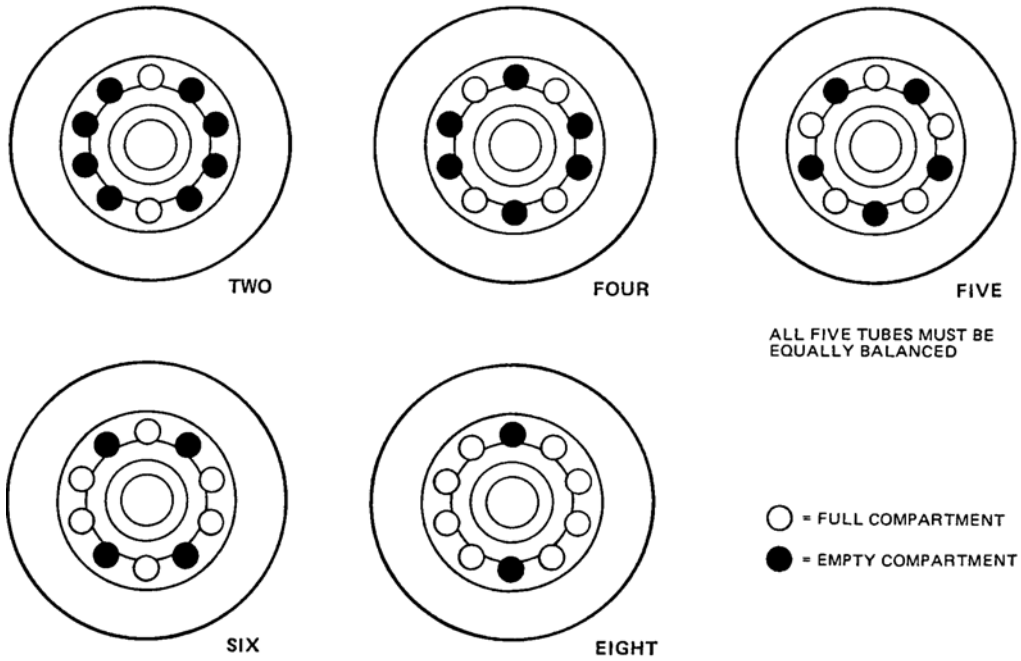

Figure 2-6. Compartment Loading

Rotor Loading and Installation

Note If using the TFT-80.4 Rotor in Thermo Fisher Scientific RC Ultraspeed Centrifuge, make sure the drive adapter has been installed on the centrifuge drive (figure 2-1). If it has not been installed, contact your Thermo Fisher Scientific Service Representative.

1. Check locking nut O-ring and rotor cover O-ring for scuffs, cracks, or breaks. Replace if necessary (see figure 3-1 for replacement catalog numbers).
2. Coat O-rings lightly with vacuum grease, PN 65937.
3. Check that the locking nut thread is lightly coated with lubricant, PN 61556.
4. Place the rotor cover (with O-ring) on the rotor body, and position the silver line on the rotor cover over the #1 tube compartment. Insert the locking nut in the cover and finger tighten the nut by turning it clockwise. Insert the rotor cover tool throughcontinue to tighten the locking nut by turning the rotor cover tool clockwise until the silver line on the locking nut lines up with the line on the rotor cover (figure 2-7). Remove the rotor cover tool from the locking nut.

CAUTION The rotor cover tool must be removed prior to the centrifuge run.

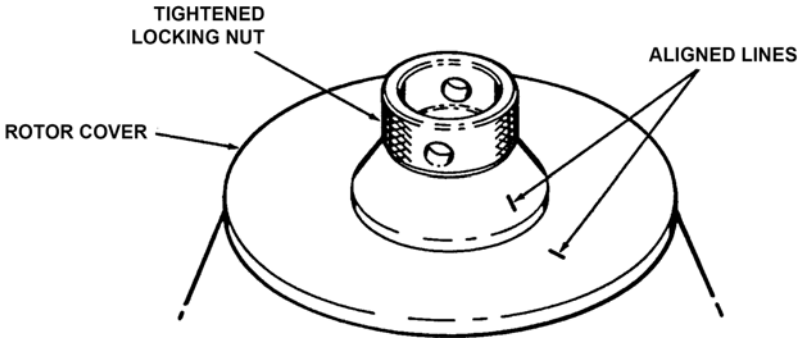

Figure 2-7. Rotor Cover Installation

5. Carry the rotor carefully and lower it into the centrifuge chamber slowly and vertically. Be sure the rotor snaps in place on the drive adapter. Check that it is properly seated by pulling it gently in an upward direction and noting a small amount of resistance.

Perform the centrifuge run as explained in the centrifuge instruction manual.

Tube Removal

ULTRACRIMP® Tubes (PN 03905)

1. Remove the rotor cover.
2. Remove the rotor caps from each tube compartment containing a filled tube.
3. Remove the tubes from the rotor. Because the tubes expand slightly during centrifugation, you may have to use the ULTRACRIMP® Tube Removal Tool, PN 12826 or needlenose pliers to grasp the tube and gently pull it from the rotor.

Note You may notice that the inner side wall of a tube may appear slightly flattened after centrifugation. This is a normal effect of centrifugation and should not be cause for any concern

4. Unload tubes according to the instructions given in the ULTRACRIMP® Tube Sealing System Instruction Manual.
5. Clean the rotor caps according to the procedure on pages 3-1 – 3-2.

Optional Tubes (PN 03955)

To remove the tube assemblies from the tube compartments: use the threaded end of the tube removal tool and thread it into the post-fill hole of the tube plug, then pull the entire assembly from the rotor.

To remove the sealing cap from the tube:

1. Remove the tube removal tool from the tube plug.
2. Hold the tube firmly, slide the seal away from the tube plug and remove it from the tube.
3. Place the tube assembly in the tube cap vise from the bottom as shown in figure 2-5. Tighten the vise securely.

4. Using the hex end of the tube removal tool, remove the post-fill screw from the post-fill hole; then remove the post-fill screw from the tube removal tool.
5. Screw the threaded end of the tube removal tool into the postfill hole of the tube plug. Hold the tube steady and pull upward on the tool with a gentle rocking motion until the plug is freed from the tube.

Centrifuge/Rotor Log

An Ultraspeed Centrifuge/Rotor Log Book is supplied with the TFT-80.4 Rotor so you can easily record all data necessary to meet the warranty stipulation that any defective Ultraspeed Centrifuge Rotor (or Ultracentrifuge) being returned to Thermo Fisher Scientific must be accompanied by an up-to-date history of the rotor.

Each time the TFT-80.4 Rotor is run, record the run in the log book as shown in Figure 2-8, Sample Centrifuge/Rotor Log Sheet.

Thermo Scientific Centrifuge and Rotor Log Book — **RUN TIME (List by Rotor Used)** — **This log is for use with one centrifuge ONLY:**

					Rotor S/N *AH-629 8731384*		Rotor S/N *TV-865 9130129*		Rotor S/N *T-1270 8931255*		Rotor S/N *T-880 9030040*		Model: *ULTRA 80* Ser. No.: *9102448*
Date	Operator	Rev. Count @ Run Start	TEMP	SPEED	HRS	MIN	HRS	MIN	HRS	MIN	HRS	MIN	Remarks*
09/04/91	J. JONES	00410290	4	57.0			05	30					*PLASMID PREP.*
09/05/91	B. SMITH	00429100	4	21.0	26	00							*SUCROSE GRADIENT*
09/07/91	J. JONES	00461860	21	70.0					18	00			*LIPOPROTEIN SEP.*

Figure 2-8. Sample Centrifuge/Rotor Log Sheet

CARE and MAINTENANCE

This chapter provides instructions on how to clean, decontaminate, and maintain your rotor. Always maintain the rotor in the recommended manner. Do not use rotors that show signs of corrosion or cracking.

Contents

Corrosion

The TFT-80.4 titanium rotor body is more resistant to corrosion than an aluminum rotor body, but it should be maintained and kept clean in the same manner. With proper care, corrosion can be minimized to significantly prolong the life of the rotor and lessen the chances of rotor failure and potential damage to the centrifuge.

Corrosion commonly refers to chemical reactions at the surface (that is, rusting or pitting) recognized by the growing areas of visible deterioration. In addition, stress corrosion attacks the inside of the metal; barely detectable surface cracks grow inward, weakening the part without visible warning. Stress corrosion applies to most commonly used alloys and even the corrosion resistant alloys have been found susceptible.

Stress corrosion is thought to be initiated by certain combinations of stress and chemical reaction. The most common chemical causing harmful effects is chloride, whether in a solution (for example, ammonium salts) or as subtle a form as hand perspiration. If the rotor is not kept clean and these chemicals remain on the rotor, corrosion will result. Also, any moisture left on the rotor for an extended period of time can initiate corrosion. Therefore, it is important to thoroughly wash and dry the rotor after each use.

In general, conditions for corrosion are present in all rotor applications; proper care and maintenance will minimize its effects.

Cleaning and Decontamination

These procedures are to be used for general cleaning purposes only.

If the rotor or any of its parts are exposed to a contaminant, they must be decontaminated first, then washed.

WARNING Always be aware of the possibility of contamination when using radioactive, toxic, or pathogenic materials. Take all necessary precautions and use appropriate decontamination procedures if exposure occurs.

CAUTION Always maintain the centrifuge in the recommended manner. The rotor and all accessories must be clean and inspected prior to each run: do not use a rotor showing signs of corrosion or cracking.

a. Rotor Body

6. Washing

   Wash the rotor body with warm water and mild soap or detergent at least once a week or, ideally, after each use. It is particularly important to wash the rotor immediately after any spills have occurred. Most laboratory chemicals can be removed with a lukewarm, 1% solution of a mild, nonalkaline detergent such as a mild dishwashing liquid. Rinse the rotor well, inside and out. After rinsing, dry the rotor thoroughly with a soft absorbent cloth or an air blast.

   Do not use strong laboratory detergents to clean rotor surface.

Use a soft bride brush to loosen encrusted materials only if necessary; be careful not to scratch the rotor surface.

CAUTION Do not expose aluminum rotor components to: strong acids, bases, or alkaline laboratory detergents, liquid chlorine bleach or salts (chlorides) of heavy metals such as cesium, lead, silver, or mercury. Use of these materials with aluminum can cause a chemical reaction that initiates corrosion

7. Decontamination

   Ethylene oxide, a 2% glutaraldehyde solution, or ultraviolet radiation are the recommended methods of sterilization; however, the rotor body of the TFT-80.4 can be autoclaved at temperatures up to 121°C.

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

CAUTION Most commercially available radioactive decontamination solutions are not compatible with titanium or aluminum.

b. Rotor Cover Assembly (Figure 3-1)

Wash the rotor cover and locking nut with a mild, non-alkaline detergent; rinse and dry them carefully before storing. Do not autoclave aluminum cover assembly. If required, use gas or chemical sterilization.

CAUTION Do NOT autoclave the rotor cover or locking nut. If these parts are subjected to a temperature above 100°C, they should not be used.

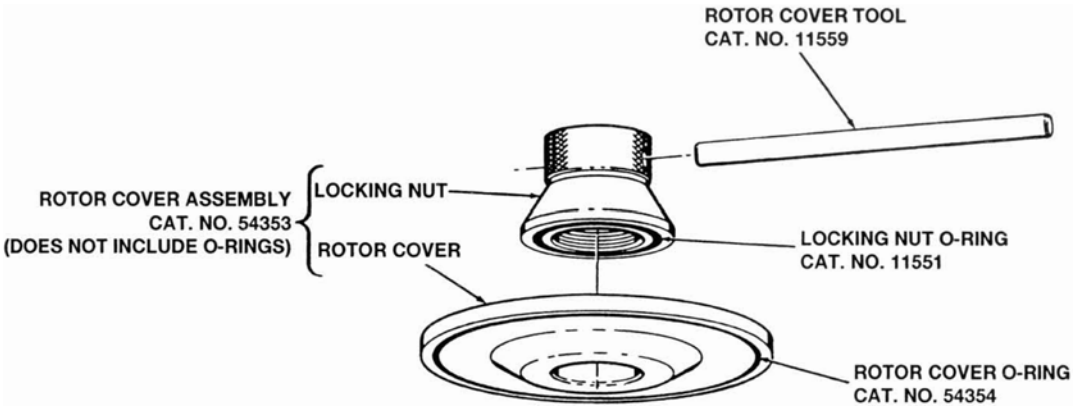

Figure 3-9. Rotor Cover Assembly

c. ULTRACRIMP® Sealing System Components

Autoclaving of the ULTRACRIMP® Sealing Tool and the aluminum rotor caps is not recommended. All parts may be cleancd with a lukewarm, 1 % solution of a mild, non-alkaline detergent, such as a mild dishwashing liquid. The tube racks can be autoclaved.

d. Optional Multipiece Sealing Assembly Components

1. Before each use:
   a. inspect the titanium seal O-ring for signs of cracking; replace if necessary;
   b. inspect the tube plugs for signs of cracking or corrosion; replace if necessary.
2. Wash the seal cap assembly components regularly with a mild, non-alkaline detergent; rinse and dry them carefully before storing.

CAUTION Never use ordinary lab detergents to clean the aluminum tubeplugs' use a mild, non-alkaline deter- gent only. Also, no not autoclave the tube plugs. If they are subjected to a temperature above 100°C, they should not be used. If required, the titanium seal rings can be autoclaved.

Overspeed Decal Replacement

Before replacing the decal, be sure that the rotor is dry and at room temperature: this ensures that the new decal adheres properly.

To replace the decal:

1. Remove the existing decal from the bottom of the rotor; be careful not to scratch the rotor surface.
2. Clean the adhesive from the rotor surface using acetone or 3M General Adhesive Remover #8984.
3. Wipe the surface dry with a clean, soft cloth.

Note Check that the new decal has the correct number of black segments - the TFT-80.4 Rotor decal should have 11 black segments.

4. Peel the paper backing off the new decal. Fit the decal into the recess in the bottom of the rotor. Be sure the decal is properly centered, then press the decal firmly into place.

Storage

Rotors should be stored upside down, with covers removed, so air can circulate. This will help prevent moisture from gathering and settling at the bottom of the tube compartments.

Service Decontamination Policy

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 following procedure to ensure the safety of all personnel:

1. Clean the centrifuge or rotor to be serviced of all encrusted material and decontaminate (see Maintenance Section of centrifuge or rotor instruction manual) it 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.

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

The Thermo Fisher Scientific Product Guide contains descriptions of commonly used decontamination methods and a chart showing method compatibility with various materials. The Care and Maintenance Section of the centrifuge or rotor instruction manual contains specific guidance about cleaning and decontamination methods appropriate for the product it describs.

Clean and decontaminate your centrrfuge or rotor as follows:

For ultraspeed centrifuges:

a. Remove rotor from the rotor chamber.

b. Decontaminate door and rotor chamber using an appropriate method.

For rotors:

Remove tubes, bottles, and adapters from the rotor and decontaminate rotor using an appropriate method. If tubes or rotor caps are stuck in the rotor, or the rotor lid is stuck, and nature of the sample so the Thermo Fisher Scientific ChemicaI Hazards Officer can decide whether to authorize the rotor's return to a Thermo Fisher Scientific facility.

2. Complete and attach Decontamination Information Certificate (in the back of your rotor or instrument manual) to the centrifuge or rotor before servicing or return to 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.

Note United States federal regulations require that parts and instruments musf be decontaminated before being transported.

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 potentiaI 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. Disposition costs will be borne by the sender.

Decontamination Information Certificates are included with these instructions. Additional certificates are availabIe from the local Account or Field Service Engineer. In the event these certificates are not available, a written statement certifying that the unit has been properly decontaminated and outlining the procedures used will be acceptable.

Note The Field Service Engineer will note on the Customer Service Repair Report if decontamination was required and, if so, what the contaminant was and what procedure was used. If no decontamination was required, it will be so stated.

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	PET*, POLYCLEAR®,CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	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

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	PET*, POLYCLEAR®, CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A®, TEFLON®	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON®	VITON®
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
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
Diethylpyrocarbonate		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

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	PET*, POLYCLEAR®, CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A®, TEFLON®	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON®	VITON®
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
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

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	PET*, POLYCLEAR®, CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A®, TEFLON®	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON®	VITON®
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-Dimethylformamide		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
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

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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
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

*Polyethyleneterephthalate

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.

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

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