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INSTRUCTION MANUAL

SORVALL® SUPERSPEED ANGLE ROTORS:

GSA SE-12
GS-3 SM-24
SA-600 SS-34

Du Pont Company
Instrument Products
Biomedical Division
Newtown, Connecticut 06470

Du Pont Instruments

PN 28505
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This manual is a guide for the use of

SORVALL SUPERSPEED ANGLE ROTORS

Data herein has been verified and validated and is believed adequate for the intended use of the instrument. If the instrument or procedures are used for purposes over and above the capabilities specified herein, confirmation of their validity and suitability should be obtained, otherwise Du Pont does not guarantee results and assumes no obligation or liability. This publication is not a license to operate under, or a recommendation to infringe upon, any process patents.

Notes, cautions, and warnings within the text of this manual are used to emphasize important and critical instructions.

WARNING: An operating procedure, practice, etc., which if not correctly followed, could result in personal injury.

CAUTION: An operating procedure, practice, etc., which, if not strictly observed, could result in damage of equipment.

NOTE: An operating procedure, condition, etc., which it is essential to highlight.

Health hazards precaution data. If and when hazardous chemicals or adverse health affect the environment or use of the equipment, appropriate precautions are provided.

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DU PONT INSTRUMENT SUPERSPEED ROTOR WARRANTY

Every Sorvall Superspeed Rotor is warranted (subject to the conditions specified below and in the warranty clause of the Du Pont Instruments terms and conditions of sale in effect at the time of sale) against defects in materials or workmanship for seven (7) years (properly reduced for certain fluid densities, fluid gradients, tube assemblies, and adapters as described in these operating instructions).

Conditions

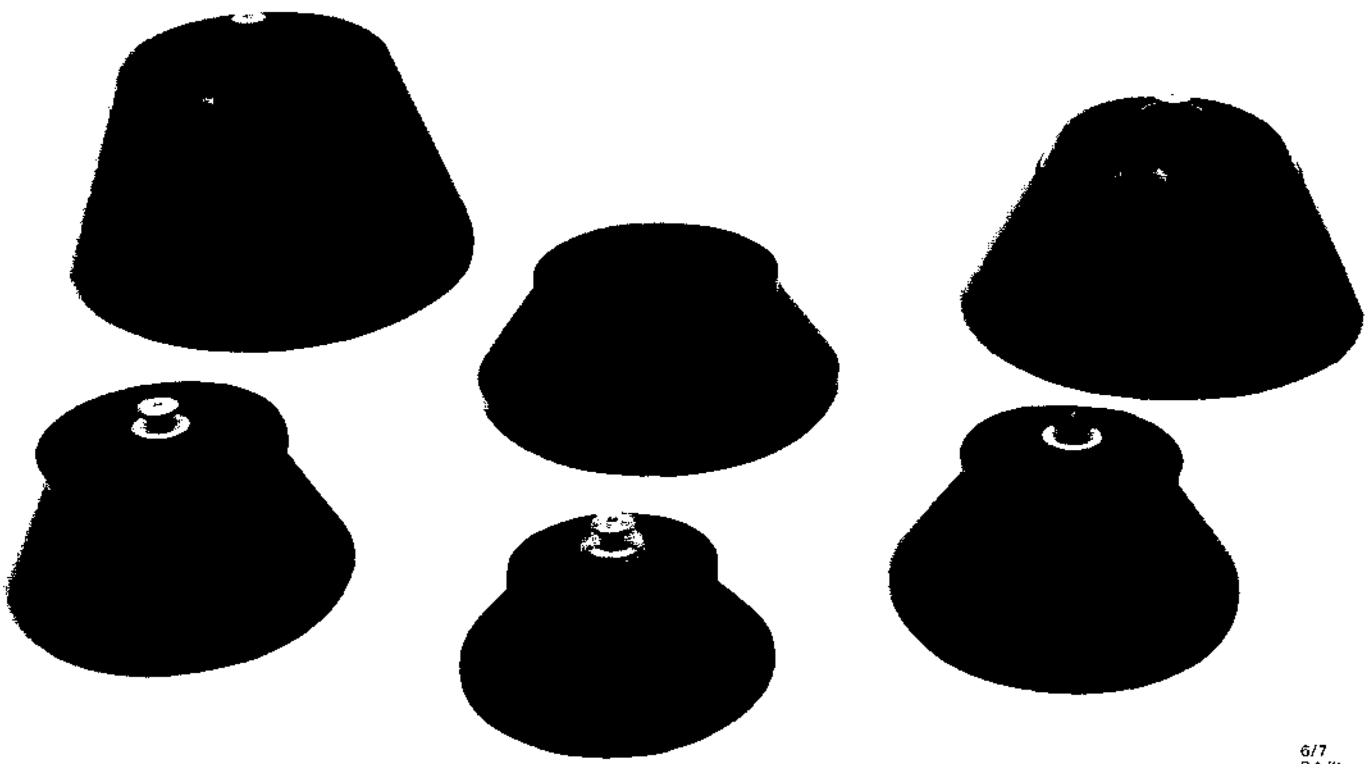
a. This warranty is valid for seven (7) years from the date of shipment to the original buyer by Du Pont Instruments or by any authorized Du Pont Instruments representative.

b. This warranty extends only to the original buyer and may not be assigned or extended to a third person without the written consent of Du Pont Instruments.

c. This warranty covers the rotor only and Du Pont Instruments shall not be liable for damage to accessories or ancillary supplies including but not limited to (i) tubes, (ii) tube caps, (iii) tube adapters, or (iv) tube contents.

d. This warranty is void if the rotor is (i) operated or maintained in a manner contrary to the instructions in the manual for the rotor or centrifuge in use, or (ii) used in a Sorvall centrifuge that has been modified without the written permission of Du Pont Instruments.

e. Should a Sorvall Centrifuge be damaged due to the failure of rotor covered by this warranty, Du Pont Instruments will supply, free of charge, (i) all centrifuge parts required for repair and (ii) if the centrifuge is currently covered by a Du Pont Instruments warranty or service agreement; all labor necessary for repair of the centrifuge.



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SA/2

Figure 1-1. Sorvall Superspeed Angle Rotors
(Top, L-R) GS-3, SA-600, GSA
(Bottom, L-R) SM-24, SE-12, SS-34

Section 1. DESCRIPTION

1-1. SCOPE.

This manual contains descriptive, operational and maintenance data for all Sorvall Superspeed Angle Rotors, including the GSA, GS-3, SA-600, SE-12, SM-24 and SS-34 rotors.

1-2. DESCRIPTION.

Sorvall Superspeed Angle Rotors, are designed for use in the Sorvall RC-2, RC2-B, RC-5, and RC-5B Superspeed Refrigerated Centrifuges. With the exception of the GS-3, the rotors may also be used in the Sorvall SS-3 Automatic Superspeed Centrifuge. The rotors are machined from an aluminum alloy forging for a high centrifugal force strength-to-weight ratio. Table 1-1 provides basic specifications for each superspeed angle rotor.

Table 1-1. Superspeed Angle Rotors: Basic Specifications

	GSA	GS-3	SA-600	SE-12	SM-24	SS-34
Diameter	31 cm (12-1/4 in)	33 cm (13-3/16 in)	27 cm (10-3/4 in)	19 cm (7-4/5 in)	24 cm (9-1/8)	23 cm (9 in)
Mass (weight)	14.9 kg (33 lbs)	21.4 kg (47 lbs)	10.2 kg (22.5 lbs)	4.1 kg (9 lbs)	7.7 kg (17 lbs)	6.8 kg (15 lbs)
Angle	28°	20°	34°	40°	28°	34°
Number of Places	6	6	12	12	24	8
Maximum Angular Velocity (in rev/min)	13 000/min	9 000/min	16 500/min	20 000/min	20 000/min	20 000/min
Maximum Relative Centrifugal Force (RCF)	27 600	13 700	39 400	41 500	Outer Row 49 300 Inner Row 39 700	48 200

1-3. TUBES, BOTTLES AND ADAPTERS.

Each Sorvall Superspeed Angle Rotor accepts a variety of plastic, glass and stainless steel tubes and bottles. Special adapters permit the use of tubes and bottles other than those which fit the basic rotor.

Tables 1-3, 1-4 and 1-5 provide the following data necessary to select the appropriate tube or bottle of glass, plastic or stainless steel

a. For Use in Rotor (Adapter) — Lists the rotor or rotors which will accept that tube or bottle. If an adapter is required to permit the rotor to accept the desired tube or bottle, a key number will follow the rotor initials in parentheses. Table 1-6, Adapters, lists the adapters by key number and provides part numbers and descriptions. Table 1-6 is keyed by part number to figure 1-5 which illustrates the adapters listed.

b. Part Number – Gives the part number assigned to each item by the Biomedical Division*. Tables 1-3, 1-4 and 1-5 are keyed by part number to figures 1-2, 1-3 and 1-4 respectively. The figures illustrate the tubes, bottles and covers listed.

c. Nominal Capacity — Gives the rounded amount of milliliters of solution which each tube or bottle can contain.

d. Material — Gives an abbreviation for the specific glass or plastic of which the item is made. Table 1-2, Key to Abbreviations is provided for interpretation of the material code. Table 1-7, Chemical Compatability of Rotor Elements, is provided as an aid in selecting the tube or bottle best suited to the solution which will be used.

e. Nominal External Dimensions — Gives the rounded diameter and length of the tube or bottle in millimeters.

f. Covers — Gives material and part number of cover(s) if required with the desired tube or bottle.

Table 1-2. Key to Abbreviations Used in Tables 1-3, 1-4, 1-5 and 1-6

CAB	=	Cellulose Acetate Butyrate	PE	=	Polyethylene
C	=	Corex®	Pl	=	Plastic
G	=	Graduated	PP	=	Polypropylene
N	=	Nylon	R	=	Rubber
NM	=	Narrow Mouth	RB	=	Round Bottom
OR	=	Oak Ridge Style	S/S	=	Stainless Steel
P	=	Pyrex	T	=	Tapered
PA	=	Polyallomer	TW	=	Thin Wall
PC	=	Polycarbonate			

*The part number cannot be used to order replacement parts. Please refer to the Sorvall Tube, Bottle and Adapter Price List for the correct catalog number before ordering.

Table 1-3. Glass Tubes and Bottles for Superspeed Angle Rotors

	Tubes/Bottles				Covers	
For Use in Rotor (Adapter)	Part Number	Nominal Capacity (ml)	Material	Nominal External Dimensions (mm x mm)	Material	Part Number
SA-600 (7); SE-12 (20); SM-24 (17); SS-34 (7)	00120	1 (T)	P	8 x 63	—	—
GSA (12 in 46); SA-600 (6); SE-12(19); SM-24 (16); SS-34 (6)	00100	3	P	10 x 75	—	—
GSA (30); SE-12 (21); SM-24 (18)	00124	5	P	12 x 75	—	—
SE-12 (22)	00118	5	P	14 x 60	R	00326
GSA (11 in 46); SA-600 (8); SM-24 (15); SS-34 (8)	00101	10	P	13 x 100	—	—
SA-600 (9); SS-34 (9)	00123	10 (T)	P	18 x 102	—	—
SA-600 (9); SS-34 (9)	00125	10 (T) (G)	P	18 x 102	—	—
GSA (46)	00104	12 (T)	P	17 x 120	—	—
SA-600 (5); SS-34 (5)	00119	12	P	178 x 102	R	00321
GSA (46)	00127	14	P	18 x 120	R	00321
SA-600 (5); SM-24 (1) SS-34 (5)	00152	15	C	18 x 102	—	—
GSA (46)	00103	20	P	18 x 120	—	—
SA-600 (2); SS-34 (2)	00128	30 (NM)	P	28 x 90	R	00304 or 00331
GSA (45); SA-600 (10); SS-34 (10)	00156	30	C	24 x 105	—	—
SA-600, SS-34	00105	45	P	29 x 101	—	—
GSA (13)	00129	70	P	44 x 128	—	—
GSA (13)	00116	100	P	44 x 137	Plastic Screw Cover Supplied	
GSA (14)	00158	150	C	53 x 132	Plastic Screw Cover Supplied	
GSA (30)	—	4	Standard glass test tubes	10 x 75	—	—
GSA (30)	—	5	Standard glass test tubes	12 x 75	—	—

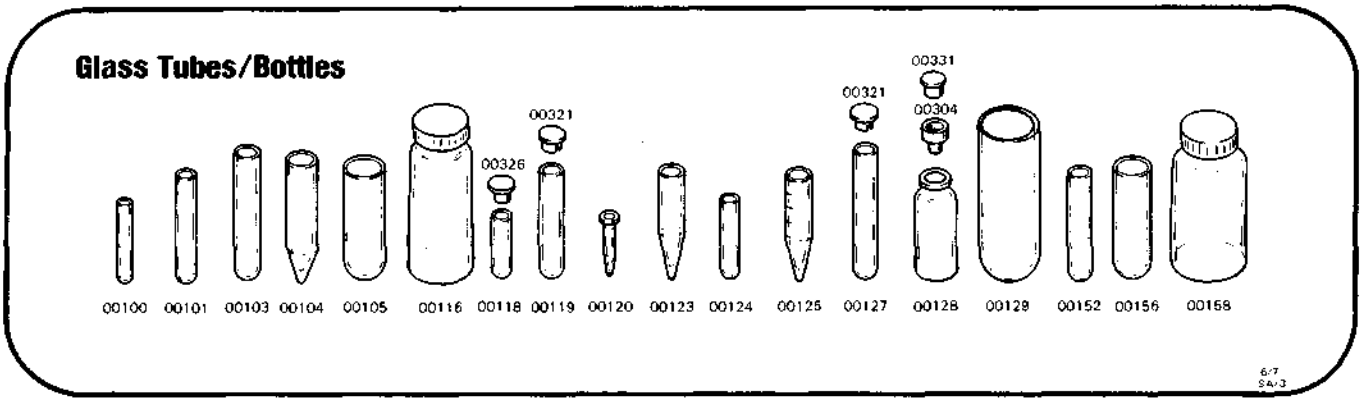


Figure 1-2. Glass Tubes and Bottles

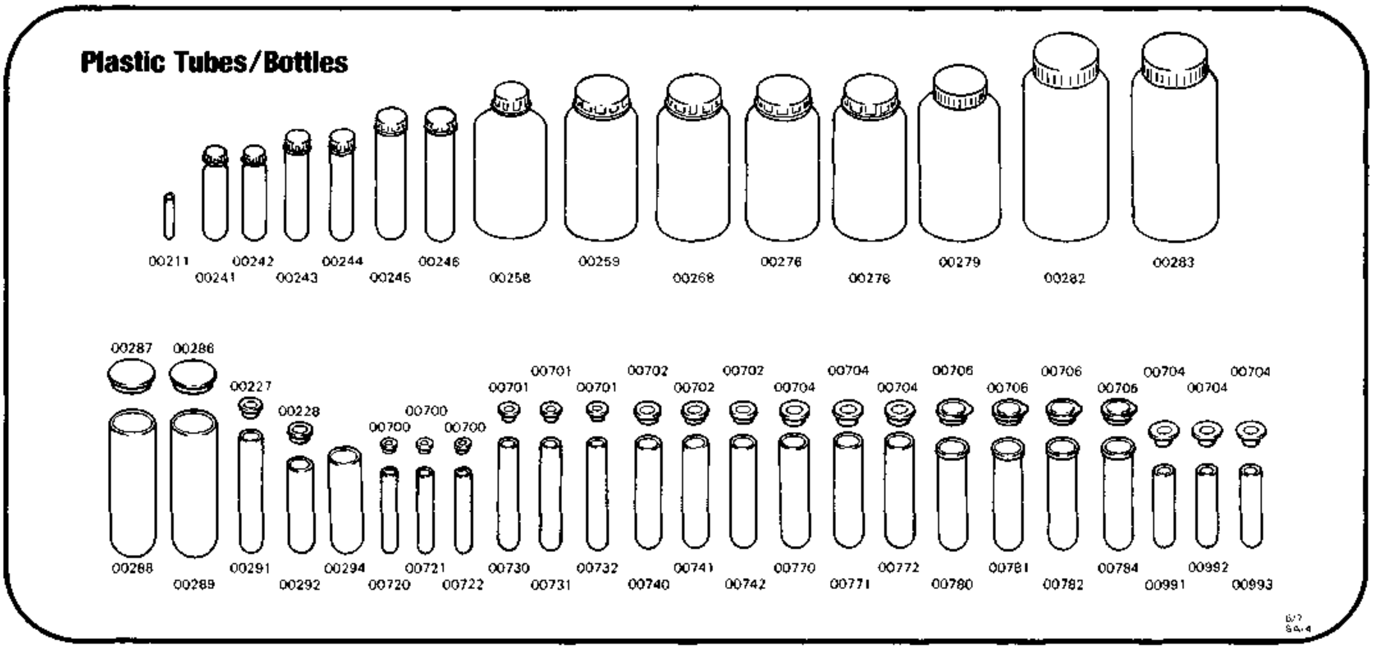


Figure 1-3. Plastic Tubes and Bottles

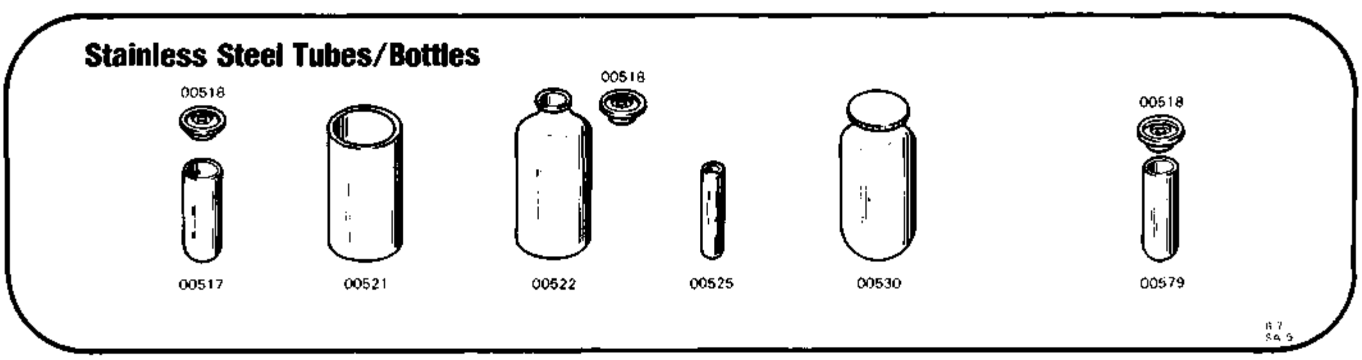


Figure 1-4. Stainless Steel Tubes and Bottles

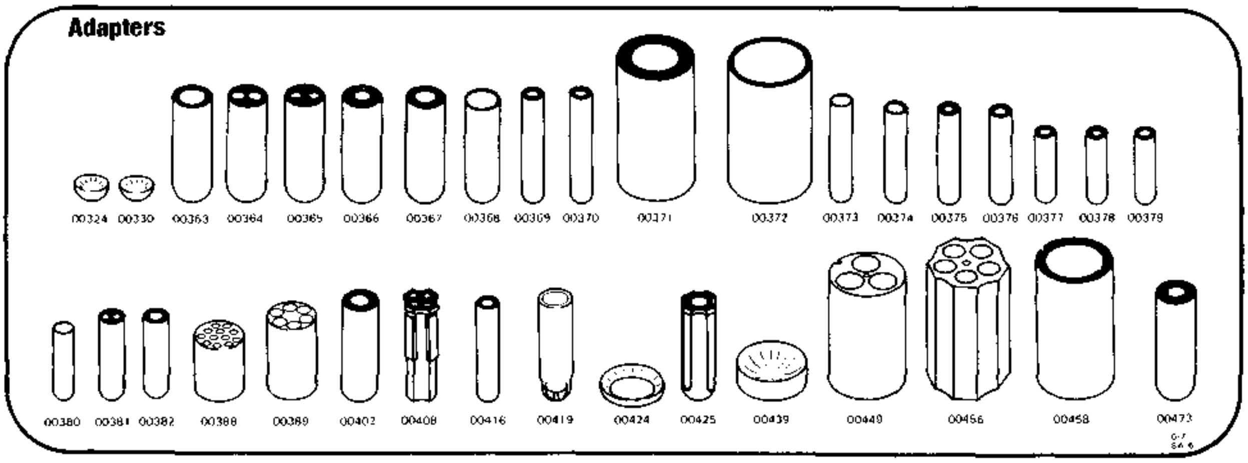


Figure 1-5. Adapters

Table 1-4. Plastic Tubes and Bottles for Superspeed Angle Rotors

For Use in Rotor (Adapter)	Tubes/Bottles				Covers	
	Part Number	Nominal Capacity (ml)	Material	Nominal External Dimensions (mm x mm)	Material	Part Number
SA-600 (33); SS-34 (33)	00211	1	CAB	7 x 50	—	
GSA (30); SA-600 (23) SS-34 (23)	00720	4	PC	10.6 x 75	PP	00700
GSA (30); SA-600 (23) SS-34 (23)	00721	4	PP	10.6 x 75	PP	00700
GSA (30); SA-600 (23) SS-34 (23)	00722	4	PE	10.6 x 75	PP	00700
SA-600 (50); SM-24 (34) SS-34 (50)	00730	7	PC	13 x 100	PP	00701
SA-600 (50); SM-24 (34) SS-34 (50)	00731	7	PP	13 x 100	PP	00701
SA-600 (50); SM-24 (34) SS-34 (50)	00732	7	PE	13 x 100	PP	00701
SA-600 (37); SS-34 (37)	00241	10 (OR)	PC	16 x 80	Plastic Screw Cover Supplied	
SA-600 (37); SS-34 (37)	00242	10 (OR)	PP	16 x 80		
SA-600 (50); SM-24 (34) SS-34 (50)	00291	10 (TW)	PA	13 x 100	PP	00227
GSA (31); SA-600 (32) SS-34 (32)	00740	12	PC	16 x 100	PP	00702
GSA (31); SA-600 (32); SS-34 (32)	00741	12	PP	16 x 100	PP	00702
GSA (31); SA-600 (32) SS-34 (32)	00742	12	PE	16 x 100	PP	00702
SE-12	00991	14	PC	18 x 75	PP	00704

Table 1-4. Plastic Tubes and Bottles for Superspeed Angle Rotors (continued)

	Tubes/Bottles				Covers	
For Use in Rotor (Adapter)	Part Number	Nominal Capacity (ml)	Material	Nominal External Dimensions (mm x mm)	Material	Part Number
SE-12	00992	14	PP	18 x 75	PP	00702
SE-12	00993	14	PE	18 x 75	PP	00702
SA-600 (32); SS-34 (32)	00292	15 (TW)	PA	16 x 100	PP	00228
SA-600 (24); SM-24 SS-34 (24)	00770	16	PC	18 x 100	PP	00704
SA-600 (24); SM-24; SS-34 (24)	00771	16	PP	18 x 100	PP	00704
SA-600 (24); SM-24 SS-34 (24)	00772	16	PE	18 x 100	PP	00704
SA-600 (35); SS-34 (35)	00243	30 (OR)	PC	25 x 90	Plastic Screw Cover Supplied	
SA-600 (35); SS-34 (35)	00244	30 (OR)	PP	25 x 90	Plastic Screw Cover Supplied	
SA-600; SS-34	00245	50 (OR)	PC	29 x 104	Plastic Screw Cover Supplied	
SA-600; SS-34	00246	50 (OR)	PP	29 x 104	Plastic Screw Cover Supplied	
SA-600; SS-34	00780	50	PC	29 x 102	PP	00706
SA-600; SS-34	00781	50	PP	29 x 102	PP	00706
SA-600; SS-34	00782	50	PE	29 x 102	PP	00706
SA-600; SS-34	00784	50	N	29 x 102	PP	00706
SA-600; SS-34	00294	50 (TW)	PA	28 x 104	—	—
GSA (47)	00288	150 (TW)	PA	45 x 122	PP	00287
GSA (47)	00289	150	PC	45 x 122	PP	00286
GSA	00258	250 (NM)	PE	60 x 137	Plastic Screw Cover Supplied	
GSA (36)	00268**	250	PE	61 x 122	PI	00450*
GSA (36)	00259	250	PP	61 x 122	PI	00450*
GSA (36)	00276	250	PC	61 x 122	PI	00450*
GSA (38)	00278	250 (RB)	PC	61 x 136	PI	00450* ring
GSA (36)	00279	290	PC	61 x 138	PI	00450*
GS-3	00282	500	PP	70 x 166	PI	00430*
GS-3	00283	500	PC	70 x 166	PI	00430*

*Plastic screw caps supplied but sealing caps 00450 or 00430 must be used for full volume, full speed operation.

** The 00268 bottles are limited to 8 000 rev/min.

Table 1-5. Stainless Steel Tubes and Bottles for Superspeed Angle Rotors

For Use in Rotor (Adapter)	Tubes/Bottles				Covers	
	Part Number	Nominal Capacity (ml)	Material	Nominal External Dimensions (mm x mm)	Material	Part Number
SM-24	00525	175	S/S	18 x 96	—	—
SA-600; SS-34	00517	50	S/S	28 x 101*	S/S	00518***
SA-600; SS-34	00579	50	S/S	28 x 101**	S/S	00518***
GSA	00521	200	S/S	61 x 124	—	—
GSA	00530	285	S/S	61 x 140	Stainless Steel Screw Cover Supplied	
GSA	00522	315	S/S	61 x 153	S/S	00518***

*With flange
**Without flange
***Requires wrench PN 01014

Table 1-6. Adapters

Item No.	Places	Material	PN	Item No.	Places	Material	PN
1	1	R	00324	21	1	R	00379
2	Pad	R	00330	22	1	R	00380
5	1	R	00363	23	2	Pl	00381
6	2	R	00364	24	1	Pl	00382
7	2	R	00365	30	12	Pl	00388
8	1	R	00366	31	6	Pl	00389
9	1	R	00367	32	1	Pl	00402
10	1	R	00368	33	4	Pl	00408
11			00369	34	1	Pl	00416
12			00370	35	1	Pl	00419
13	3	Pl	00371	36	Pad	Pl	00424
14	1	R	00372	37	1	Pl	00425
15	1	R	00373	38	Pad	Pl	00439
16	1	R	00374	45	3	Pl	00449
17	1	R	00375	46	5	R	00456
18	1	R	00376	47	1	Pl	00458
19	1	R	00377	50	1	Pl	00473
20	1	R	00378				

Table 1-7. Chemical Compatability of Rotor Elements

Reagent	Titanium	Delrin	Velox	Viton A	Buna N	Aluminum	Nylon	Stainless Steel	Polyallomer Polyethylene Polypropylene	Polycarbonate	Cellulose Acetate Butyrate
Acetaldehyde (100%)	S	–	–	U	S	S	–	–	M	U	U
Acetic Acid (5%)	S	M	S	S	U	S	S	S	S	S	S
Acetic Acid (60%)	S	U	S	U	U	S	S	S	M	U	U
Acetic Acid (Glacial)	S	U	S	U	U	S	–	S	M	U	U
Acetone	S	M	M	U	U	S	S	S	S	U	U
Allyl Alcohol	S	S	S	–	–	–	S	–	S	S	U
Alum, Concentrated	S	–	S	S	S	–	S	S	S	–	–
Aluminum Chloride	M	U	S	S	S	U	S	U	S	S	S
Aluminum Fluoride	S	M	–	S	S	M	S	M	S	U	–
Ammonium Acetate	S	–	–	–	–	–	–	–	S	S	–
Ammonium Carbonate	S	–	S	–	U	S	S	S	S	U	S
Ammonium Hydroxide (10%)	S	–	S	U	S	–	S	S	S	U	U
Ammonium Hydroxide (Conc.)	S	–	U	U	U	–	S	S	S	U	U
Ammonium Persulfate (Sat'd.)	–	U	–	U	U	–	–	S	S	–	–
Ammonium Sulfide	S	U	–	U	U	S	–	S	S	U	–
Amyl Alcohol	S	S	S	S	M	S	S	–	S	S	U
Aniline	S	M	–	U	U	S	–	S	M	–	–
Aqua Regia	S	U	M	M	U	U	–	–	U	U	U
Benzene	S	M	M	S	U	S	S	S	U	U	S
Benzyl Alcohol	S	M	–	S	U	S	S	–	U	U	U
Boric Acid	S	S	S	S	S	S	S	S	S	S	S
Brine	S	S	–	S	–	–	S	S	S	S	S
N-Butyl Alcohol	S	S	S	S	S	S	S	–	S	S	U
Calcium Chloride	S	S	S	S	S	M	S	S	S	M	S
Calcium Hypochlorite	S	M	S	S	U	M	S	U	S	S	–
Carbon Tetrachloride	S	M	S	S	M	M	S	M	U	U	S
Cetyl Alcohol	S	S	–	–	–	–	S	–	S	–	U
Chlorine Water	S	U	S	S	U	U	–	–	S	S	S
Chlorobenzene	–	–	U	S	U	–	–	S	U	U	U
Chloroform	S	M	S	S	U	–	S	S	U	U	M
Chromic Acid (10%)	S	U	M	S	U	M	–	U	S	S	U
Chromic Acid (50%)	S	U	M	S	U	U	–	U	S	U	U
Citric Acid (10%)	S	M	S	S	S	S	S	S	S	S	S
Cresol	S	U	–	–	–	M	U	–	M	U	–
Cyclohexyl Alcohol	S	S	–	–	–		S	–	S	–	U
Diacetone	S	M	–	U	U	S	–	–	S	–	U
Diazo Salts	–	–	S	–	–	–	–	–	S	–	–
Diethyl Ketone	S	M	M	–	–	–	S	–	M	U	U
Dimethylformamide	S	M	–	M	U	S	–	–	S	U	–
Dioxane	–	M	–	U	U	–	–	–	M	U	U
Distilled Water	S	S	S	S	S	S	S	S	S	S	S
Ether Diethyl	S	S	–	U	U	–	–	–	M	U	U
Ethyl Acetate	S	M	M	U	U	M	S	–	S	U	U
Ethyl Alcohol (50%)	S	M	S	U	S	S	S	S	S	S	S
Ethyl Alcohol (95%)	S	M	S	U	S	S	S	S	S	S	U
Ethylene Dichloride	S	S	M	S	U	–	S	–	U	U	U
Ethylene Glycol	S	S	S	S	S	S	S	–	S	S	S
Ferric Chloride	S	M	S	S	S	U	S	U	S	–	–
Fluoboric Acid	M	–	S	–	U	–	–	–	S	–	–
Formaldehyde (40%)	S	–	M	U	U	M	S	S	S	S	–
Formic Acid (100%)	S	U	S	–	–	S	U	U	S	M	U
Fuel Oil	–	S	S	S	S	–	S	S	M	S	–
Gallic Acid	S	–	–	S	M	S	S	S	S	–	–
Gasoline (Refined)	S	S	S	S	S	S	S	S	U	S	U
Gasoline (Sour)	S	S	–	S	S	S	–	S	U	U	U
Hydrochloric Acid (10%)	S	U	S	S	U	U	S	U	S	S	S
Hydrochloric Acid (50%)	S	U	S	S	U	U	–	U	S	S	U
Hydrochloric Acid (Conc.)	S	U	U	S	U	U	–	U	S	M	U
Hydrofluoric Acid (10%)	U	U	S	M	U	U	S	U	S	M	M
Hydrofluoric Acid (100%)	U	U	U	U	U	U	–	U	S	U	U
Hydrogen Peroxide (3%)	S	S	S	S	M	S	S	S	S	S	S
Hydrogen Peroxide (100%)	U	U	M	S	U	S	–	S	S	S	S
Hydroquinone	S	M	–	M	U	S	S	–	S	–	–
Isobutyl Alcohol	S	S	S	S	M	–	S	–	S	–	U
Isopropyl Alcohol	S	S	S	S	U	–	S	–	S	S	U
Lactic Acid (20%)	S	–	S	S	–	S	–	S	S	S	–
Lactic Acid (100%)	S	–	S	S	–	–	–	S	S	–	–
Lauryl Alcohol	S	S	–	–	–	–	S	–	S	–	U
Lead Acetate	S	S	–	U	–	M	–	S	S	–	S
Linseed Oil	S	S	S	S	S	S	–	S	S	S	S
Maleic Acid	S	–	S	S	S	S	–	S	S	–	–
Manganese Salts	S	U	–	–	–	–	–	–	S	–	S
Magnesium Hydroxide	S	M	S	S	M	–	–	S	S	U	U
Mercury	S	–	S	S	S	U	–	S	S	S	S
Methyl Alcohol	S	M	S	U	S	S	S	S	S	U	U
Methyl Ethyl Ketone	S	M	M	U	U	S	S	–	S	U	U
Methyl Salicylate	S	S	–	–	U	S	–	–	–	U	U
Methylene Chloride	S	S	U	M	U	S	–	S	S	U	U
Nickel Salts	S	–	S	S	S	M	–	S	S	S	S
Nitric Acid (10%)	S	U	S	S	U	M	M	S	S	S	S
Nitric Acid (50%)	S	U	M	S	U	M	M	S	S	M	M
Nitric Acid (95%)	M	U	U	S	U	M	U	S	U	U	U
Oleic Acid	S	S	S	M	U	S	S	S	S	S	S
Oxalic Acid	U	–	S	S	M	M	S	S	S	S	S
Perchloric Acid (10%)	–	U	S	S	U	U	–	–	S	–	–
Phenol	M	U	U	S	U	S	U	S	S	U	–
Phenyl Ethyl Alcohol	S	–	–	–	–	S	S	–	S	–	U
Phosphoric Acid (10%)	M	U	S	S	U	–	–	S	S	S	S
Phosphoric Acid (Conc.)	U	U	U	S	U	–	–	S	S	S	M
Phosphorus Trichloride	S	U	–	S	U	–	–	S	S	U	–
Potassium Acetate	S	S	–	U	M	–	–	–	S	M	–
Potassium Carbonate	S	M	S	–	–	M	S	S	S	–	S
Potassium Chlorate	–	–	S	–	–	S	S	S	S	S	S
Potassium Chloride	S	S	S	S	S	M	S	S	S	S	S
Potassium Hydroxide (5%)	S	U	S	U	M	U	S	S	S	U	S
Potassium Hydroxide (Conc.)	M	U	U	U	M	U	–	S	S	U	U
Potassium Permanganate	S	M	–	–	–	S	S	S	S	–	–
Silicic Acid	–	–	–	–	–	–	–	–	S	–	–
Silicone Fluids	–	S	–	S	S	–	–	–	M	–	–
Silver Cyanide	–	U	S	–	–	–	–	S	S	–	–
Sodium Bisulfate	S	M	S	S	S	M	S	S	S	S	S
Sodium Borate	–	M	S	S	S	–	S	S	S	S	S
Sodium Carbonate	S	S	S	S	S	M	S	S	S	S	S
Sodium Chloride (10%)	S	S	S	S	S	S	S	S	S	S	S
Sodium Chloride (Sat'd.)	S	S	S	S	S	S	S	S	S	–	–
Sodium Dichromate	S	–	–	–	–	–	S	–	S	–	–
Sodium Hydroxide (>1%)	S	U	S	M	M	U	S	S	S	U	S
Sodium Hydroxide (10%)	S	U	S	M	M	U	S	S	S	U	U
Sodium Hydroxide (Conc.)	M	U	U	U	M	U	S	S	S	U	U
Sodium Hypochlorite	S	U	S	S	M	M	S	S	S	S	S
Sodium Nitrate (10%)	S	–	S	–	M	M	S	S	S	U	–
Sodium Peroxide	–	U	–	S	M	S	S	S	S	–	–
Sodium Sulfide	S	–	S	S	S	S	S	S	S	U	S
Sodium Thiosulfate	S	M	S	S	M	–	S	–	S	S	–
Sulfuric Acid (10%)	U	U	S	S	U	M	M	U	S	U	S
Sulfuric Acid (50%)	U	U	M	S	U	–	U	U	S	S	U
Sulfuric Acid (75%)	U	U	U	S	U	–	U	U	S	S	U
Sulfuric Acid (Conc.)	U	U	U	S	U	–	U	S	U	S	U
Tannic Acid	S	–	S	S	S	–	S	S	S	–	–
Toluene	S	M	S	S	U	S	S	–	U	U	S
Trichlorethylene	S	–	M	–	–	–	S	–	U	U	–
Trichloroethane	S	M	S	S	U	–	S	–	U	U	S
Trisodium Phosphate	S	M	–	–	–	–	–	–	S	M	–
Turpentine	S	S	S	S	S	S	S	–	M	U	U
Urea	S	S	–	–	–	S	S	–	S	S	S
Urine	S	S	–	–	–	–	S	–	S	S	S
Xylen	S	M	M	S	U	S	U	–	U	U	S
Zinc Chloride	S	–	S	S	S	M	S	M	S	S	S

KEY

S = Satisfactory, acceptable solutions for recommended use.

M = Mild attack, not recommended for use. If these solutions must be used, avoid prolonged exposure and thoroughly clean and dry all rotor elements after each run.

U = Unsatisfactory, not recommended under any circumstances.

— = Data unavailable at this time, not recommended for use without prior testing.

NOTE

The critical components apt to come into contact with solution when using a superspeed angle rotor are the rotor body (aluminum) and the tube, bottle and/or adapter chosen for the run. Materials of tubes, bottles and or adapters may be obtained from the appropriate table 1-3, 1-4, 1-5 or 1-6.

1-4. PARTS AND ACCESSORIES.

Parts for all Superspeed Angle Rotors are pictured in figures 1-6 and 1-7.

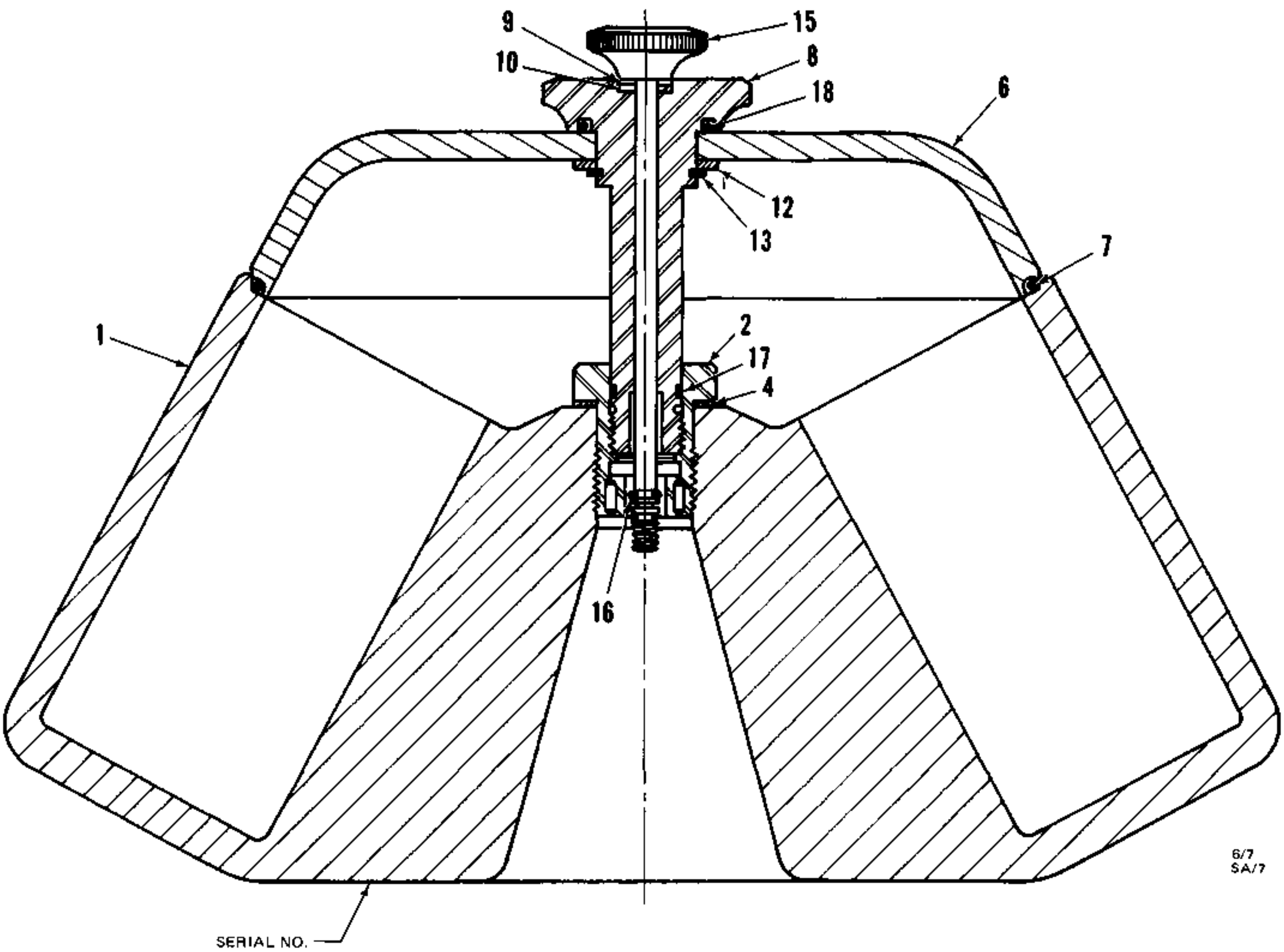
Both figures are keyed to Table 1-8, which includes all information necessary to:

- identify parts and accessories for assembly, operation and disassembly.
- order replacement parts or accessories.

To obtain replacement parts, contact any of the offices listed on the last page of this manual and include the part number and description of the desired item. To ensure that you receive the correct part for your unit, be sure to include the rotor type and its serial and/or model number.

Table 1-8. Parts: Superspeed Angle Rotors

Item No.	Description	Part Number					
		GSA	GS-3	SA-600	SE-12	SM-24	SS-34
1	Rotor Body	08140	07010	28509	27001	29001	28001
2	Adapter-Sub Assy	08139	07026	28021	28021	28021	28021
3	Cap Screw	—	—	63078 (3)	63078 (4)	63078 (4)	63078 (4)
4	Seal Washer	08132	07004	—	—	—	—
5	Setscrew	—	—	60574 (3)	60574 (4)	60574 (4)	60574 (4)
6	Rotor Cover	08107	07012	28506	27003	29002	28005
7	O-Ring	60356	—	60810	61720	60696	60188
8	Cover Sealing Stud	08131	07024	28008	28008	28008	28008
9	Flat Washer (1/4")	60751 (2)	60751 (2)	60751 (2)	60751 (2)	60751 (2)	60751 (2)
10	Lock Washer	28016	28016	28016	28016	28016	28016
11	Cover Stud Top Washer	—	—	28010	28010	28010	28010
12	Cover Seat Washer	08125	08125	28011	28011	28011	28011
13	Retaining Ring	60357	60357	60067	60067	60067	60067
14	Cover Seat	—	—	28510	28007	28007	28007
15	Cover Stamping Stud	08120	07022	28006	28006	28006	28006
16	O-Ring	61616	61616	61616	61616	61616	61616
17	O-Ring	61617	—	60189	60189	60189	60189
18	O-Ring	60358	—	—	—	—	—
	Carrying Handle	01047	10147	01031	01031	01031	—



NOTE

Earlier Models may not conform exactly to illustration.

Figure 1-6. Parts of the GSA and GS-3 Superspeed Angle Rotors

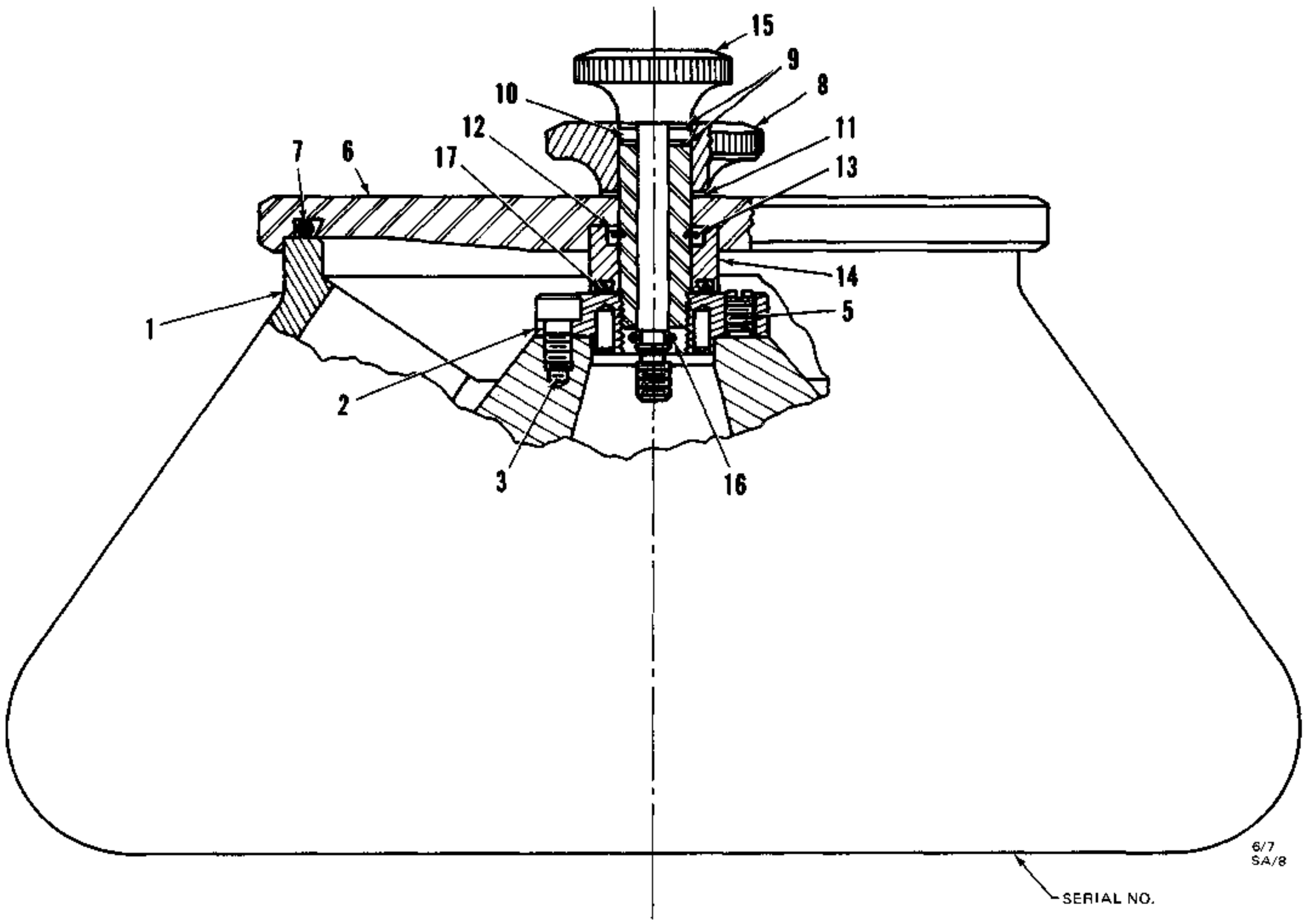


Figure 1-7. Parts of the SA-600, SE-12, SM-24 and SS-34 Superspeed Angle Rotors

1-5. RCF DETERMINATION.

Relative centrifugal force (RCF) is determined by the "common usage" formula:

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

when r = the radius in centimeters
ω = the angular speed in revolutions per minute

Figure 1-8 shows the minimum, average and maximum radii of a superspeed rotor. The value for each radius may be found in the appropriate table 1-9 through 1-14. With this information, RCF for the rotor at a given speed can either be calculated by the formula given above or extracted from the appropriate table.

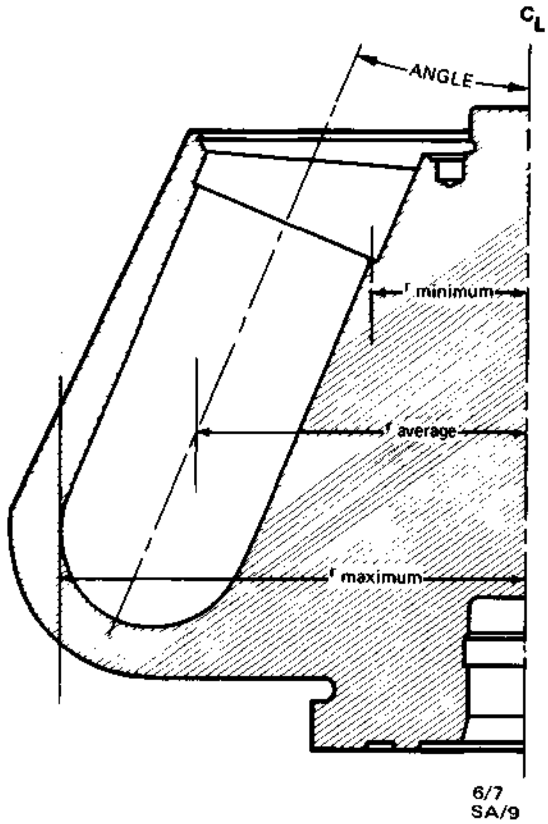


Figure 1-8. Superspeed Angle Rotor Cross Section

Table 1-9. GSA Rotor: RCF and K Factor

Angular Velocity (rev/min)	RCF (Radius) r minimum 9.27 cm (3.65 in)	r average 11.94 cm (4.70 in)	r maximum 14.63 cm (5.75 in)	K Factor
1 000	104	133	163	115 000
1 500	233	300	367	51 100
2 000	414	534	653	28 800
2 500	647	834	1 020	18 400
3 000	932	1 200	1 470	12 800
3 500	1 270	1 630	2 000	9 890
4 000	1 660	2 130	2 610	7 190
4 500	2 100	2 700	3 300	5 680
5 000	2 590	3 330	4 080	4 600
5 500	3 130	4 030	4 950	3 800
6 000	3 730	4 800	5 870	3 200
6 500	4 380	5 640	6 890	2 720
7 000	5 080	6 540	8 000	2 350
7 500	5 830	7 500	9 180	2 040
8 000	6 630	8 540	10 400	1 800
8 500	7 480	9 640	11 800	1 600
9 000	8 390	10 800	13 200	1 420
9 500	9 350	12 000	14 700	1 270
10 000	10 400	13 300	16 300	1 150
10 500	11 400	14 700	18 000	1 040
11 000	12 500	16 100	19 700	950
11 500	13 700	17 600	21 700	869
12 000	14 900	19 200	23 500	799
12 500	16 200	20 800	25 500	736
13 000	17 600	22 500	27 600	680

Table 1-10. GS-3: RCF and K Factor

Angular Velocity (rev/min)	RCF r minimum 10.47 cm (4.12 in)	r average 12.80 cm (5.04 in)	r maximum 15.14 cm (5.96 in)	K Factor
1 000	117	143	169	93 400
1 500	263	322	381	41 500
2 000	468	572	677	23 400
2 500	731	894	1 060	14 900
3 000	1 050	1 290	1 520	10 400
3 500	1 430	1 750	2 070	7 630
4 000	1 870	2 290	2 710	5 840
4 500	2 370	2 900	3 430	4 610
5 000	2 920	3 580	4 230	3 740
5 500	3 540	4 330	5 120	3 090
6 000	4 210	5 150	6 090	2 600
6 500	4 940	6 040	7 150	2 210
7 000	5 730	7 010	8 290	1 910
7 500	6 580	8 050	9 510	1 660
8 000	7 490	9 150	10 800	1 460
8 500	8 450	10 300	12 200	1 290
9 000	9 470	11 600	13 700	1 150

Table 1-11. SA-600: RCF and K Factor

Angular Velocity (rev/min)	r minimum 7.93 cm (3.12 in)	r average 10.44 cm (4.11 in)	r maximum 12.95 cm (5.10 in)	K Factor
1 000	89	117	145	124 000
1 500	199	262	326	55 300
2 000	354	467	579	31 100
2 500	553	729	905	19 900
3 000	792	1 050	1 300	13 800
3 500	1 080	1 430	1 770	10 100
4 000	1 420	1 870	2 320	7 770
4 500	1 790	2 370	2 930	6 140
5 000	2 210	2 920	3 610	4 970
5 500	2 680	3 530	4 380	4 110
6 000	3 190	4 200	5 210	3 450
6 500	3 740	4 930	6 120	2 940
7 000	4 340	5 720	7 090	2 540
7 500	4 980	6 560	8 140	2 210
8 000	5 670	7 470	9 260	1 940
8 500	6 400	8 430	10 500	1 720
9 000	7 170	9 450	11 700	1 530
9 500	7 990	10 600	13 100	1 380
10 000	8 850	11 700	14 500	1 240
10 500	9 760	12 900	16 000	1 130
11 000	10 700	14 100	17 500	1 030
11 500	11 700	15 400	19 100	940
12 000	12 800	16 800	20 800	863
12 500	13 800	18 200	22 600	796
13 000	15 000	19 700	24 500	736
13 500	16 100	21 300	26 400	682
14 000	17 400	22 900	28 400	634
14 500	18 600	24 500	30 400	591
15 000	19 900	26 200	32 600	552
15 500	21 300	28 000	34 800	517
16 000	22 700	29 900	37 100	486
16 500	24 100	31 800	39 400	457

Table 1-12. SE-12 Rotor: RCF and K Factor

Angular Velocity (rev/min)	RCF r minimum 5.21 cm (2.05 in)	RCF r average 7.25 cm (2.86 in)	RCF r maximum 9.30 cm (3.66 in)	K Factor
1 000	58	81	104	147 000
1 500	131	182	234	65 200
2 000	233	324	416	36 700
2 500	364	506	649	23 500
3 000	524	729	935	16 300
3 500	713	993	1 270	12 000
4 000	931	1 300	1 660	9 170
4 500	1 180	1 640	2 100	7 240
5 000	1 450	2 030	2 600	5 870
5 500	1 760	2 450	3 140	4 850
6 000	2 090	2 920	3 740	4 070
6 500	2 460	3 420	4 390	3 470
7 000	2 850	3 970	5 090	3 000
7 500	3 270	4 560	5 840	2 610
8 000	3 720	5 190	6 650	2 290
8 500	4 200	5 850	7 500	2 030
9 000	4 710	6 560	8 410	1 810
9 500	5 250	7 310	9 370	1 620
10 000	5 820	8 100	10 400	1 470
10 500	6 410	8 930	11 500	1 330
11 000	7 040	9 800	12 600	1 210
11 500	7 690	10 700	13 800	1 110
12 000	8 380	11 700	15 000	1 020
12 500	9 090	12 700	10 200	939
13 000	9 830	13 700	17 600	868
13 500	10 600	14 800	18 900	805
14 000	11 450	15 900	20 450	748
14 500	12 200	17 000	21 800	698
15 000	13 100	18 200	23 450	652
15 500	14 000	19 500	25 000	610
16 000	14 900	20 700	26 600	573
16 500	15 900	22 100	28 300	539
17 000	16 800	23 400	30 000	507
17 500	17 800	24 800	31 900	471
18 000	18 900	26 300	33 700	453
18 500	19 900	27 700	35 500	429
19 000	21 000	29 300	37 500	400
19 500	22 100	30 800	39 500	386
20 000	23 300	32 400	41 500	367

Table 1-13. SM-24 Rotor: RCF and K Factor

	INNER ROW				OUTER ROW			
	RCF				RCF			
Angular Velocity (rev/min)	r minimum 4.83 cm (1.90 in)	r average 6.48 cm (2.70 in)	r maximum 8.40 cm (3.50 in)	K Factor	r minimum 6.60 cm (2.75 in)	r average 8.99 cm (3.54 in)	r maximum 10.42 cm (4.34 in)	K Factor
1 000	54	77	99	155 000	78	101	123	115 000
1 500	121	172	224	68 700	176	226	277	51 300
2 000	216	307	398	38 600	312	402	493	28 900
2,500	337	479	621	24 800	488	629	770	18 500
3 000	485	690	894	17 200	702	906	1 110	12 800
3 500	661	939	1 220	12 600	956	1 230	1 510	9 420
4 000	863	1 230	1 590	9 660	1 250	1 610	1 970	7 210
4 500	1 090	1 550	2 010	7 630	1 580	2 040	2 490	5 700
5 000	1 350	1 920	2 480	6 180	1 950	2 520	3 080	4 620
5 500	1 630	2 320	3 000	5 110	2 360	3 040	3 730	3 820
6 000	1 940	2 760	3 580	4 290	2 810	3 621	4 430	3 210
6 500	2 280	3 240	4 200	3 660	3 300	4 250	5 200	2 730
7 000	2 640	3 750	4 870	3 150	3 820	4 930	6 040	2 360
7 500	3 030	4 310	5 590	2 750	4 390	5 660	6 930	2 050
8 000	3 450	4 900	6 360	2 420	4 990	6 440	7 880	1 800
8 500	3 900	5 540	7 180	2 140	5 640	7 270	8 900	1 600
9 000	4 370	6 210	8 050	1 910	6 320	8 150	9 980	1 430
9 500	4 870	6 920	8 960	1 710	7 040	9 080	11 100	1 280
10 000	5 390	7 660	9 930	1 550	7 800	10 100	12 300	1 150
10 500	5 940	8 450	11 000	1 400	8 600	11 100	13 600	1 050
11 000	6 520	9 210	12 000	1 280	9 440	12 200	14 900	954
11 500	7 130	10 100	13 100	1 170	10 300	13 300	16 300	873
12 000	7 760	11 000	14 300	1 070	11 200	14 500	17 700	802
12 500	8 430	12 000	15 500	989	12 200	15 800	19 200	739
13 000	9 110	12 900	16 800	915	13 200	17 000	20 800	683
13 500	9 830	14 000	18 100	848	14 200	18 300	22 400	633
14 000	10 600	15 000	19 500	789	15 300	19 700	24 100	589
14 500	11 300	16 100	20 900	735	16 400	21 200	25 900	549
15 000	12 100	17 200	22 300	687	17 600	22 600	27 700	513
15 500	13 000	18 400	23 900	643	18 800	24 200	29 600	481
16 000	13 800	19 600	25 400	604	20 000	25 800	31 500	451
16 500	14 700	20 900	27 000	568	21 200	27 400	33 500	424
17 000	15 600	22 100	28 700	535	22 600	29 100	35 600	399
17 500	16 500	23 500	30 400	505	23 900	30 800	37 700	377
18 000	17 500	24 800	32 200	477	25 300	32 600	39 900	356
18 500	18 500	26 200	34 000	452	26 700	34 400	42 200	337
19 000	19 500	27 700	35 900	428	28 200	36 300	44 500	320
19 500	20 500	29 100	37 800	407	29 700	38 300	46 800	304
20 000	21 600	30 750	39 700	386	31 200	40 200	49 300	289

Table 1-14. SS-34 Rotor: RCF and K Factor

Angular Velocity (rev/min)	RCF r minimum 5.72 cm (2.25 in)	RCF r average 8.26 cm (3.25 in)	RCF r maximum 10.80 cm (4.25 in)	K Factor
1 000	64	92	121	161 000
1 500	144	208	271	71 500
2 000	255	369	483	40 200
2 500	399	577	754	25 700
3 000	575	830	1 090	17 900
3 500	782	1 130	1 480	13 100
4 000	1 020	1 480	1 930	10 100
4 500	1 290	1 870	2 440	7 950
5 000	1 600	2 310	3 020	6 450
5 500	1 930	2 790	3 650	5 320
6 000	2 300	3 320	4 340	4 470
6 500	2 700	3 900	5 100	3 810
7 000	3 130	4 520	5 910	3 280
7 500	3 590	5 190	6 780	2 860
8 000	4 090	5 900	7 720	2 510
8 500	4 610	6 660	8 710	2 230
9 000	5 170	7 470	9 770	1 990
9 500	5 760	8 320	10 900	1 780
10 000	6 390	9 220	12 100	1 610
10 500	7 040	10 200	13 300	1 460
11 000	7 730	11 200	14 600	1 630
11 500	8 440	12 200	16 000	1 220
12 000	9 200	13 200	17 400	1 120
12 500	9 980	14 400	18 800	1 030
13 000	10 800	15 600	20 400	952
13 500	11 600	16 800	22 000	883
14 000	12 500	18 100	23 600	821
14 500	13 400	19 400	25 400	765
15 000	14 400	20 800	27 100	715
15 500	15 300	22 200	29 000	670
16 000	16 300	23 600	30 900	629
16 500	17 400	25 100	32 800	591
17 000	18 500	26 700	34 900	557
17 500	19 600	28 200	36 900	525
18 000	20 700	29 900	39 100	497
18 500	21 900	31 600	41 300	470
19 000	23 100	33 300	43 500	446
19 500	24 300	35 100	45 900	423
20 000	25 500	36 900	48 200	402

1-6. CRITICAL ANGULAR VELOCITY (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 (i.e., rotor, and the centrifuge drive). At this "speed", the rotor exhibits large amplitude vibrations which can be felt in the instrument frame. Mass imbalance will contribute to increased vibration intensity at the critical "speed" range. Good operating procedure is to avoid operation at the critical "speed" range.

Critical "speed" ranges for the superspeed angle rotors are given in Table 1-15.

CAUTION

Continued operation at the critical "speed" range will have a detrimental effect on centrifuge component life.

Table 1-15. Critical Angular Velocity of Superspeed Angle Rotors (in rev/min)

	RC-2B, RC-5, RC-5B	SS-3
GSA	800	800
GS-3	—	600
SA-600	950	950
SE-12	1100	1100
SM-24	1100	1100
SS-34	1140	1140

Section 2. OPERATION

2-1. PRE-RUN CHECKS.

Before every run, make a quick check of the following to ensure optimum safety performance:

a. Check that the tube cavities are free of corrosion.

b. Check that the tapered mounting surface is clean.

WARNING

Every part of a centrifuge rotor should be kept scrupulously clean. It should be carefully inspected by the user prior to every run. If inspection reveals any sign of corrosion or cracking, rotor should be withdrawn from service.

2-2. TUBE, BOTTLE AND ADAPTER ASSEMBLY AND INSTALLATION.

Refer to the assembly and installation instructions which accompany the tube, bottle, and/or adapter used.

Tubes or bottles may be installed either before or after the rotor is placed in the centrifuge per the rotor balancing instructions in paragraph 2-3.

2-3. ROTOR MOUNTING AND BALANCING.

a. Mounting

Prior to mounting the rotor on the tapered spindle of the centrifuge rotor drive, insure that the rotor center hole and tapered spindle are free of foreign materials, nicks, and scratches. Wipe surfaces clean before each seating operation to minimize rotor sticking, scratching, and corrosion. Place the rotor on the tapered spindle and carefully engage the drive pins.

If centrifuge temperature is below room temperature, and unless the rotor has been pre-chilled, allow time for the rotor to cool to the lower temperature before clamping the rotor in place to preclude the rotor sticking to the spindle. Relative motion of the rotor with respect to the spindle may wedge the rotor on the spindle as it contracts with decreasing temperature.

All superspeed angle rotors are equipped with double locking screws on the cover. The larger hand screw secures the cover to the rotor and the smaller hand screw secures the rotor to the tapered spindle. Tighten each screw separately — first the larger screw, then the smaller.

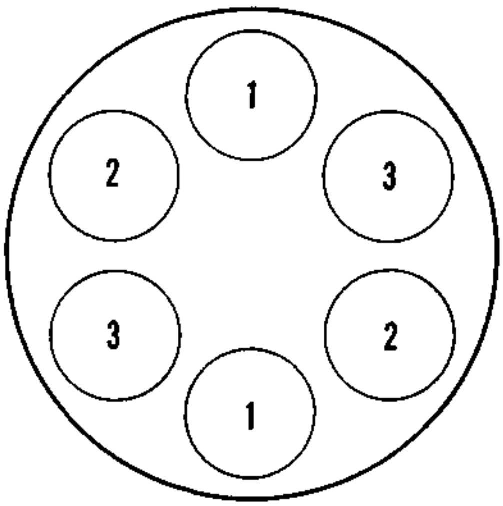
b. Balancing

For best performance, each rotor compartment load, including adapters (where applicable), tubes, and specimen must be properly balanced within 3 to 5 grams. Improper rotor balance may damage the rotor drive. For a fully loaded rotor, a visual check of tube contents is generally sufficient to prove the rotor is balanced.

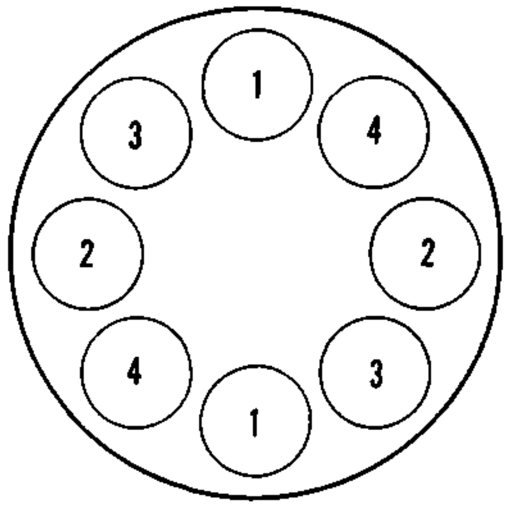
WARNING

Do not attempt to operate rotors with masses that differ by more than five grams in opposing compartments.

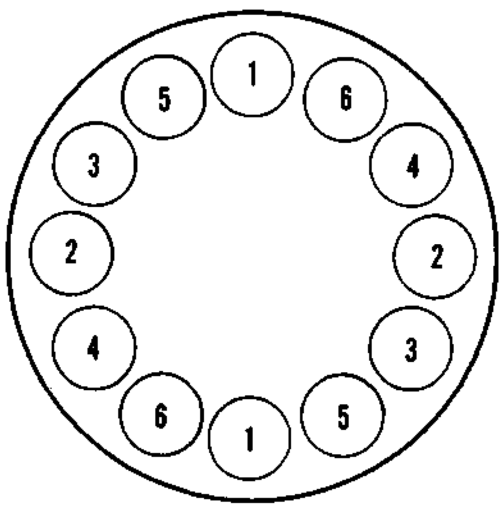
If less than a full complement of specimen tubes is being run, place them in opposite compartments. Water-filled tubes may be used to balance the rotor as required. Balance each opposing pair individually, as shown in figure 2-1.



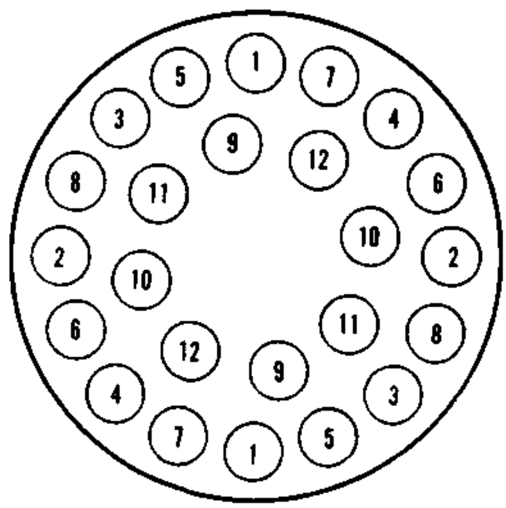
Six Place Rotor
(GSA, GS-3)



Eight Place Rotor
(SS-34)



Twelve Place Rotor
(SA-600, SE-12)



Twenty-four Place Rotor
(SM-24)

6/7-1
SA/10

Figure 2-1. Positioning Pairs of Tubes or Bottles in the Rotor

2-4. ROTOR "SPEED"/TEMPERATURE DIFFERENTIAL DETERMINATION.

Rotor "speed"/temperature differential graphs and tables, such as figure 2-2, are supplied with the instruction manual for most centrifuges. These are only an approximate guide showing the temperature run control setting required to maintain desired sample temperature in the rotor being used. The curves are approximate since the temperature offset (difference between indicated and sample temperature) depends upon instrument efficiency and location, ambient temperature, type of rotor and rotor "speed". When sample temperature is critical, the required offset should be determined for each specific run.

CAUTION

The temperature offset technique should be used on all runs at either low *or* high "speeds" to prevent overtemperature and/or freezing of sample.

To plot a correction curve and create graphs for each rotor for an individual instrument, it is necessary to plot the set temperature versus the actual sample temperature for the rotor used at a specific operating "speed" and ambient temperature.

Example: To derive a +7.5 °C sample temperature with a SE-12 rotor at a speed of 15 000 rev/min in an RC-5 centrifuge in an ambient temperature of 25 °C, it is necessary to set the blue set temperature at approximately +5 °C, or 2.5 °C colder than the desired sample temperature.

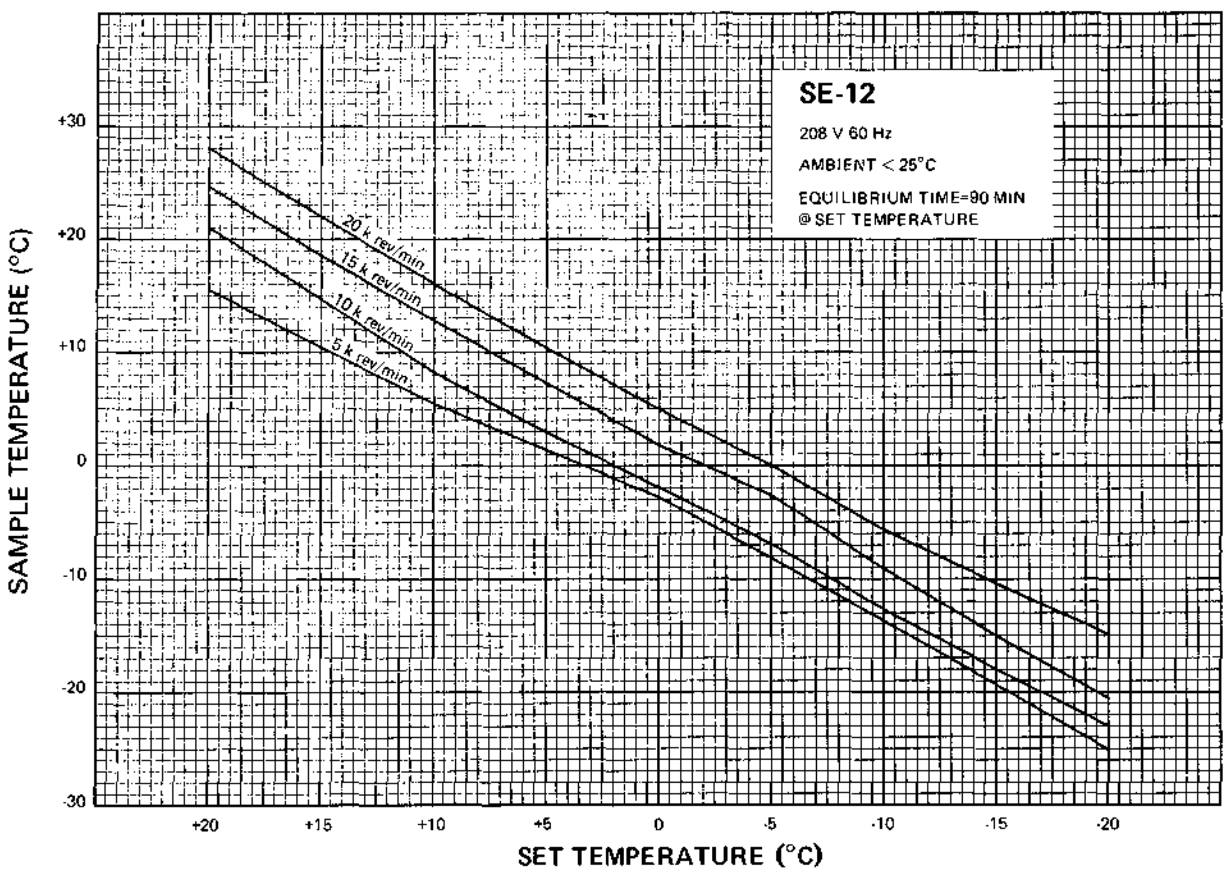


Figure 2-2. Sample Rotor "Speed"/Temperature Differential Chart

NOTE

An ambient temperature of 25 °C or less is required to obtain optimum cooling efficiency. At higher ambient temperatures, lower operating "speed" to maintain sample temperature may be necessary.

Correction curve data can be obtained and plotted in a test run by dynamically calibrating a rotor/centrifuge/desired speed combination for an actual run. Using an immersable centigrade thermometer calibrated in 0.1 °C increments, and performing the following sequence, the result will be a more accurate temperature correction for that rotor/centrifuge combination at that specific "speed" and ambient temperature.

NOTE

Blank rotor "speed"/temperature differential charts are provided in the back of this manual.

a. Set temperature to the desired sample temperature.

b. Prepare two opposing compartments with dispensable fluid (compatible with aluminum and with a freezing point somewhat below sample temperature described) per rotor balancing instructions described in Section 2-3.

c. Pre-cool the rotor in the centrifuge as per instrument operating instructions.

d. Pre-cool the thermometer in a refrigerator to 1.0 °C below desired sample temperature established in step (1) above.

e. When pre-cool time has elapsed, mount the rotor in the centrifuge and run at the speed for which the offset is to be determined for at least 1/2 hour.

f. When run time has elapsed and the rotor has stopped, open the door, quickly open a compartment and immerse the pre-cooled thermometer into the liquid. Agitate the thermometer in the liquid for approximately five to ten seconds and record the temperature indication.

g. The desired temperature for the actual run is obtained by resetting the blue set temperature upward or downward from the indication recorded on the thermometer.

Example: If the recorded indication is 2 °C warmer than that desired, reset set temperature downward 2 °C.

h. Record the data on the appropriate Rotor "Speed"/Temperature Differential Chart for future use.

2-5. REDUCING "SPEEDS" FOR DENSE FLUIDS.

There is a recommended design mass established for each superspeed angle rotor, representing the maximum mass which should be carried in each compartment. The total package of contents for each compartment, including specimen, tubes, cover, and adapter (if used), should not exceed the recommended figure given in Table 2-1 unless rotor "speed" is lowered proportionately.

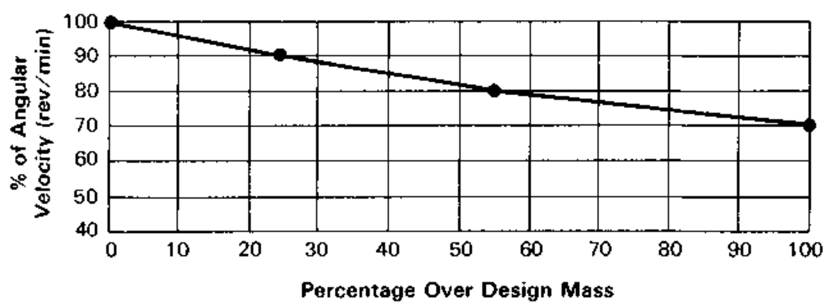
$$\text{Angular Velocity} = \underset{\text{(from Table 2-1)}}{\text{maximum rev/min}} \times \sqrt{\frac{\text{Design Mass (from Table 2-1)}}{\text{Actual Compartment Mass}}}$$

CAUTION

- Solubility limits of gradients at the operating temperature should never be exceeded.
- The structural parts of the rotor are made of aluminum alloy. For this reason it is not intended for use with strong acids, strong bases or with the salts of heavy metals such as cesium, lead, silver or mercury.

Table 2-1. Recommended Design Mass per Compartment for Each Rotor

Rotor	Design Mass per Compartment (g)	Maximum Angular Velocity (rev/min)
SS-34	115	20 000
SE-12	30	20 000
SM-24	27	20 000
GSA	580	13 000
GS-3	780	9 000
SA-600	115	16 500



2-6. ESTIMATION OF SEDIMENTATION TIMES IN AQUEOUS (NON-GRADIENT) SOLUTIONS.

The time required to sediment a particle in water at 20 °C through the maximum rotor path length (i.e. the distance between ^{r} minimum and ^{r} maximum) can be estimated using the equation

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

where t = sedimentation time in hours

K = the clearing factor for the rotor (defined below) expressed in hour-Svedbergs*

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

The clearing, or **K** factor, is defined by the equation

$$K = (253\ 300) \left[\ln \left(\frac{r\ \text{maximum}}{r\ \text{minimum}} \right) \right] \div \left(\frac{\text{rotor angular velocity}}{1000} \right)^2$$

Where ^{r} maximum and ^{r} minimum are the maximum and minimum rotor radii, respectively, and rotor angular velocity ("speed") is expressed in rev/min.

K factors for the superspeed angle rotors for "speeds" from 1000 rev/min to maximum rev/min have been listed in Tables 1-9 through 1-14.

EXAMPLE

The SS-34 rotor has a **K** factor of 402 at the maximum permitted "speed" (20 000 rev/min). If the particles to be sedimented have a sedimentation coefficient of 100 **S**, the estimated run time required at maximum "speed" will be

$$t = \frac{402}{100\ \mathbf{S}} = 4.02 \text{ hours} = 4 \text{ hours, } 1 \text{ min}$$

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 centrifugal field is defined by the equation $s = \frac{dx}{dt} \frac{1}{x \omega^2}$, where $\frac{dx}{dt}$ = sedimentation velocity of the particle in cm/s; ω = rotor "speed" in radians/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 named in honor of the pioneer in ultracentrifugation, The Svedberg. Thus a particle with an experimentally determined sedimentation coefficient of 10^{-11} seconds is usually referred to in the literature as "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 $S_{20,\omega}$.

Section 3. MAINTENANCE

3-1. CORROSION.

The precision-engineered rotor is made from aluminum alloy for a high strength-to-weight ratio. Although its corrosion resistance is good, it is not as good as stainless steel or titanium. Therefore, exercise greater care in its maintenance. With a few precautions, you can minimize corrosion and significantly prolong the useful life of the rotor. A little care, conscientiously applied, may preclude rotor failure and its potential damage to the centrifuge.

Generally, corrosion refers to chemical reactions at the surface; rusting or pitting signaled by growing areas of visible deterioration. On the other hand, stress corrosion attacks the inside of the metal as well. Barely detectable cracks on the surface grow larger inward, weakening the part without a visible warning.

Stress corrosion is thought to be initiated by certain combinations of stresses and chemical reactions. The most common chemical causing deleterious effects is the chloride ion, whether in solution (ammonium salts) or in as subtle a form as the sodium chloride in perspiration. If these chemically harmful substances are allowed to remain on the rotor, corrosion almost certainly will result.

The normal environment of a working rotor is a moist atmosphere, through normal humidity or because the rotor is cooled below the dew point in a cold room or in a refrigerated centrifuge. Moisture of any sort can initiate corrosion. Therefore, the rotor should be kept dry when not in use, and tubes should be removed from the compartments after each run prior to storage. Corrosion often starts under tubes left in compartments, particularly if condensation develops.

Stress, such as high centrifugal force, with corrosive conditions, will usually accelerate the corrosive process in an exponential time relationship; i.e., time to failure, or useful life, tends to decrease rapidly as stresses increase. Thus, rotor condition, speed, and load demand equal attention.

Under appropriate conditions, the stress corrosion applies to almost all commonly used alloys. Even the corrosion-resistant alloys have been found susceptible. Therefore, be aware that favorable conditions for stress corrosion cracking are present in all rotor applications and that care and attention are required to minimize its effects.

3-2. WASHING.

Wash the rotor with warm water and a 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, non-alkaline detergent such as Ivory Liquid. Rinse the rotor well, inside and out. Ordinary tap water is usually adequate, but distilled water is preferable, especially for the last rinse. After rinsing, dry thoroughly, especially the cavities. Use a soft absorbent cloth or towel or an air blast.

CAUTION

To avoid damaging the rotor surfaces when cleaning:

- Do not use strong laboratory detergents.
- Use a stiff bristle brush only as required to loosen encrusted materials, but be careful not to scratch the surfaces with the wire tip.
- Temperature must not exceed 100 °C at any time. Use ethylene oxide not autoclaving to sterilize rotor body.

3-3. CONTAMINATION.

Because of the nature of samples likely to be processed in the rotor, the chance of contamination, either biological or radioactive, is very possible. Always be aware of this possibility and take normal precautions. Use standard decontamination procedures should exposure occur.

Should a centrifuge or rotor that has been used with radioactive or pathogenic material require servicing by Du Pont personnel either at the customer's laboratory or at Du Pont facilities, comply with the following procedure to ensure safety of our personnel.

a. Clean the centrifuge and/or rotor to be serviced of all encrusted material and decontaminate it prior to servicing by our representative. There must be no radioactivity detectable by survey equipment.

b. Complete and attach Decontamination Information Certificate (Du Pont Instruments Form No. IPDP-59) to the centrifuge or rotor.

If centrifuge or rotor to be serviced does not have a Decontamination Information Certificate attached and, in our opinion, presents a potential radioactive or biological hazard, our represe-entative will not service the equipment until proper decontamination and certification is complete. If we receive a centrifuge or rotor at our Service facilities which, in our 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.

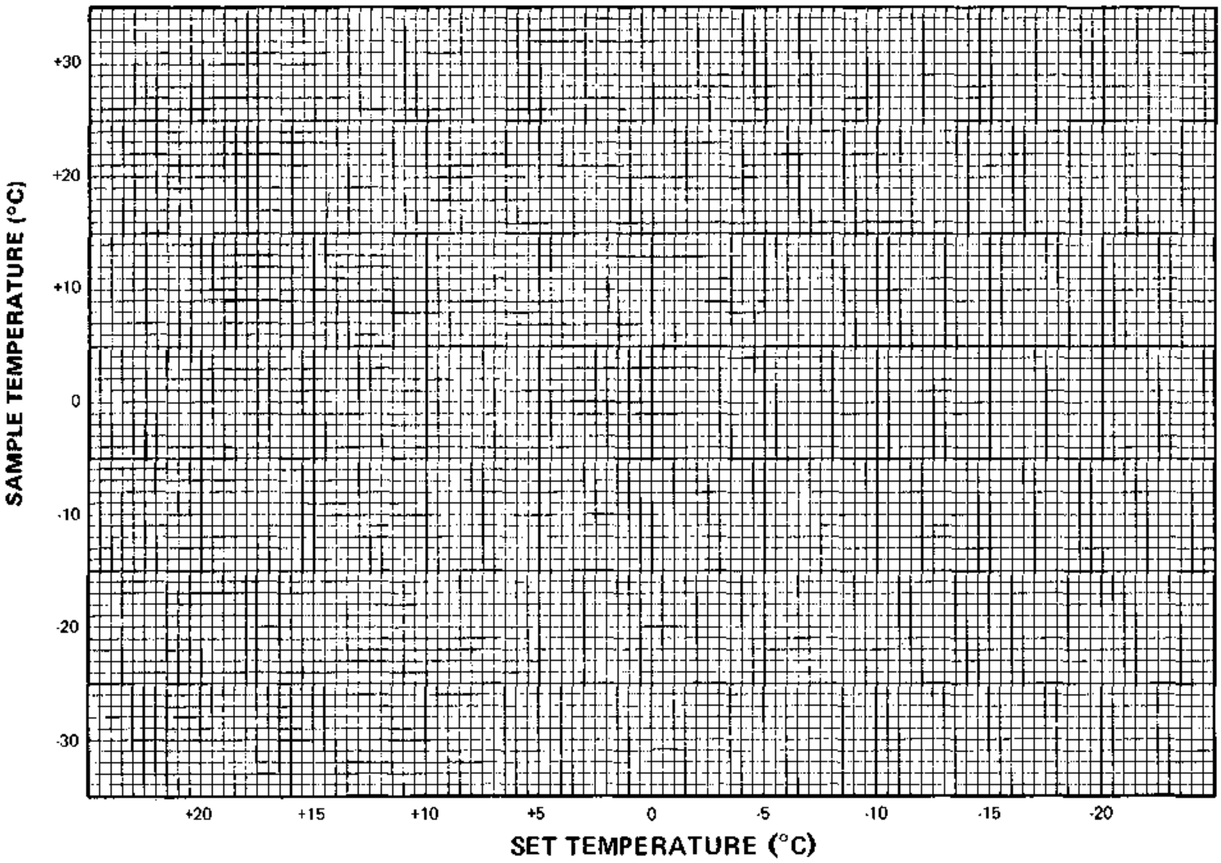
Decontamination Information Certificates are included with these instructions. Additional certificates are available from your local technical or customer service representative. In the event these certificates are not available, a written statement certifying that the unit has been properly decontaminated and outlining the procedures used will be acceptable.

NOTE

Service representative will annotate a Customer Service Repair Report if decontamination was required, and if so, what the contamination was and what procedure was used. If no decontamination was required, it will be so stated.

3-4. STORAGE.

It is recommended that rotors be stored (after rinsing and drying) upside-down, with caps, plugs, and tubes removed, so air can circulate. This will assist in preventing moisture from gathering and settling at the bottom of the tube compartments.

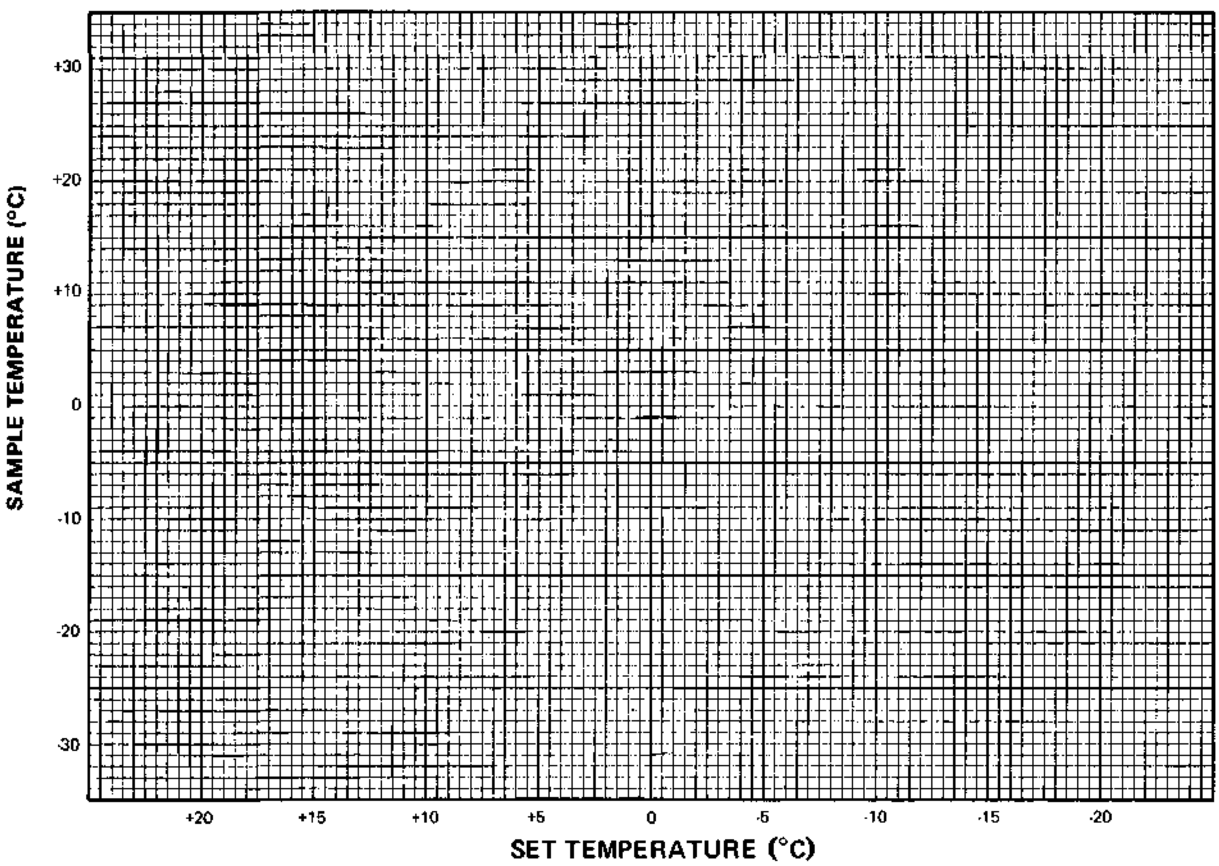


Rotor "Speed"/Temperature Differential Chart for the
____________________ Rotor

Instrument ____________________

Ambient Temperature ______________

Rotor "Speed" ____________________



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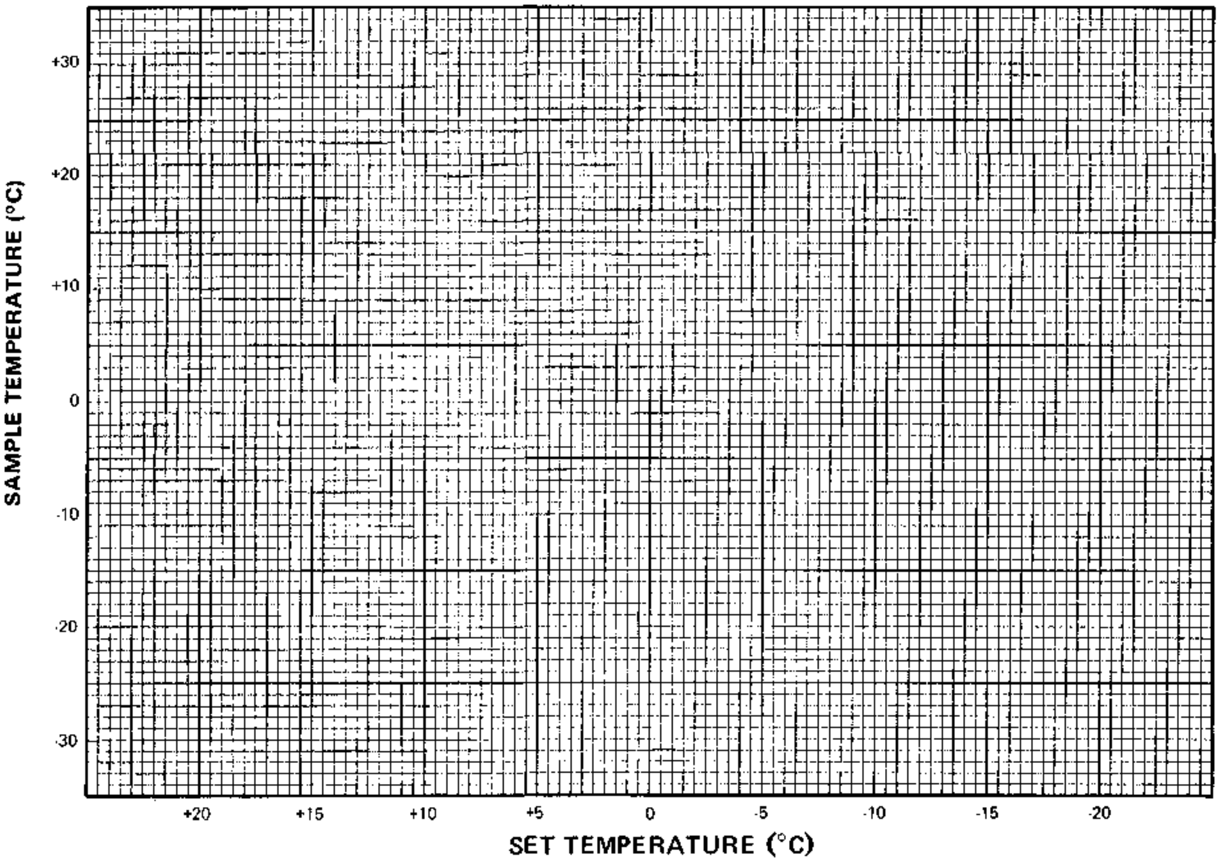
Rotor "Speed" ____________________



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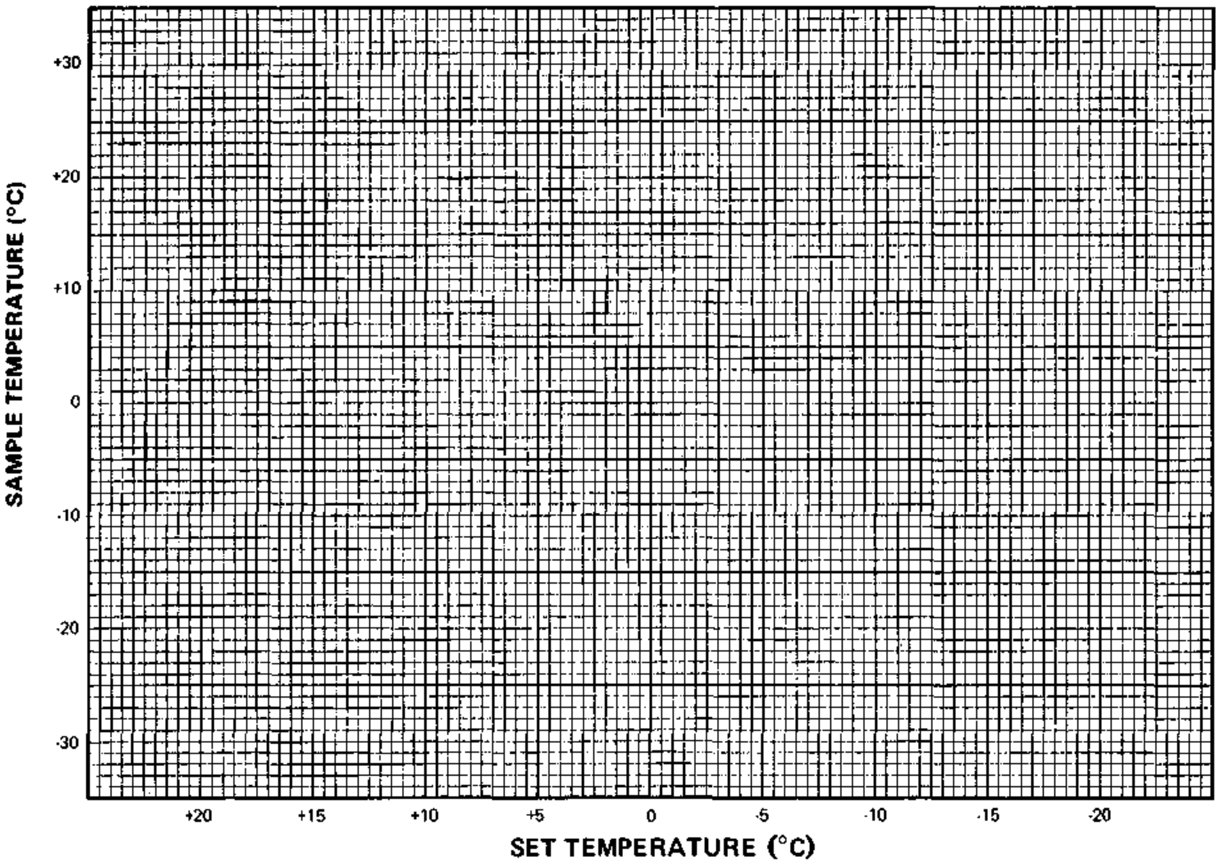
Instrument ____________________

Ambient Temperature ______________

Rotor "Speed" ____________________



Rotor "Speed"/Temperature Differential Chart for the
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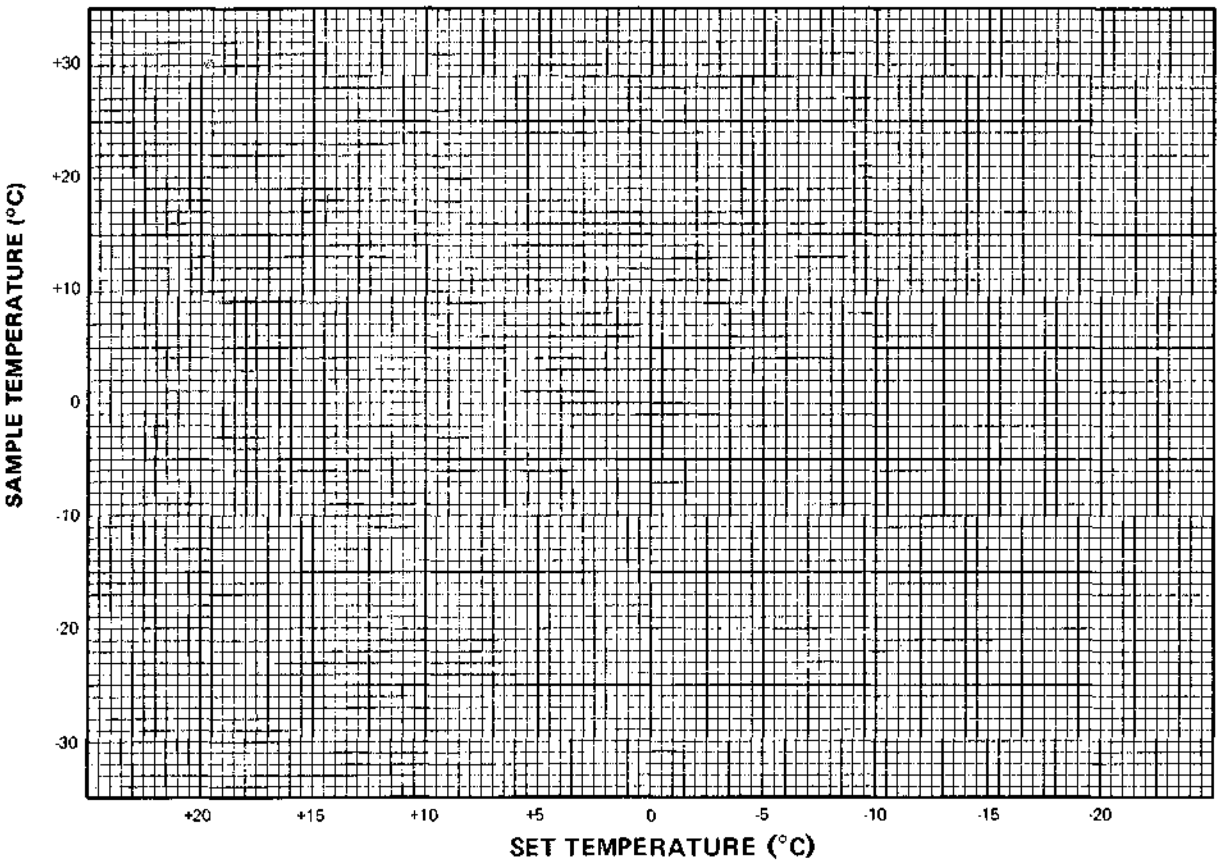
Instrument ______________
Ambient Temperature ______________
Rotor "Speed" ______________



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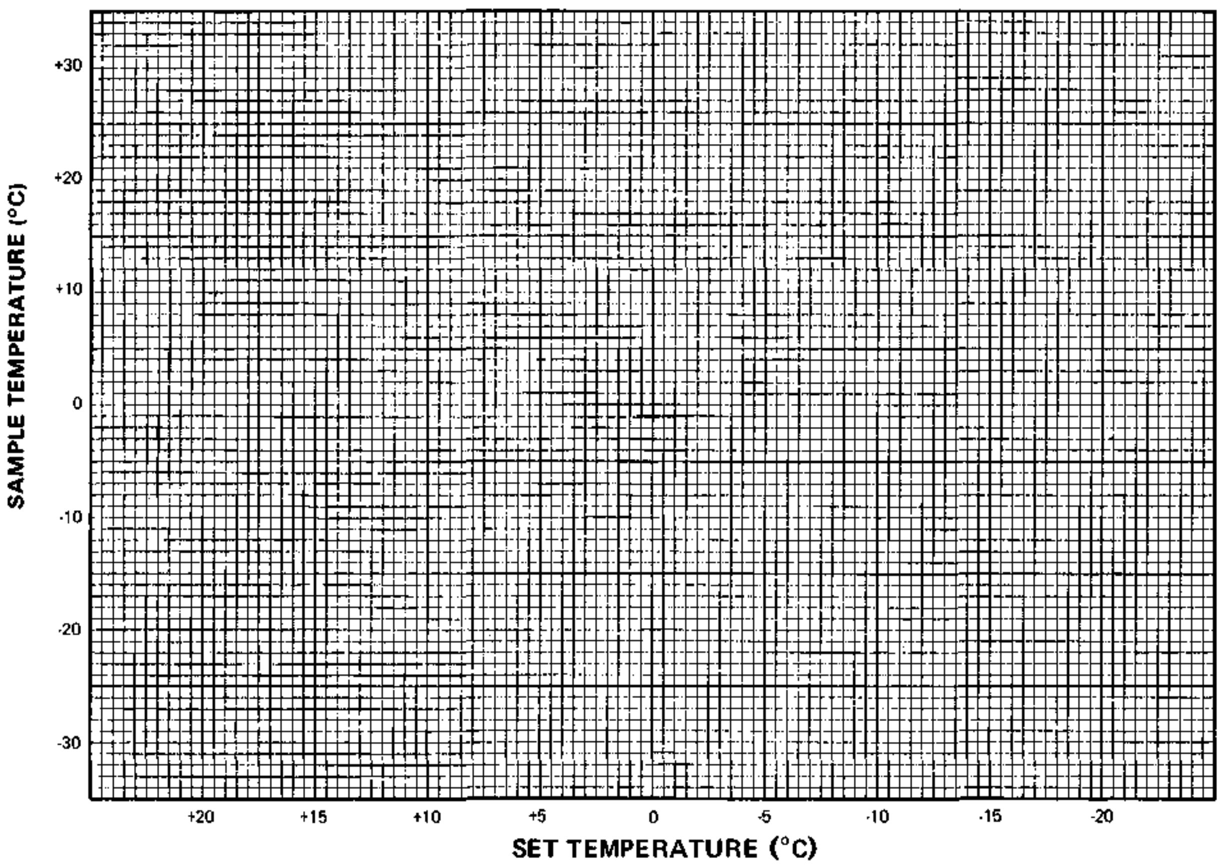
Rotor "Speed" ____________________



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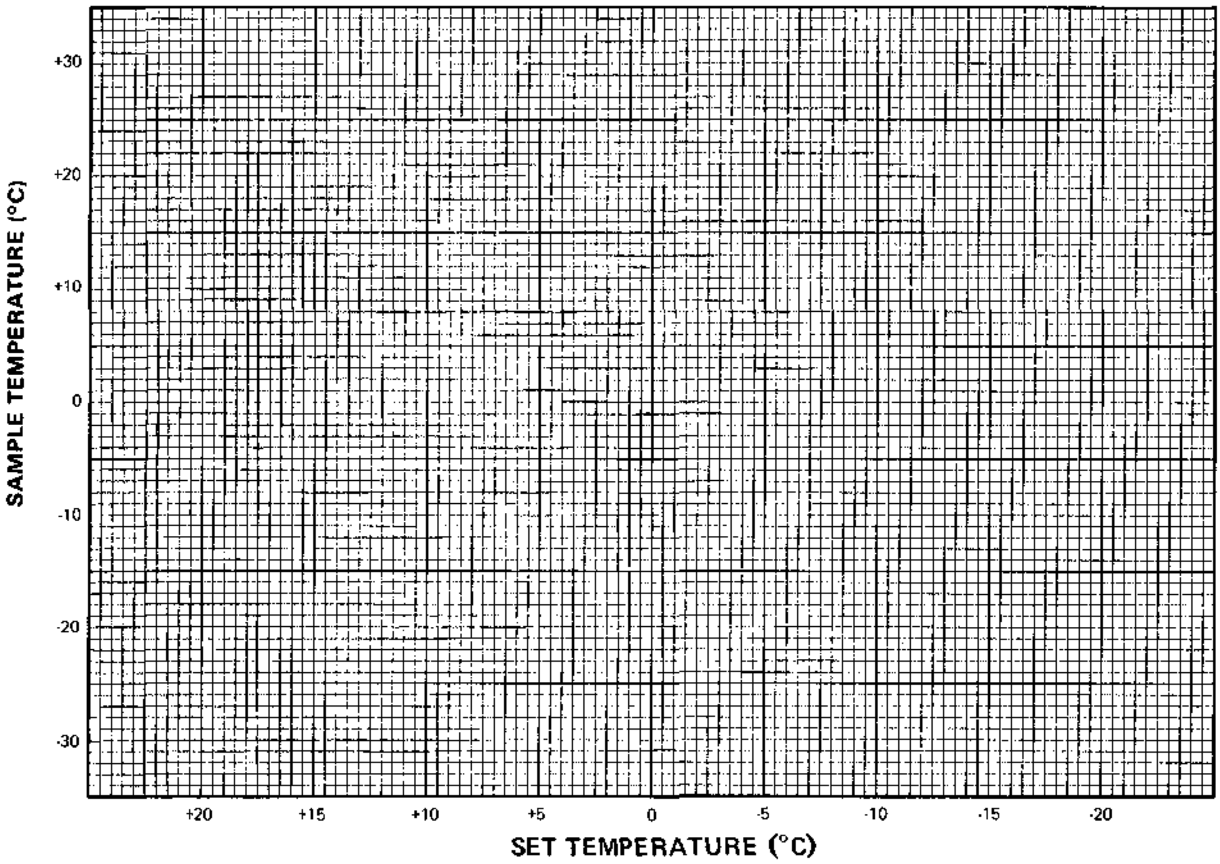
Ambient Temperature ______________
Rotor "Speed" ______________



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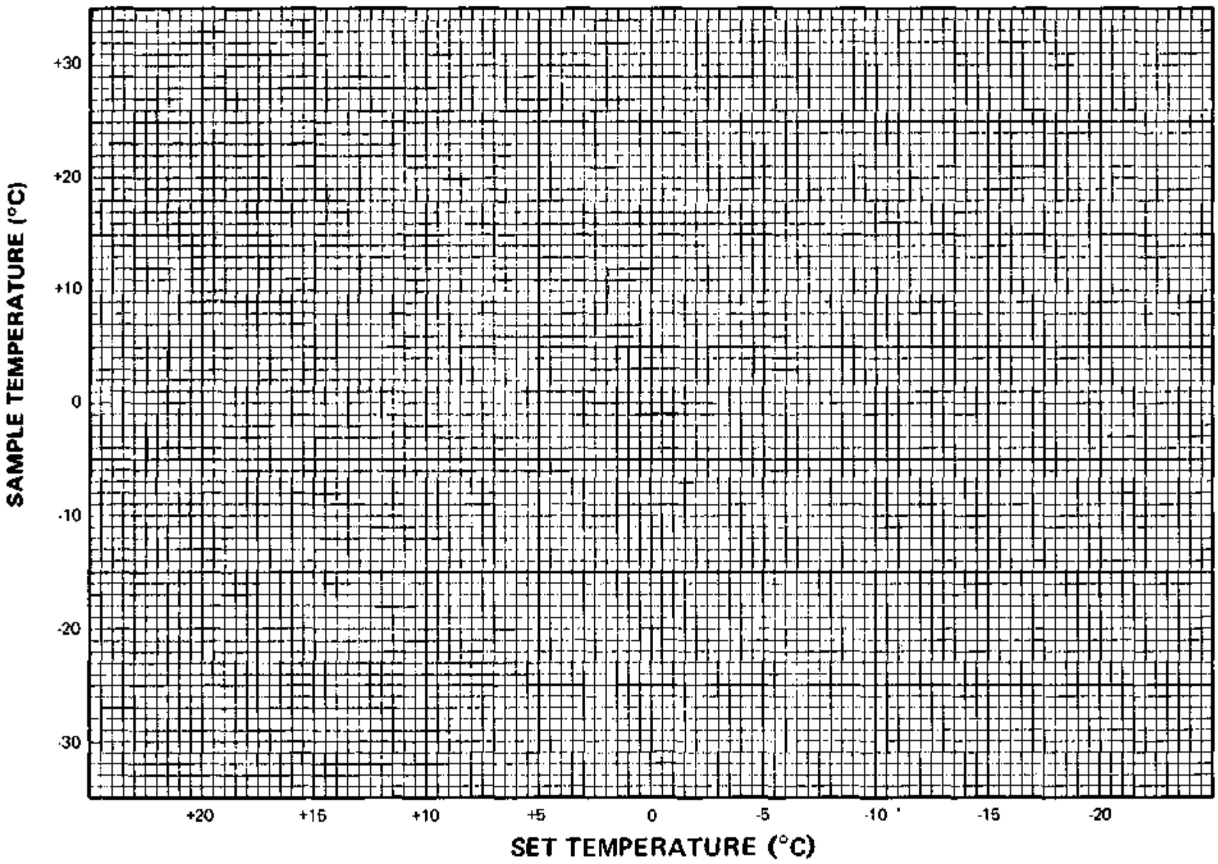

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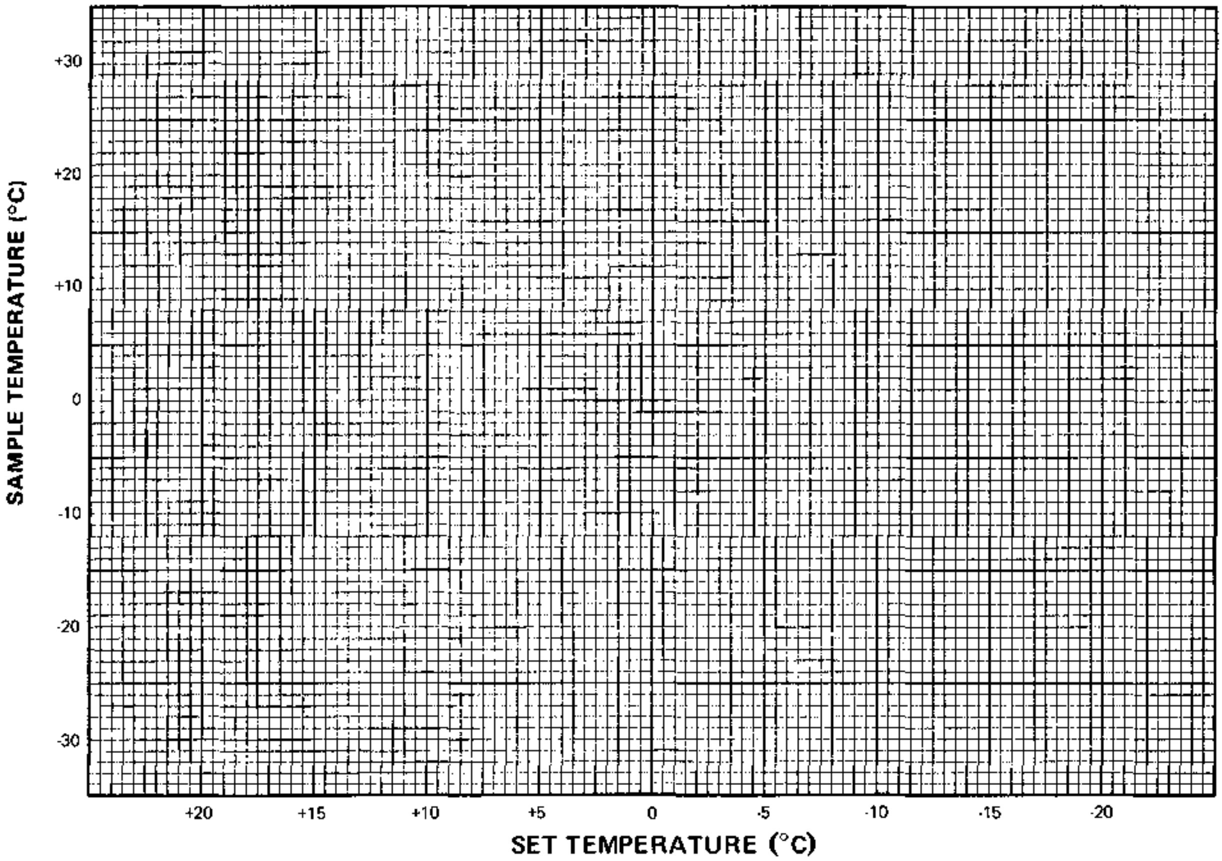
Ambient Temperature ____________

Rotor "Speed" ____________



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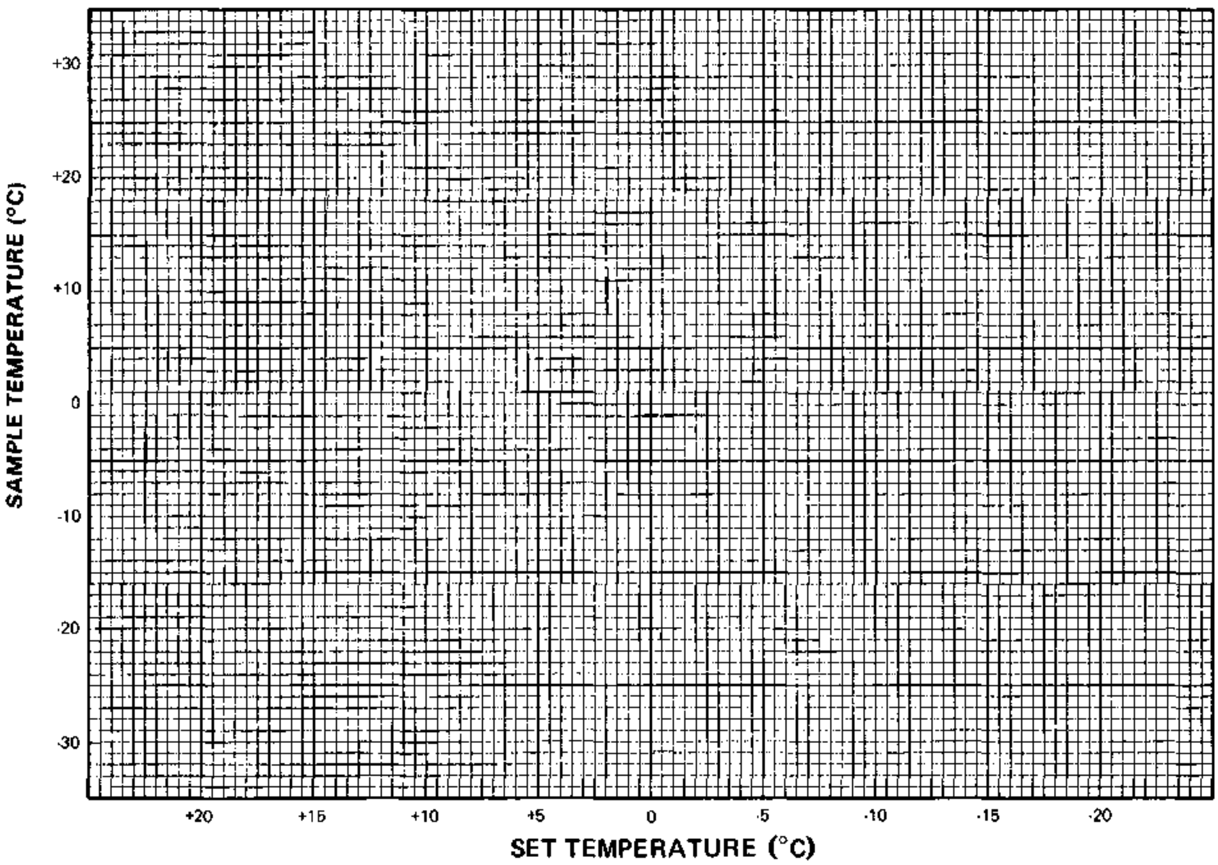
Ambient Temperature ________________

Rotor "Speed" ____________________



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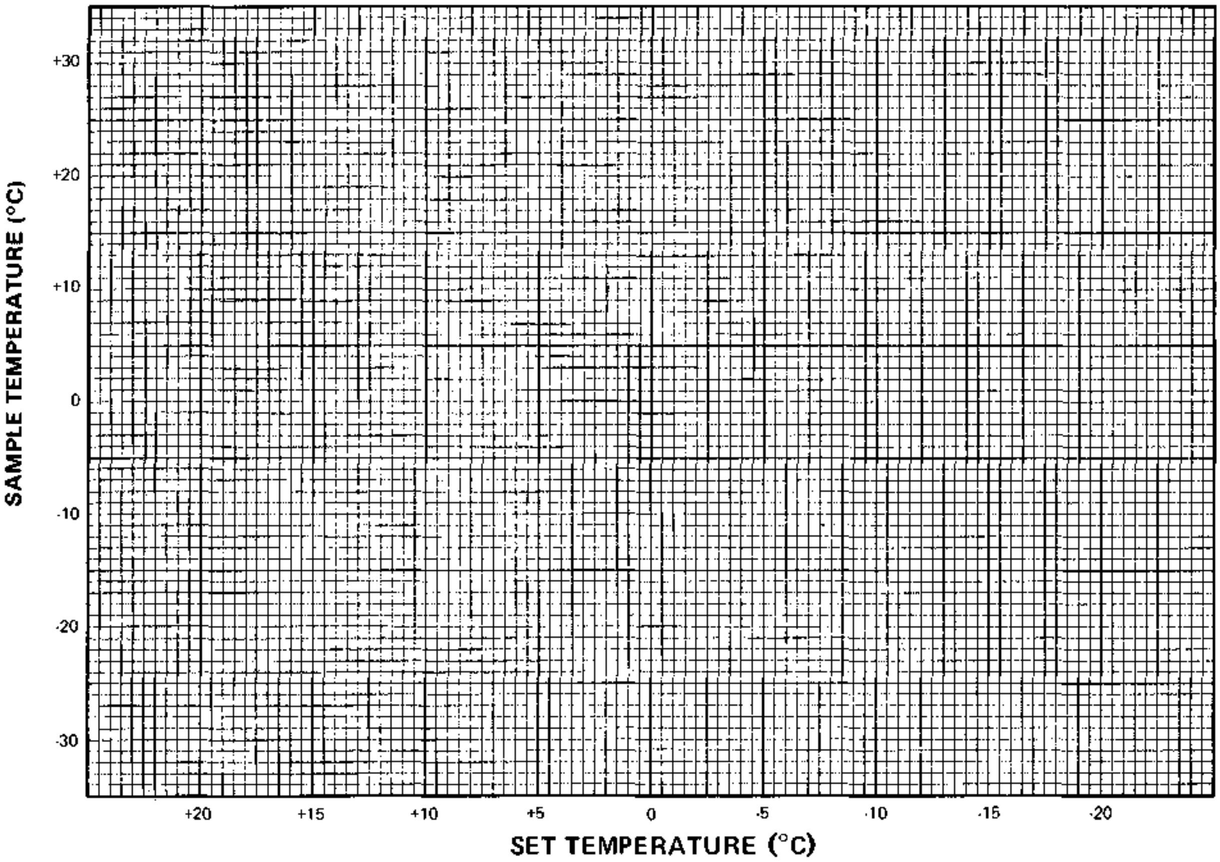
Ambient Temperature ______________
Rotor "Speed" ______________



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Ambient Temperature ________________

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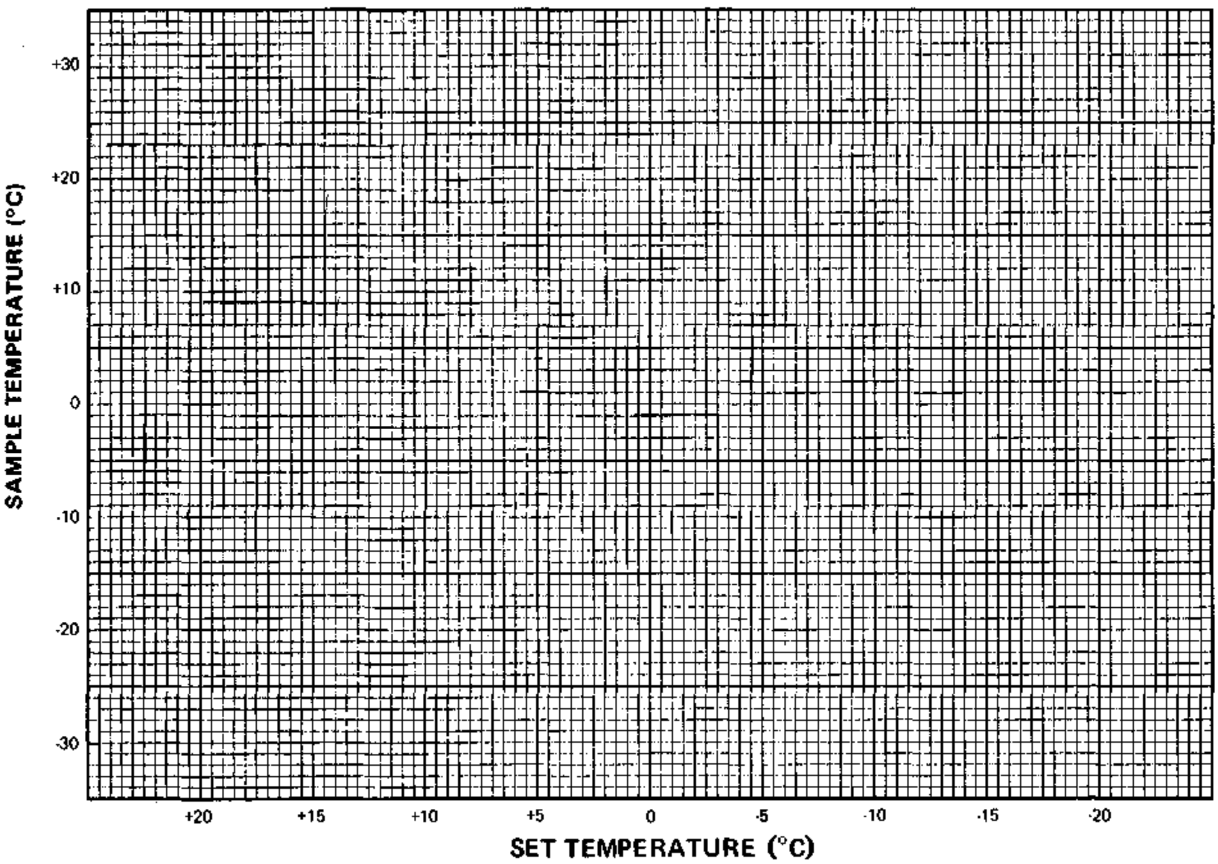

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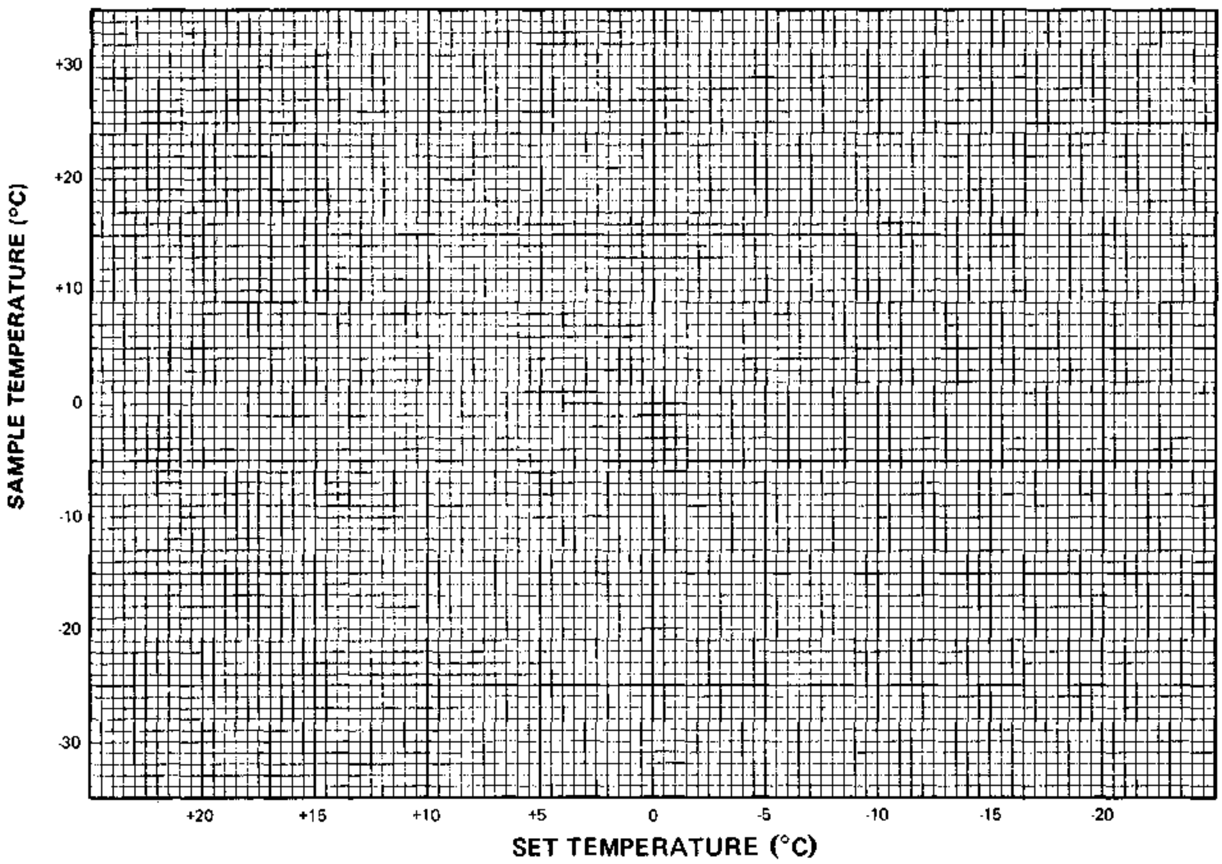
Ambient Temperature ______________

Rotor "Speed" ______________



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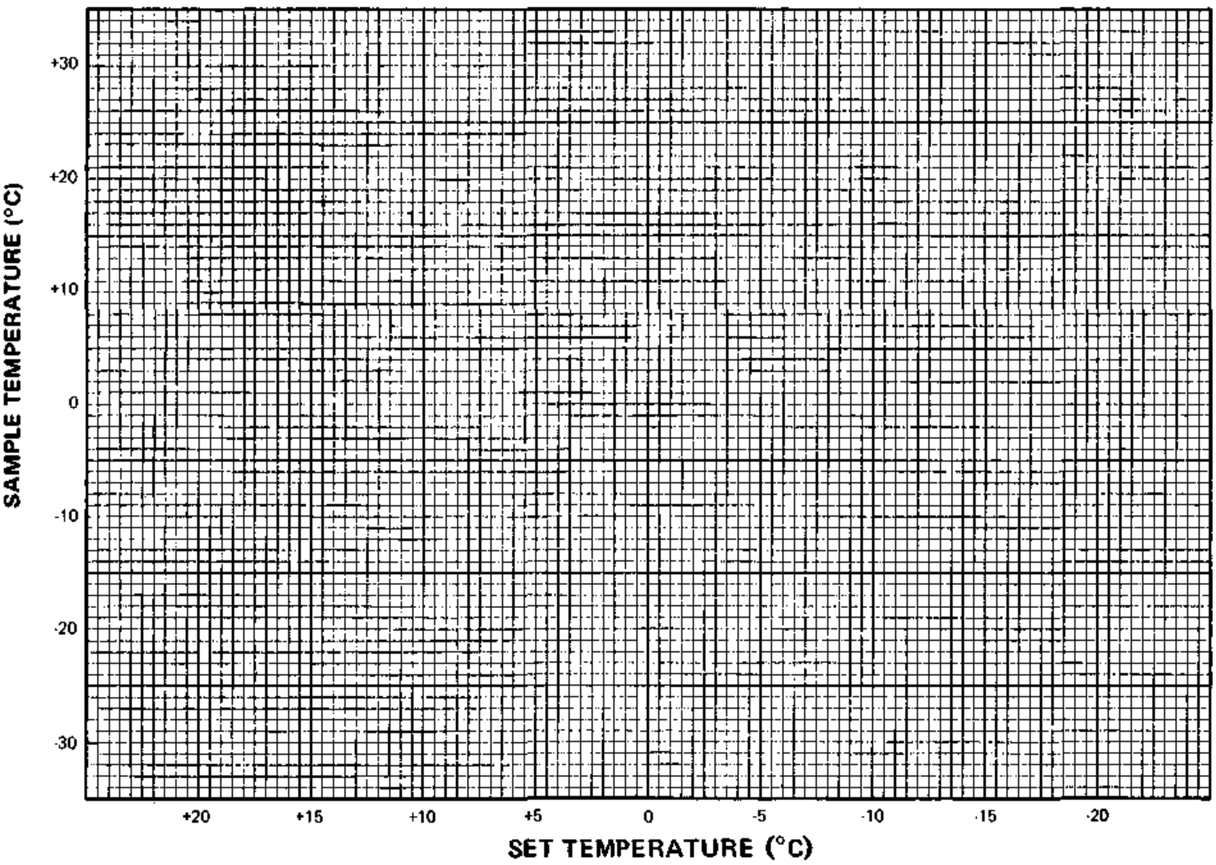

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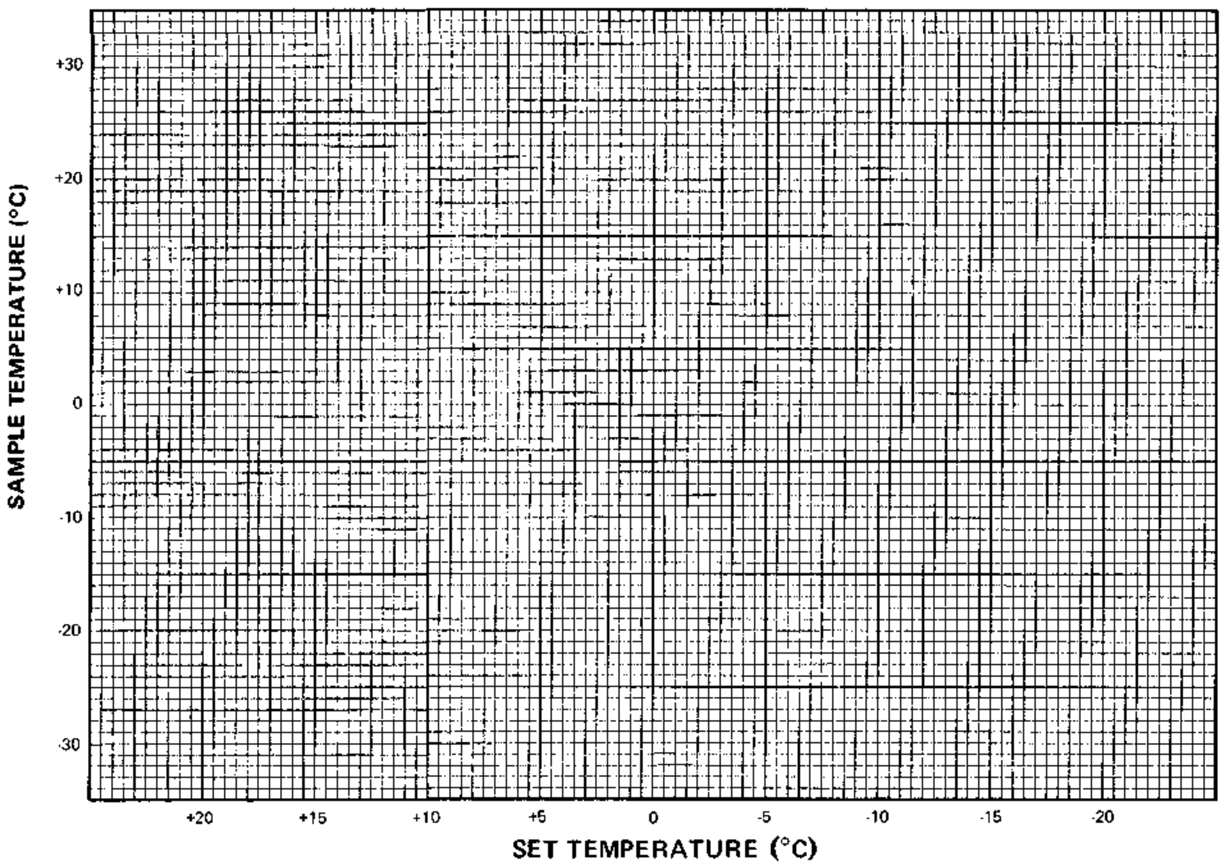
Rotor "Speed" ____________________



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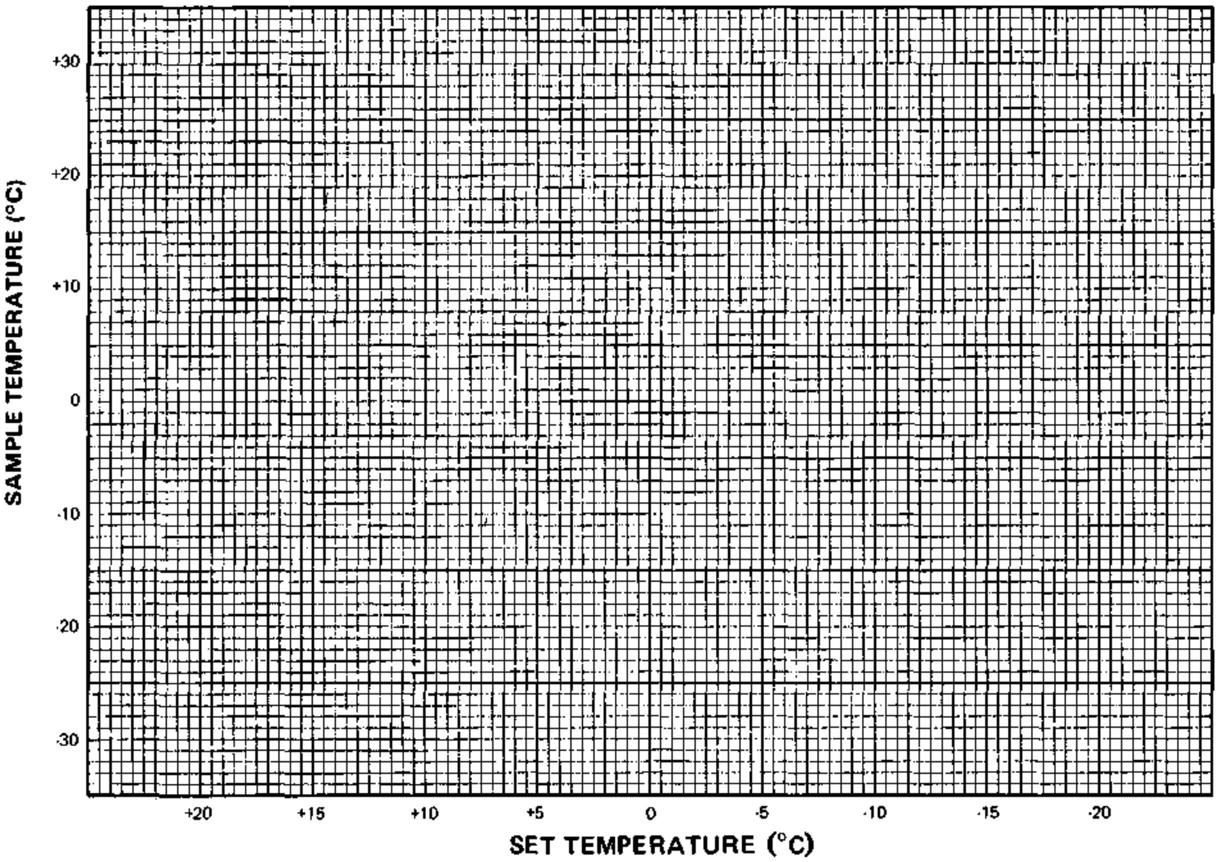

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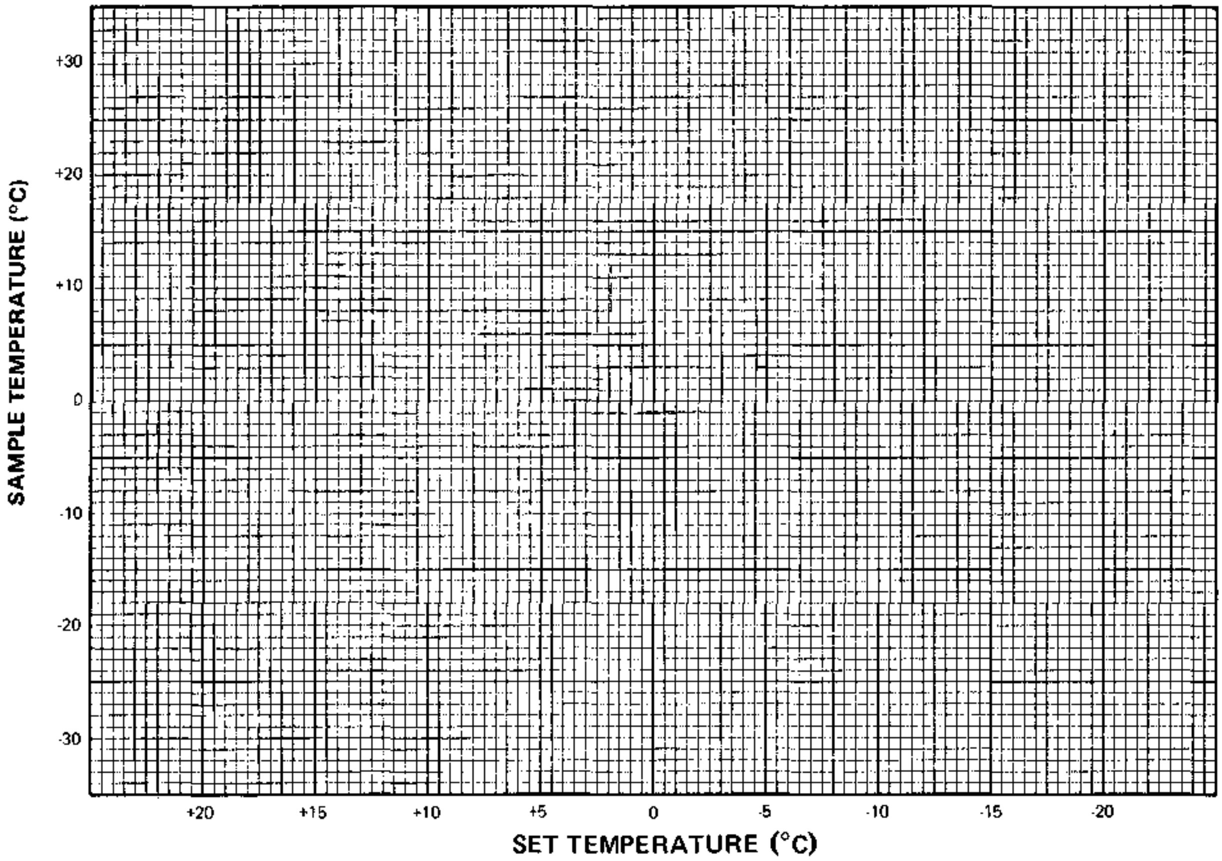
Rotor "Speed" ________________



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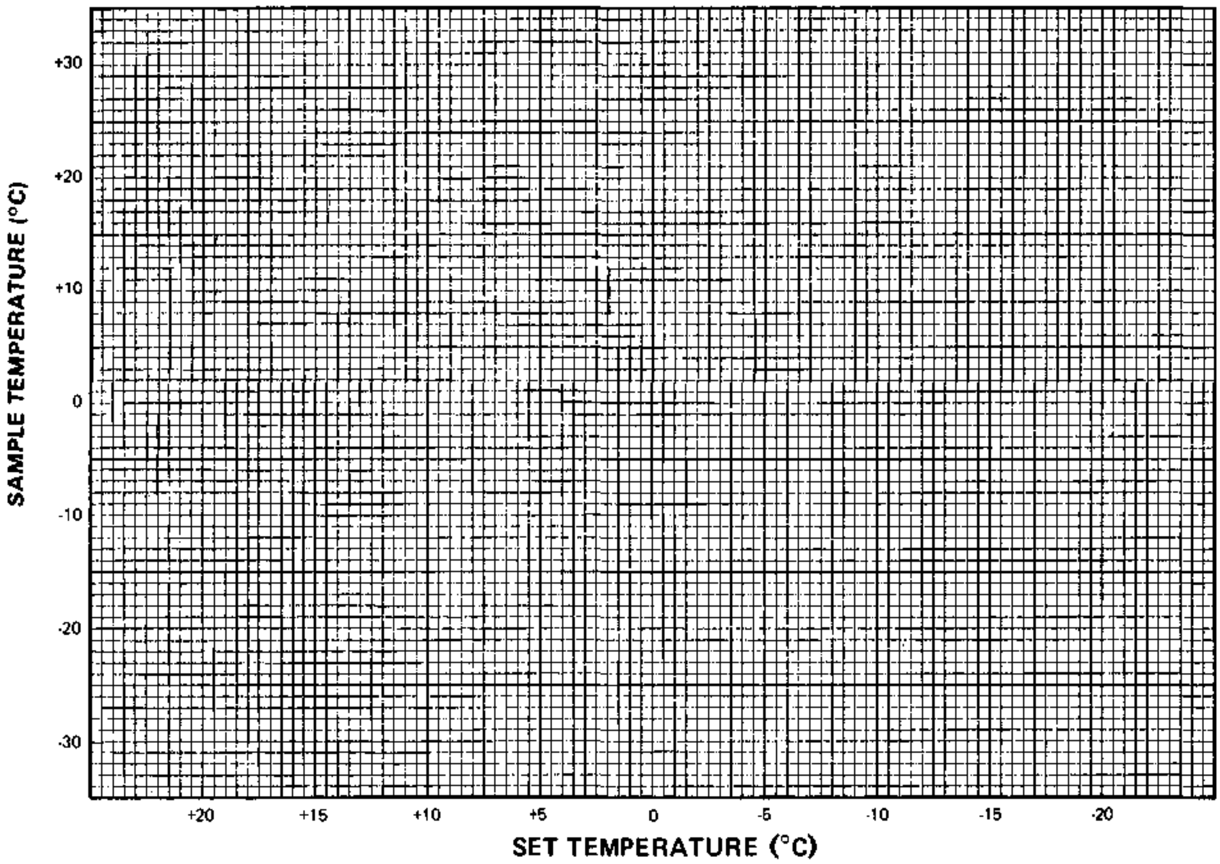

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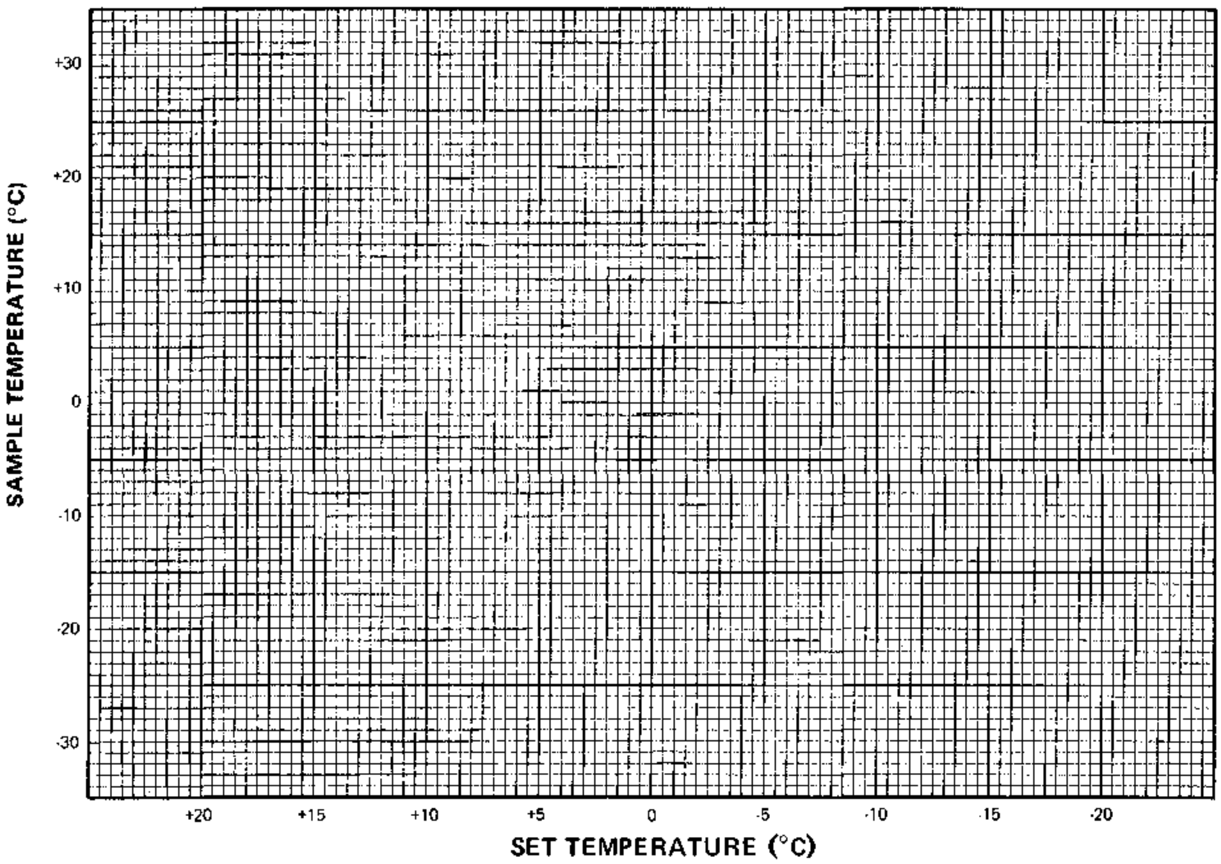
Rotor "Speed" ____________________



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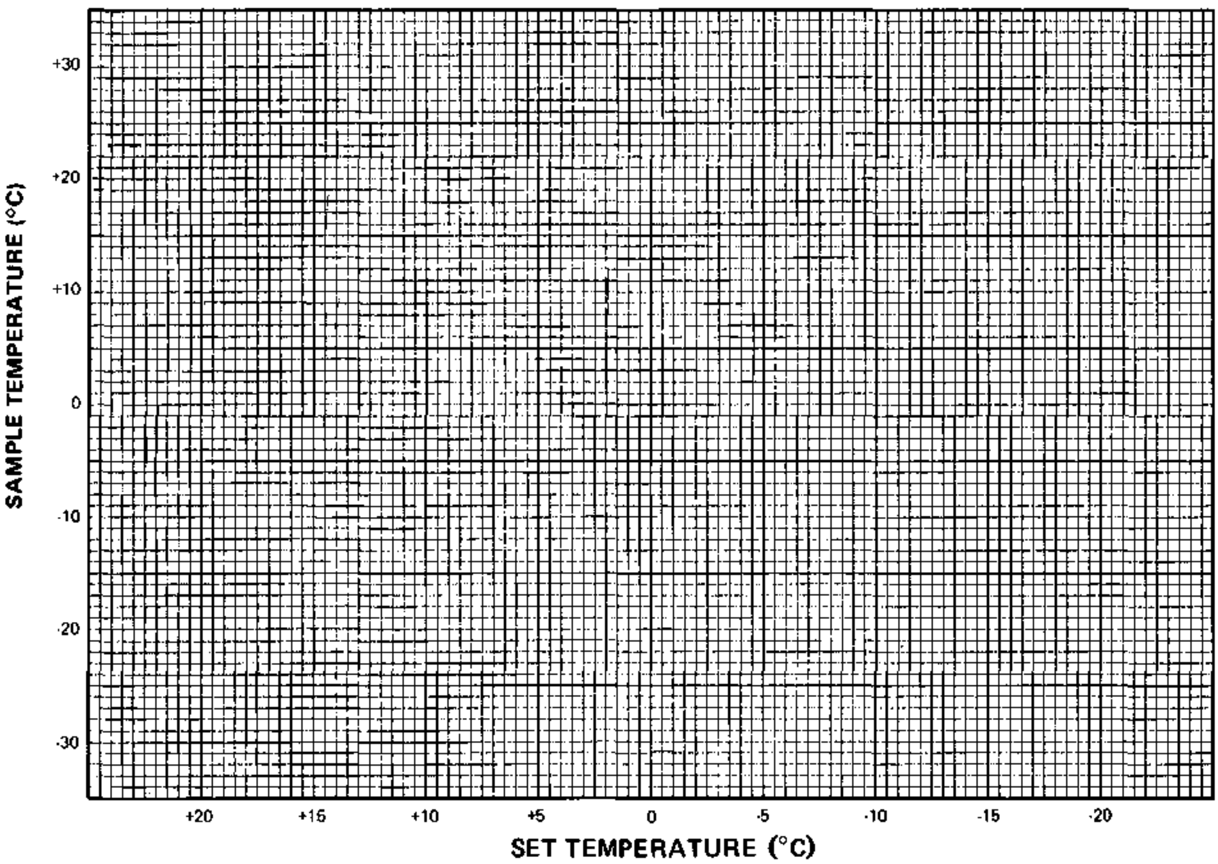
Rotor "Speed" ______________



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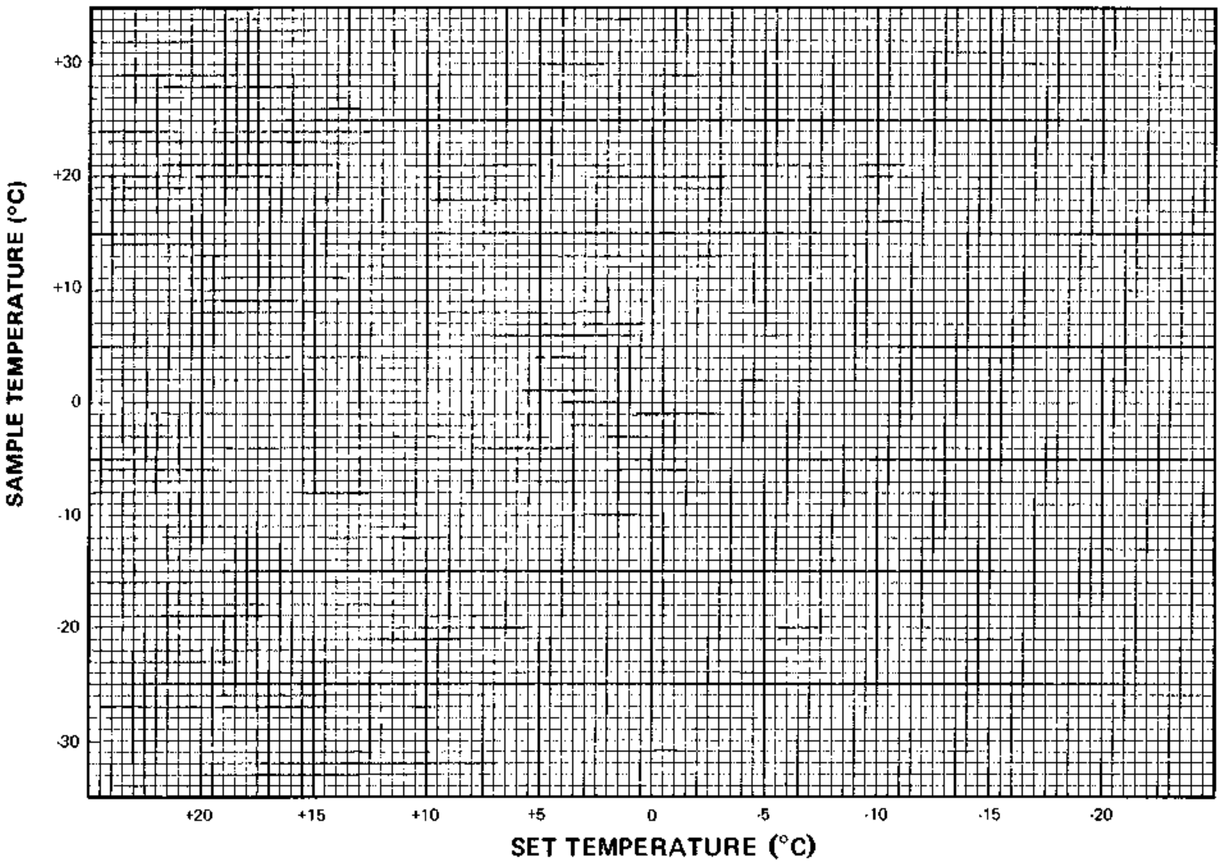
Rotor "Speed" ____________________



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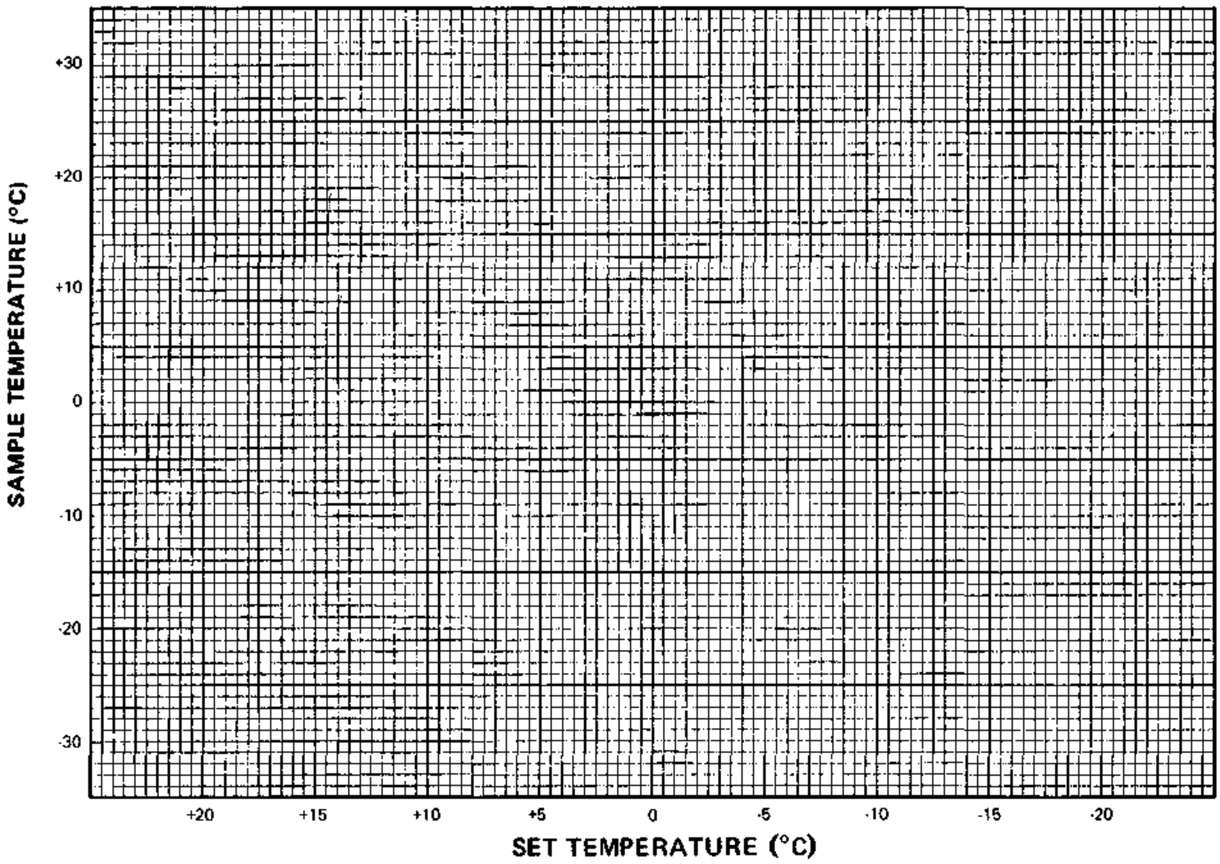
Ambient Temperature ________________

Rotor "Speed" ____________________



Rotor "Speed"/Temperature Differential Chart for the
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Instrument ____________________

Ambient Temperature ________________

Rotor "Speed" ____________________

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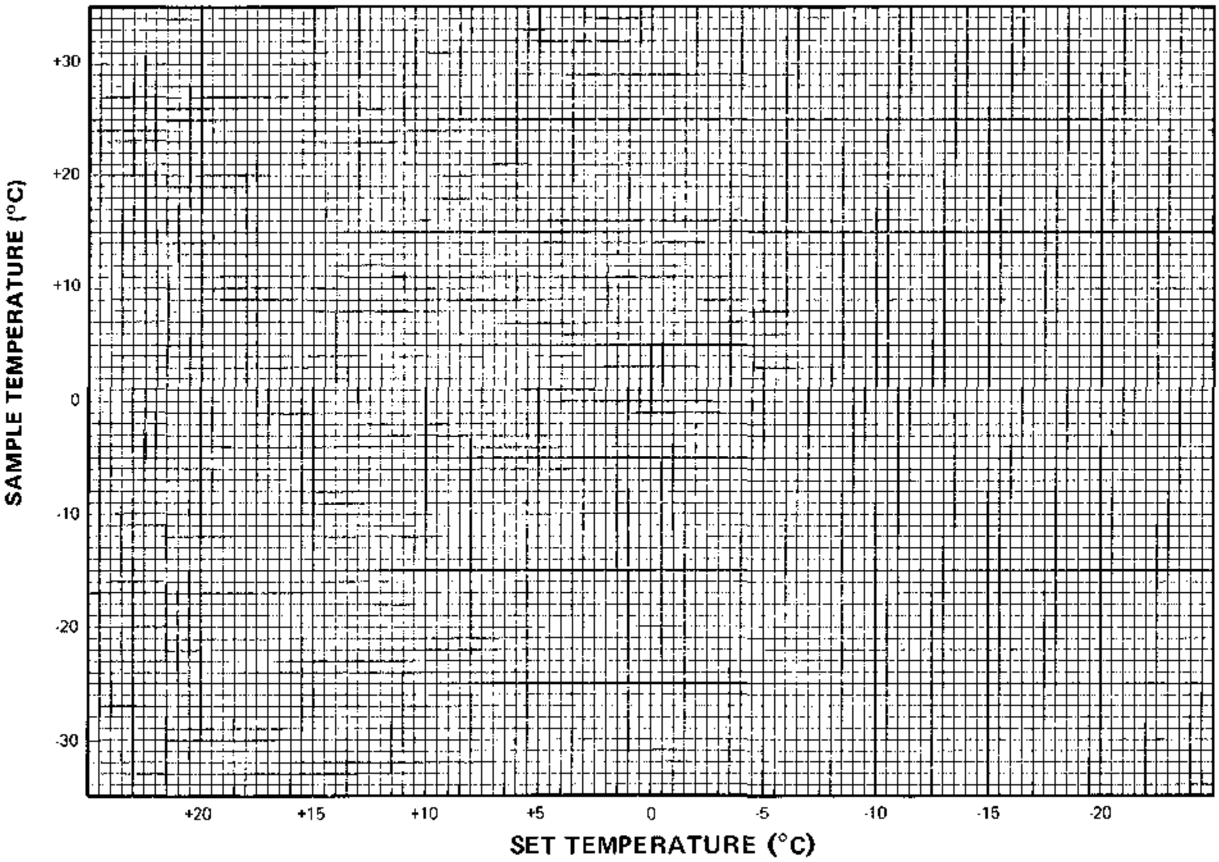

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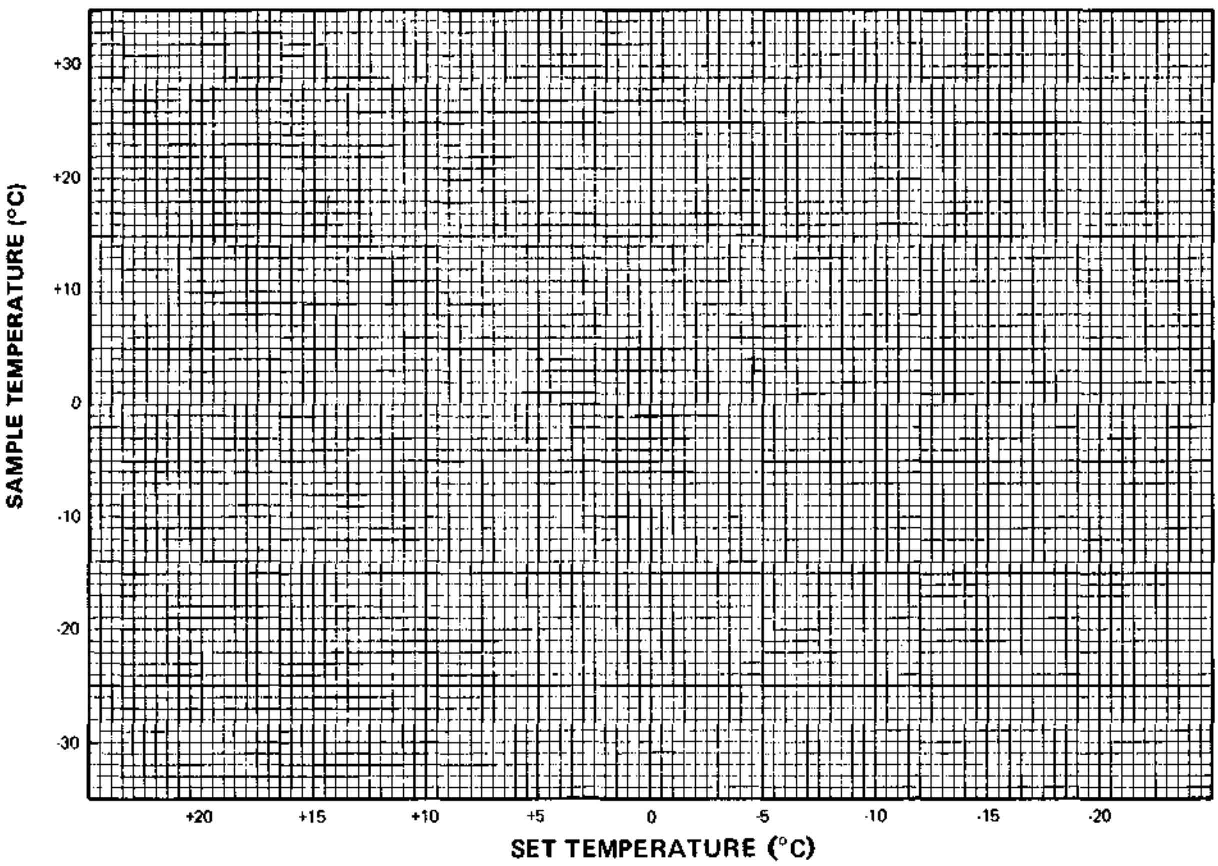

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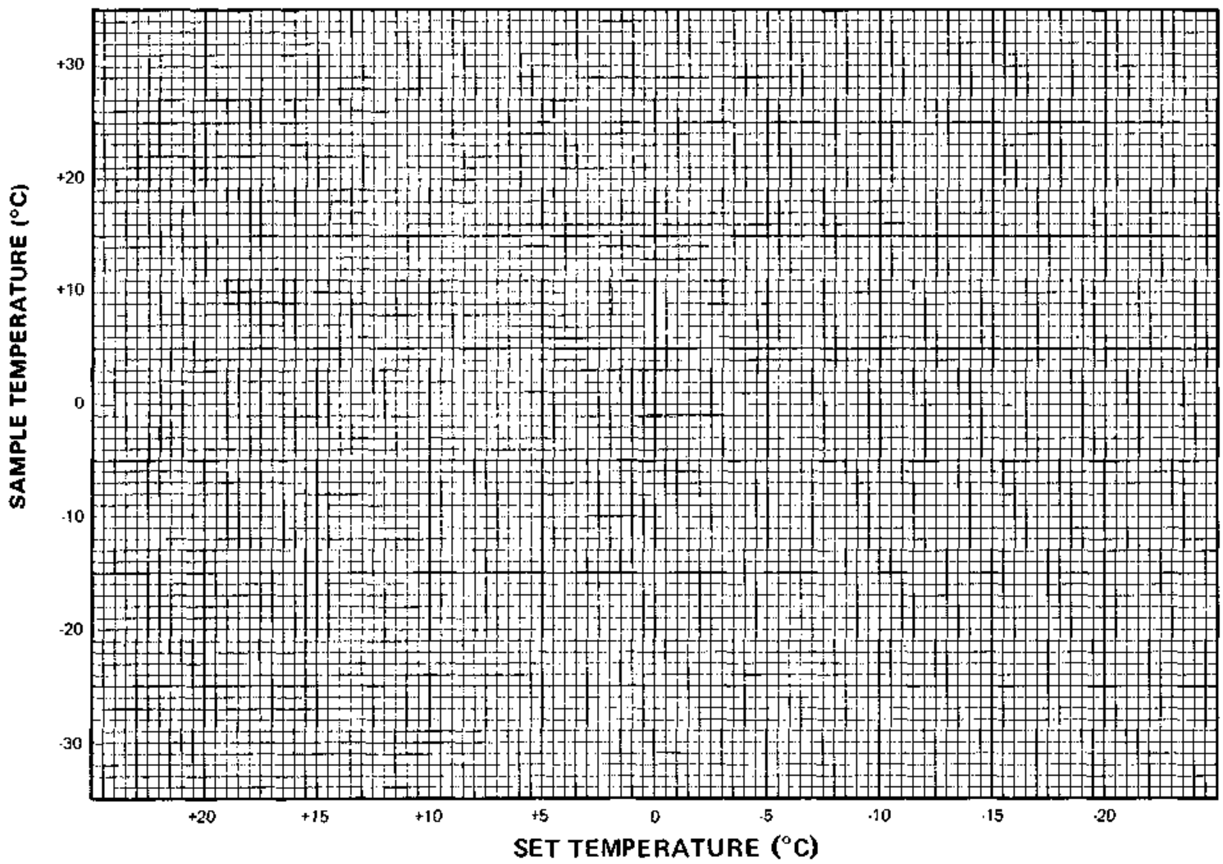
Rotor "Speed" ____________________



Rotor "Speed"/Temperature Differential Chart for the
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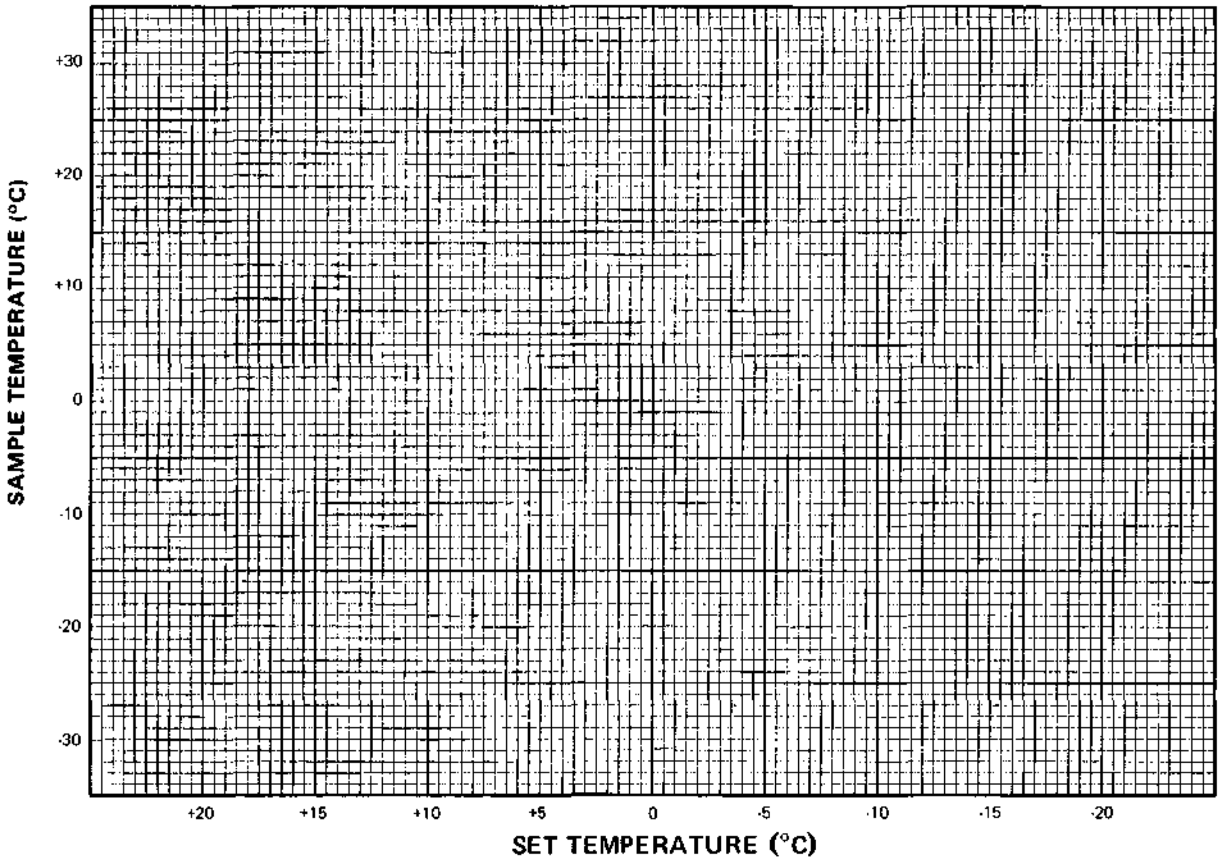
Instrument ________________

Ambient Temperature ____________

Rotor "Speed" ________________



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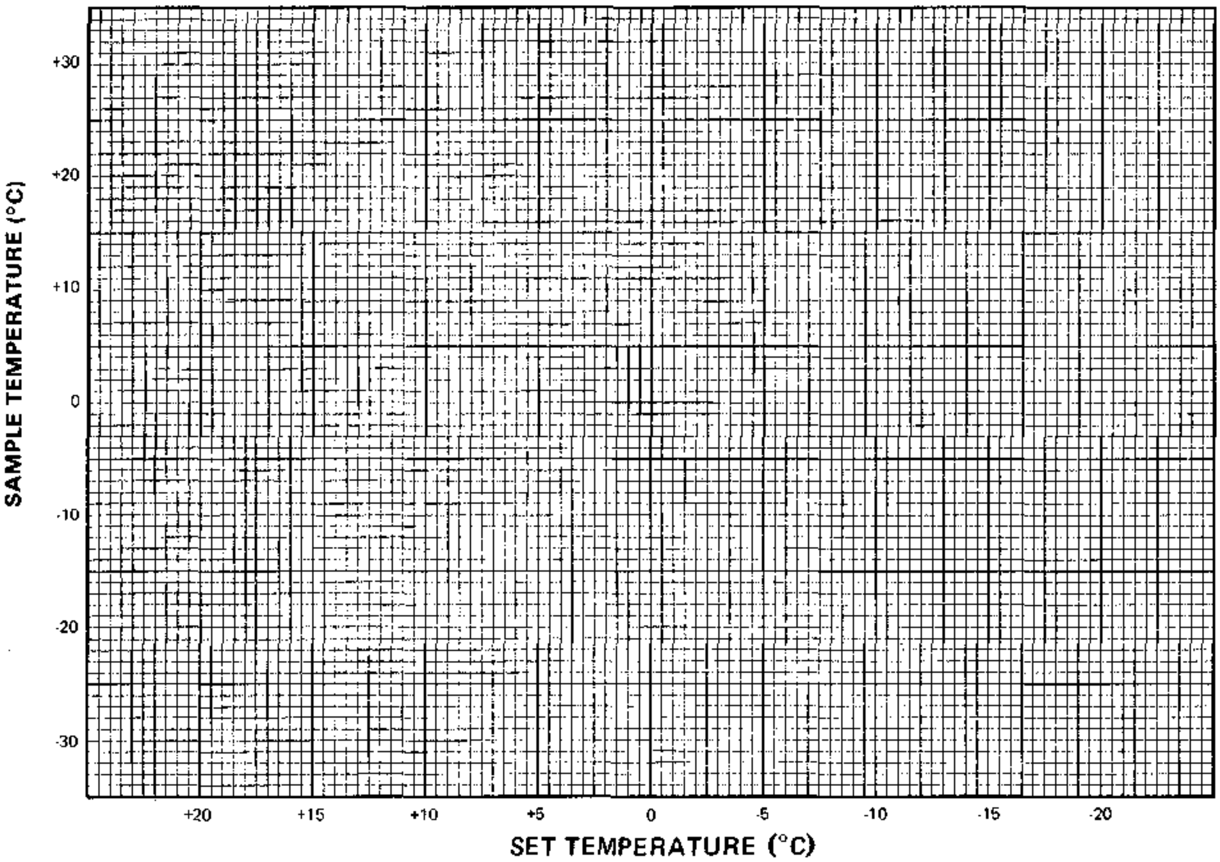
Rotor "Speed" ____________________



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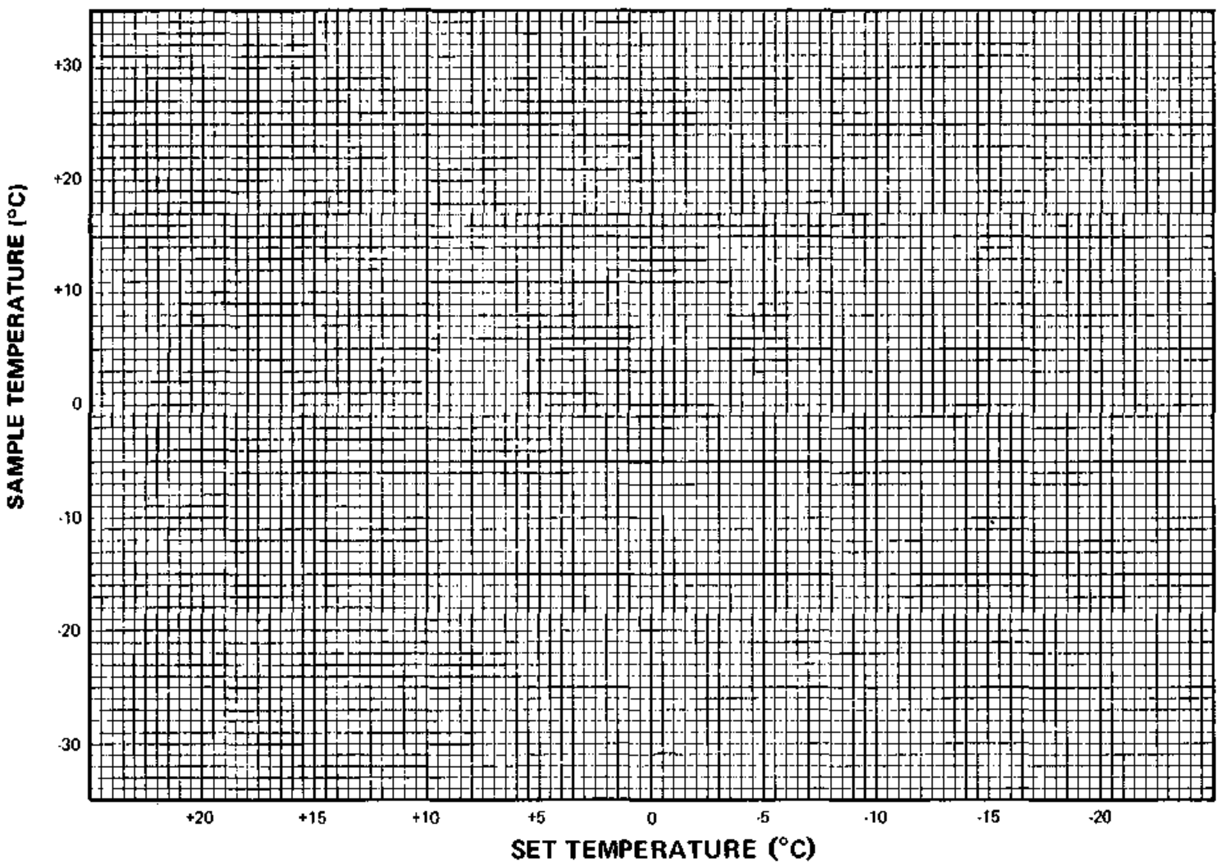
Rotor "Speed" ____________________



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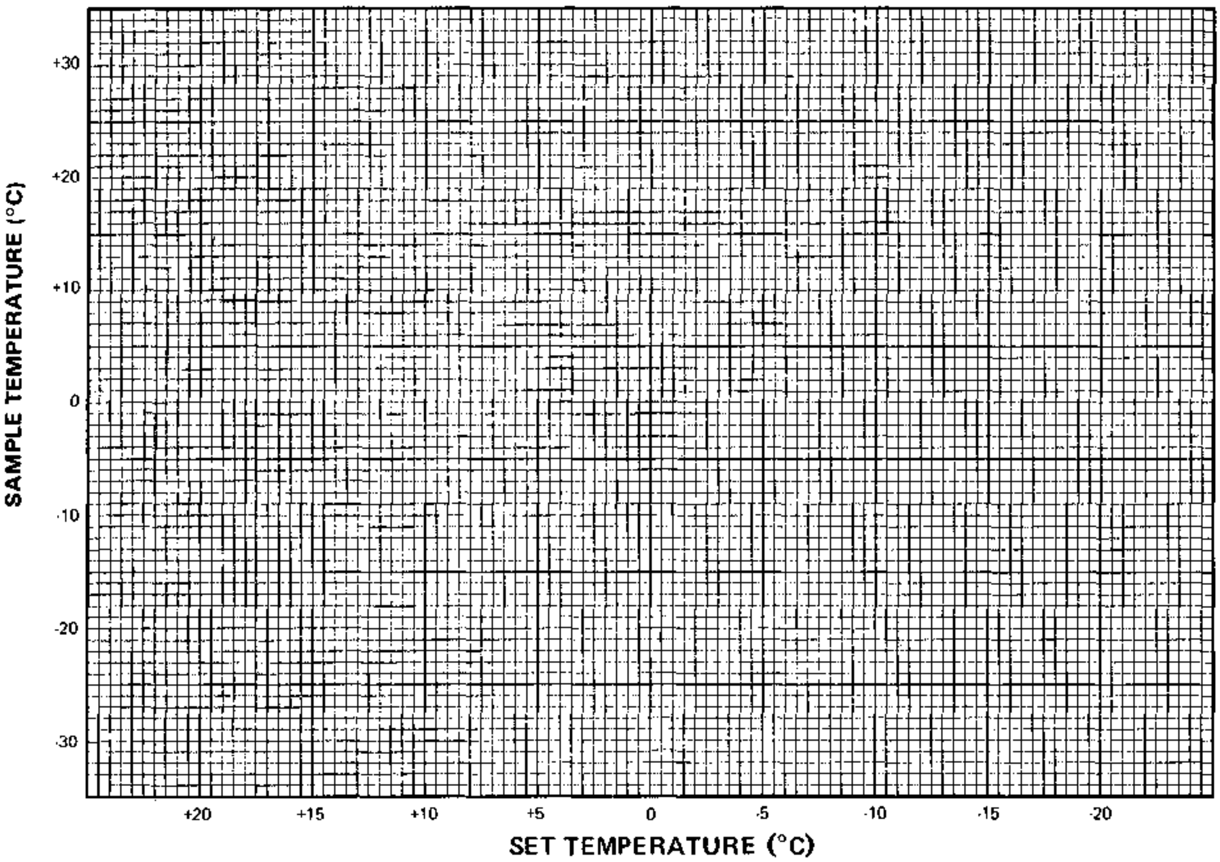
Instrument ________________
Ambient Temperature ________________
Rotor "Speed" ________________



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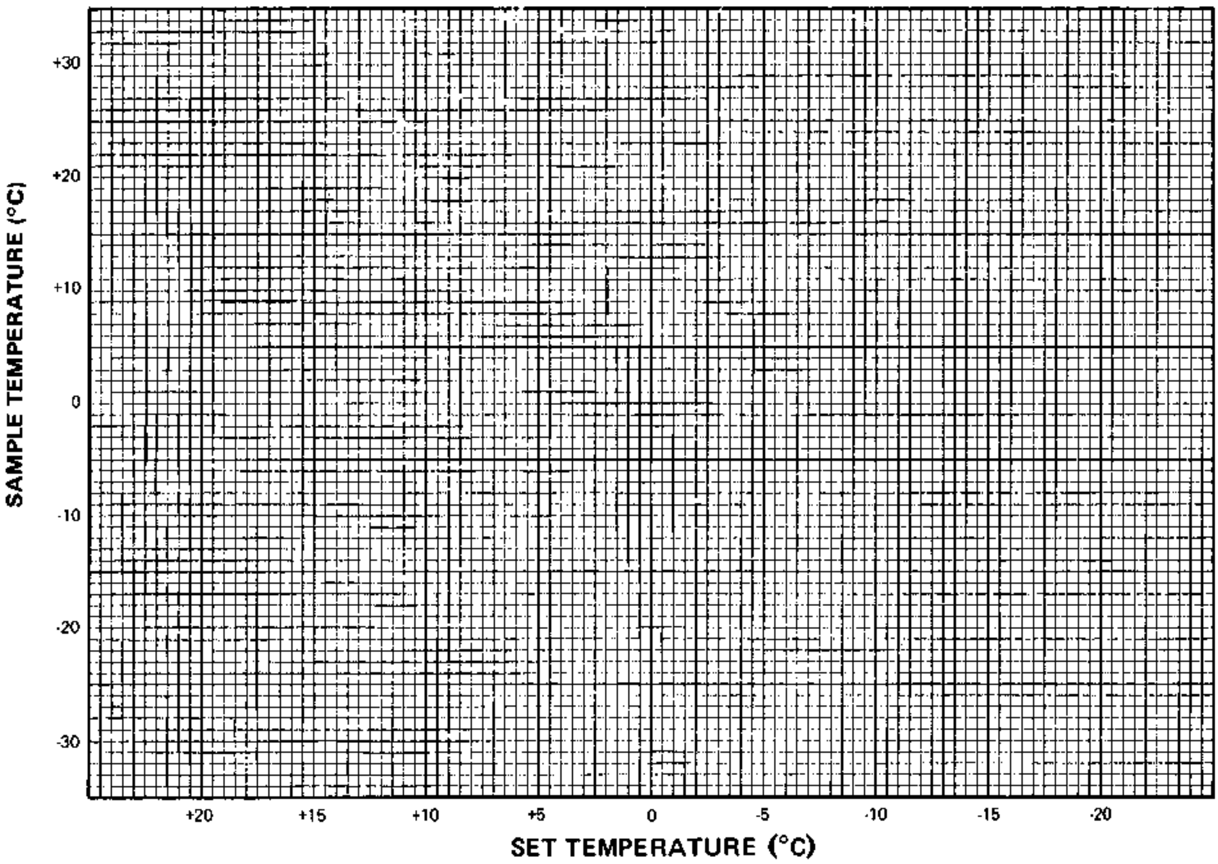
Rotor "Speed" ______________



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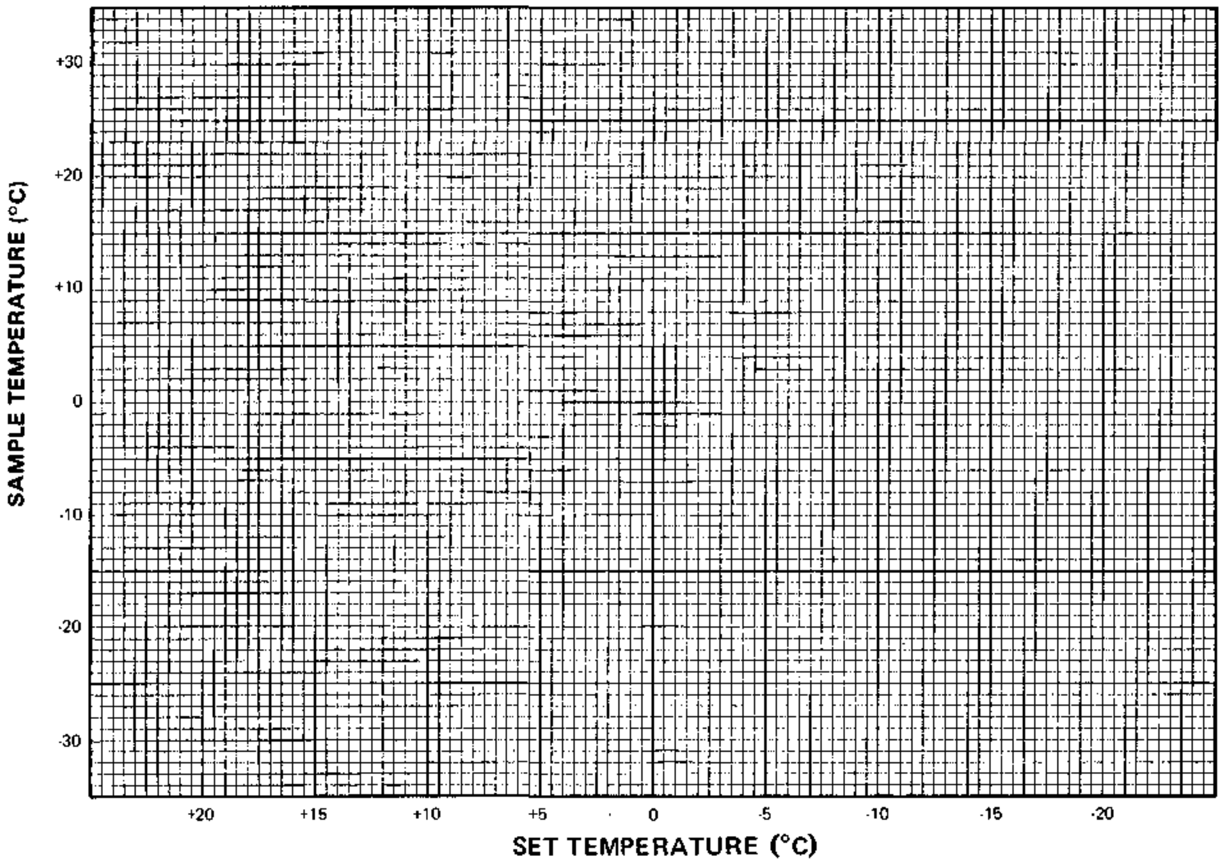
Ambient Temperature ______________

Rotor "Speed" __________________



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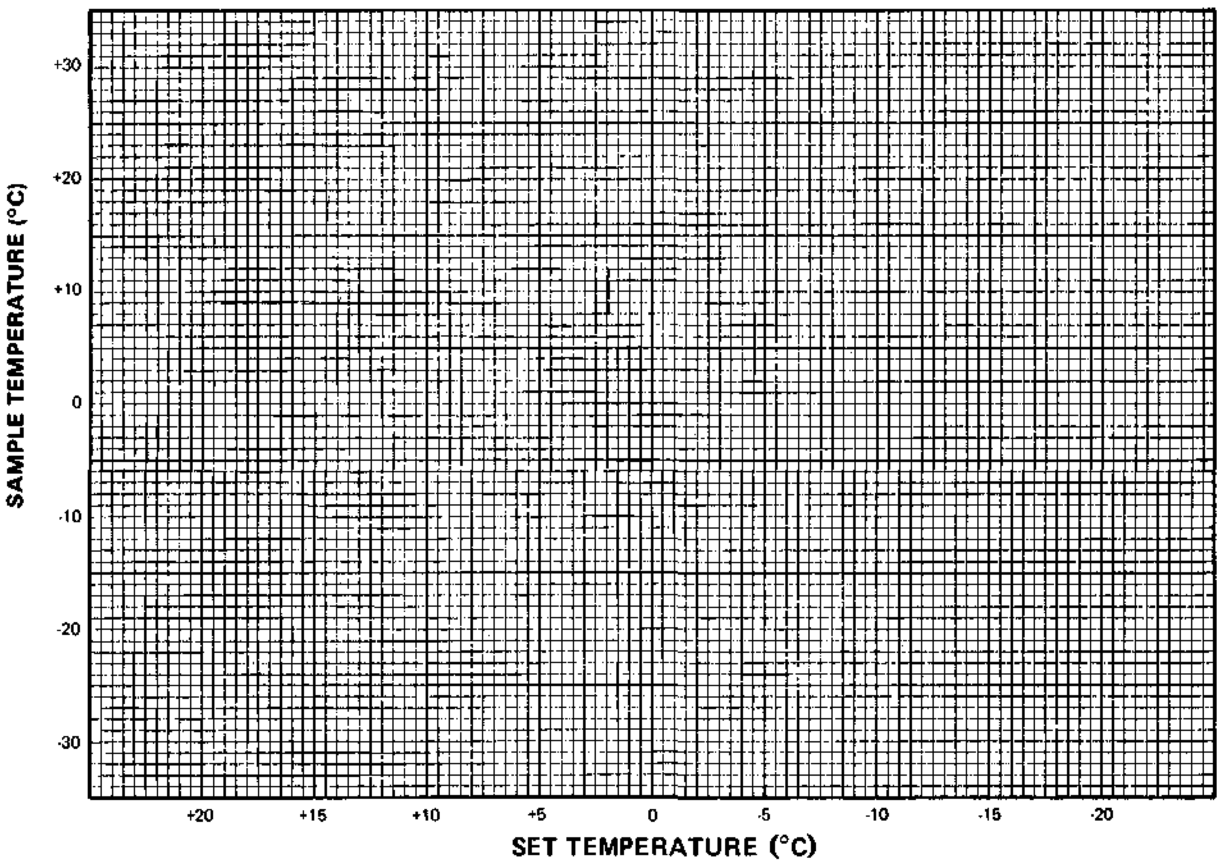
Instrument ____________________

Ambient Temperature ______________

Rotor "Speed" __________________



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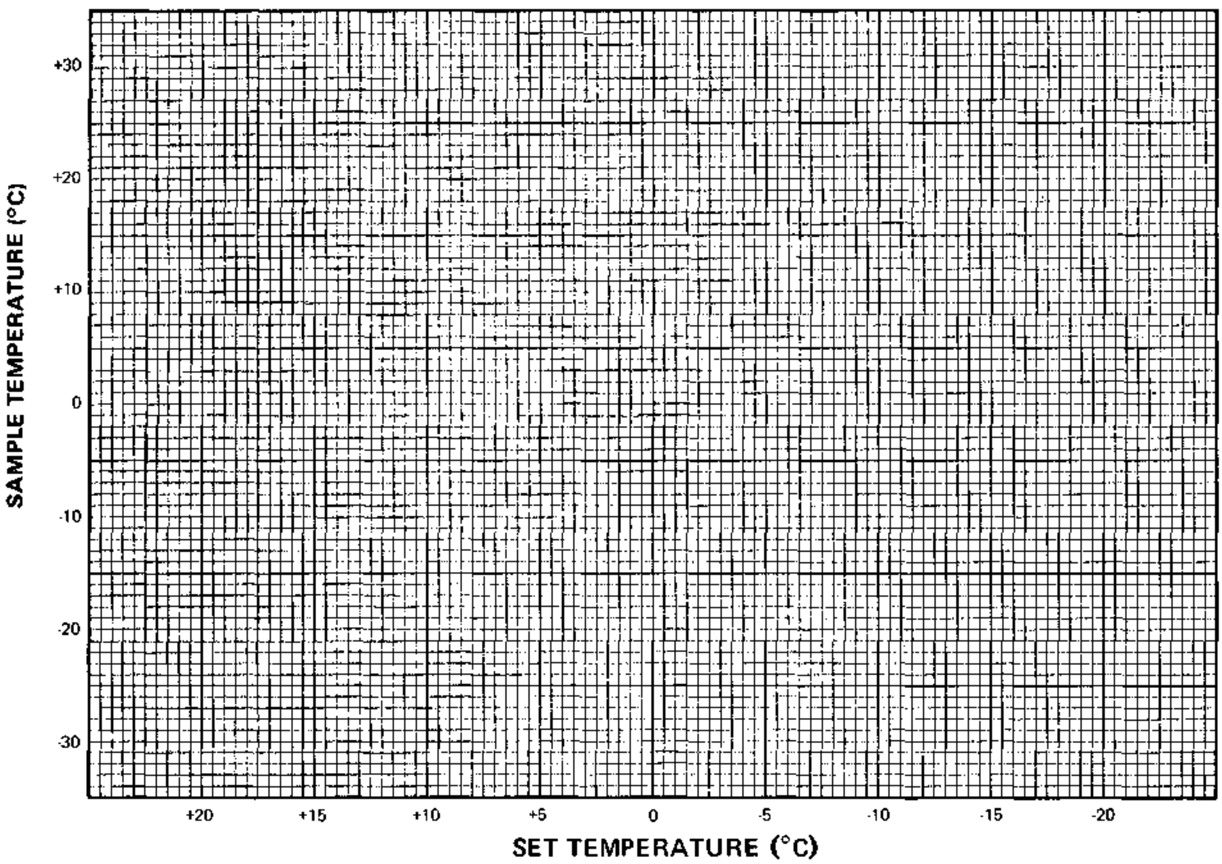
Rotor "Speed" ____________________



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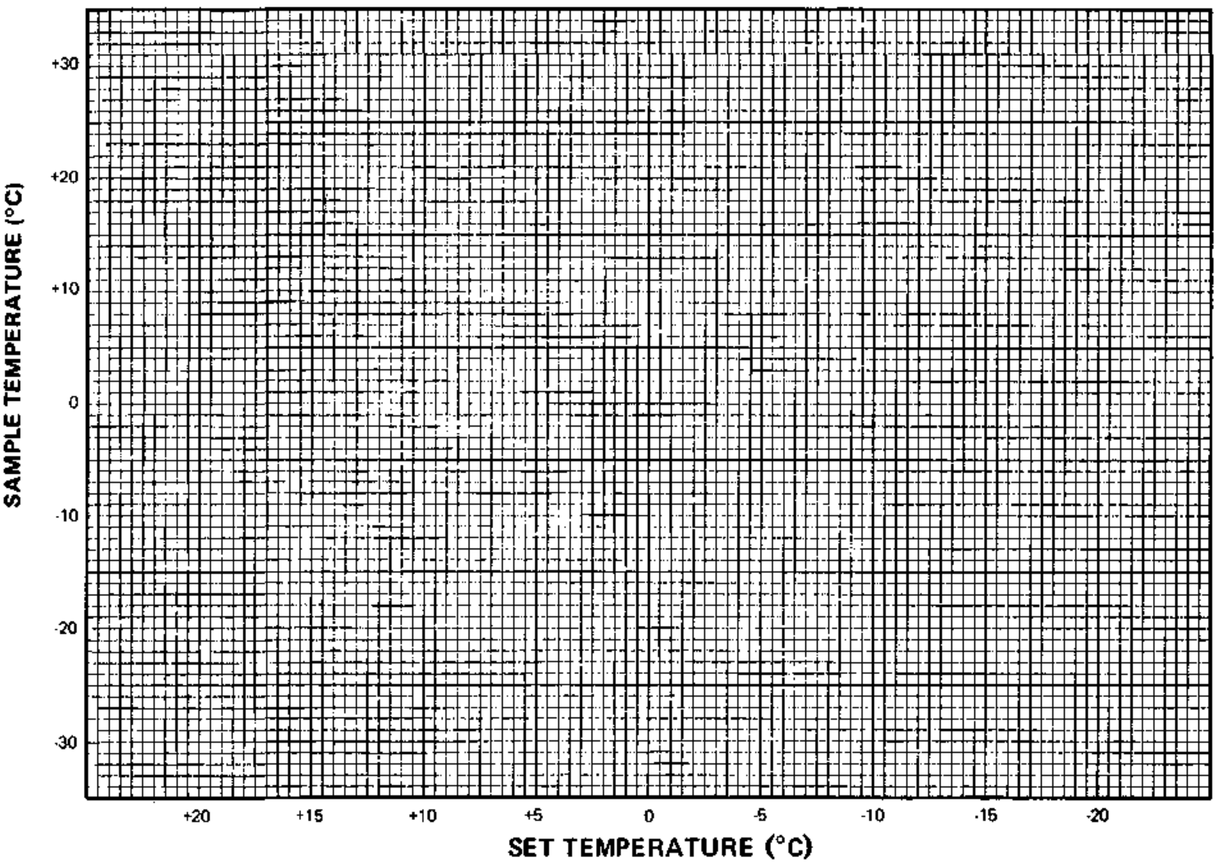
Instrument ____________________

Ambient Temperature ________________

Rotor "Speed" ____________________



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Instrument ______________________

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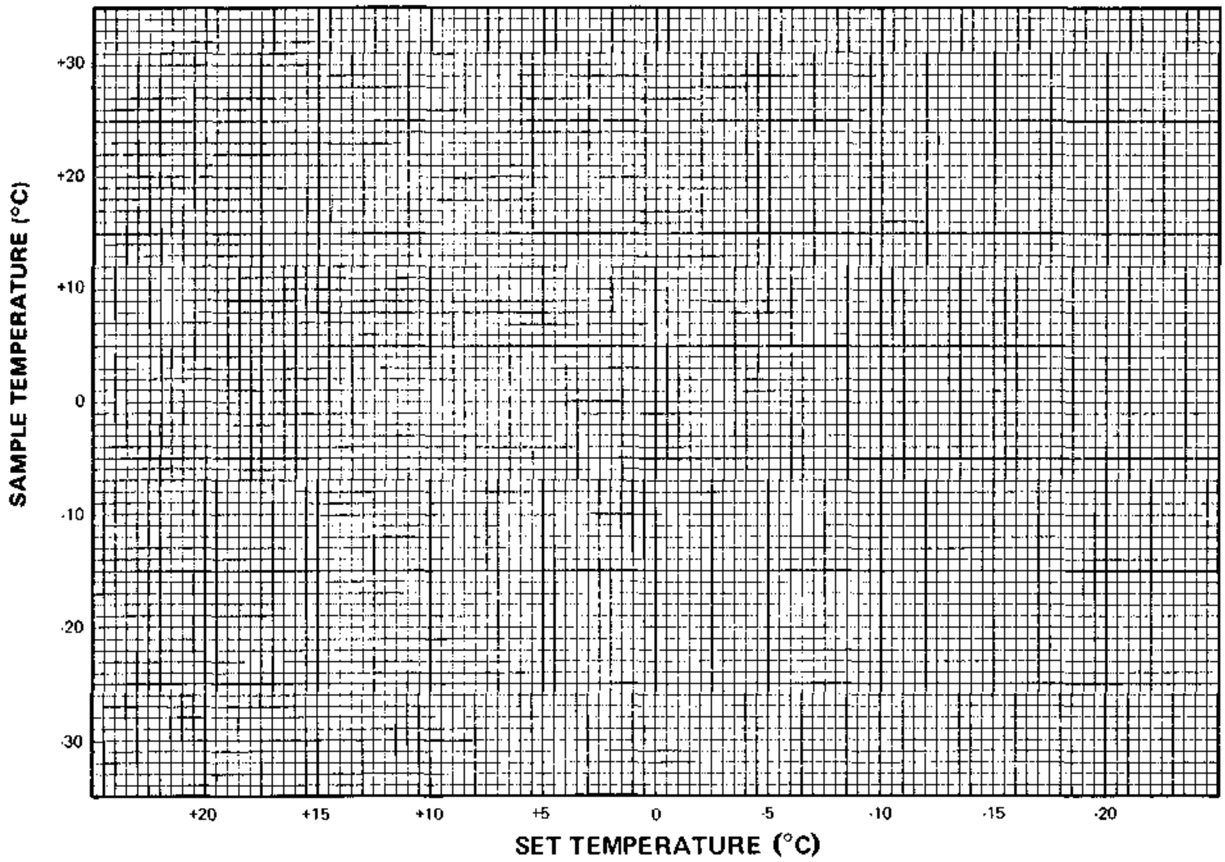
Rotor "Speed" __________________



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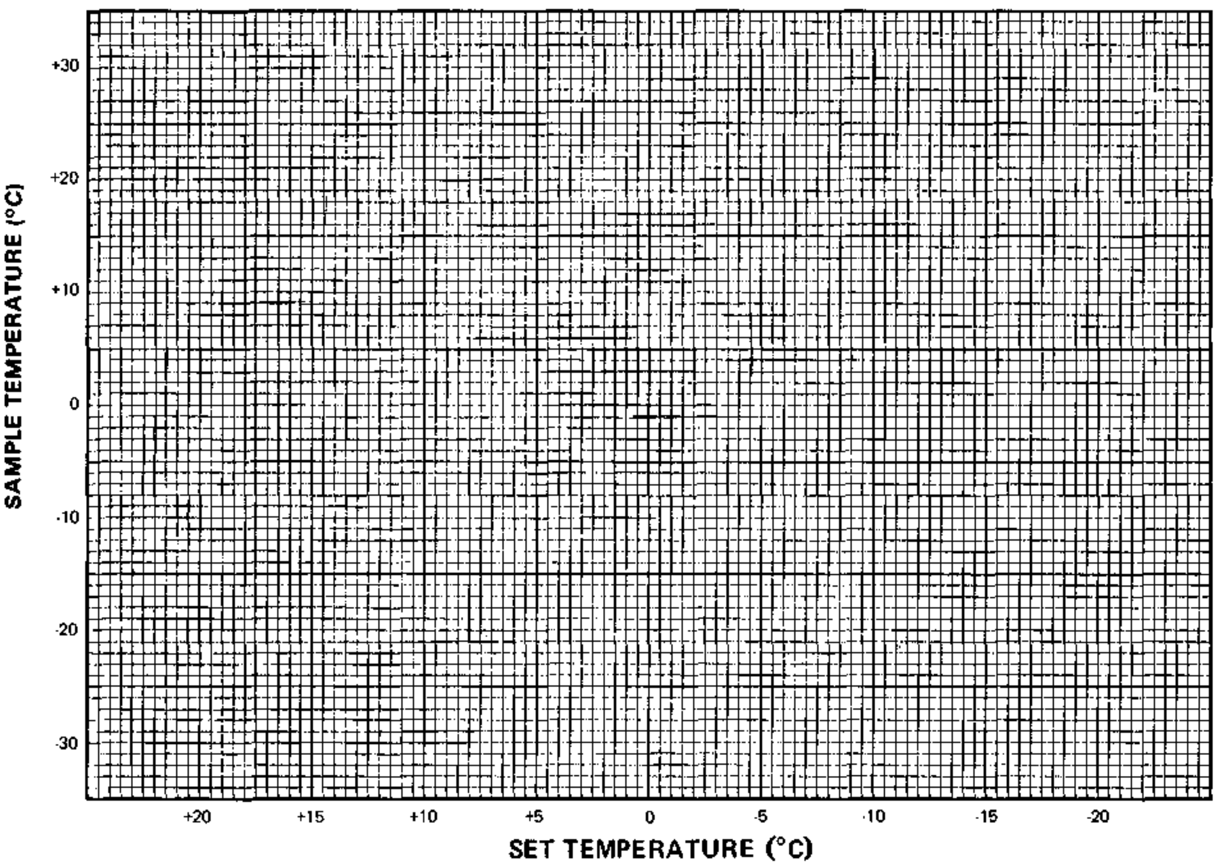
Ambient Temperature ______________

Rotor "Speed" __________________



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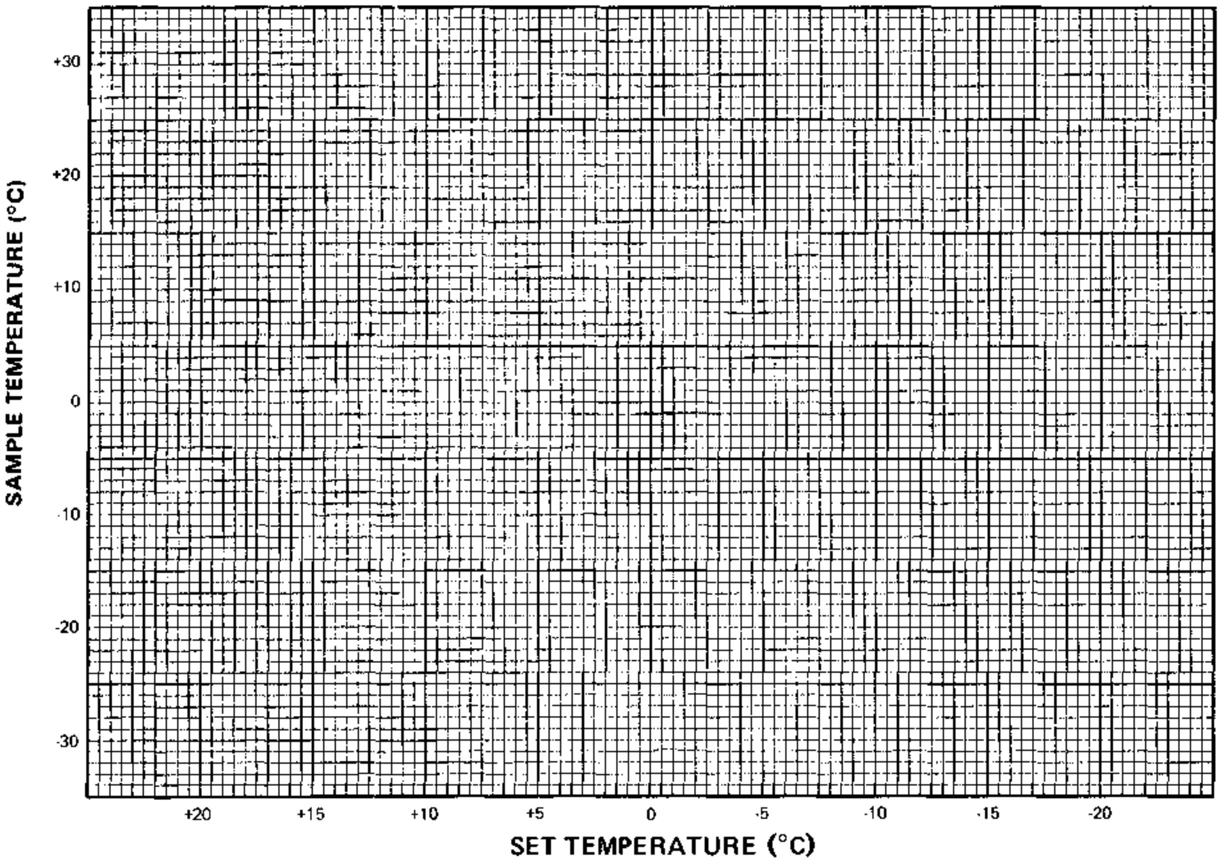
Instrument __________________
Ambient Temperature __________________
Rotor "Speed" __________________



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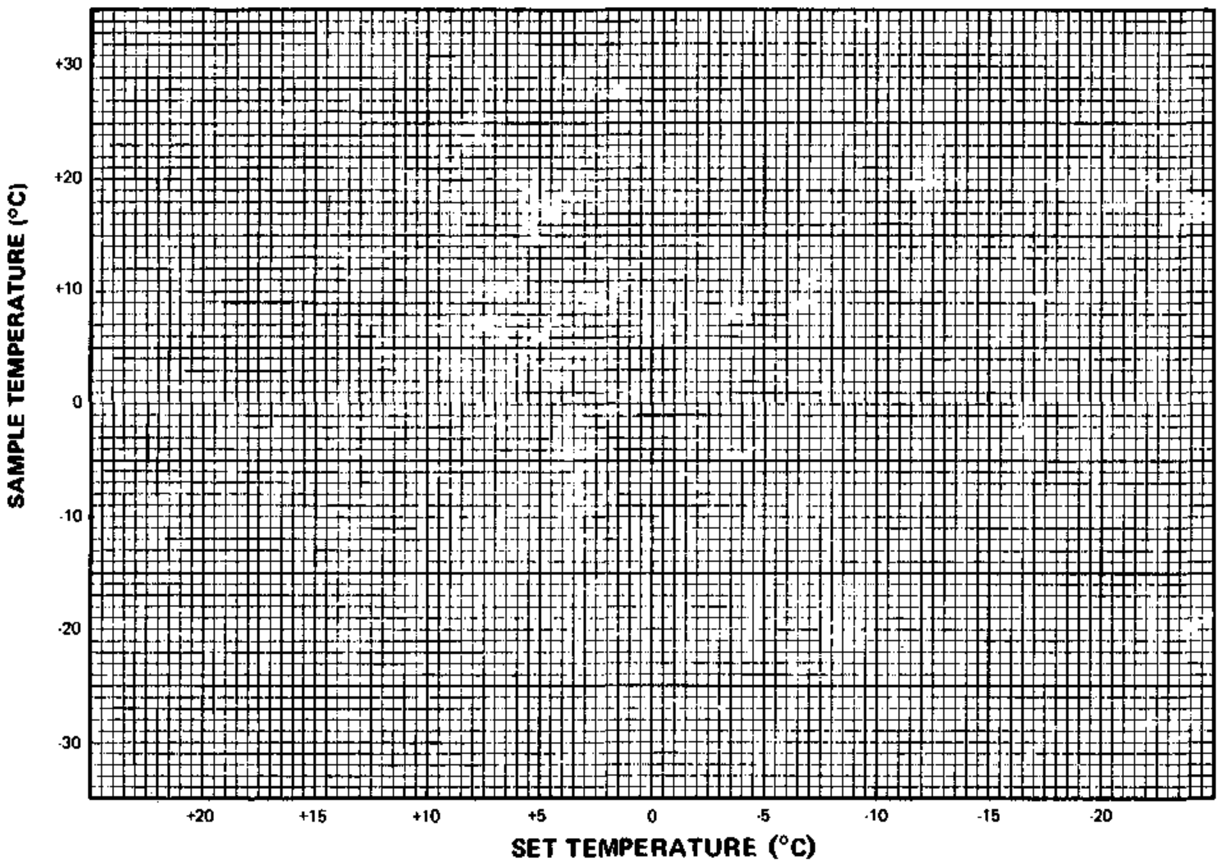
Ambient Temperature ______________

Rotor "Speed" __________________



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Instrument ____________________

Ambient Temperature ________________

Rotor "Speed" ____________________

DU PONT COMPANY • INSTRUMENT PRODUCTS • BIOMEDICAL DIVISION
NEWTOWN, CT 06470
(203) 426-5811

District Offices:

WILMINGTON, DE 19898
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DES PLAINES, IL 60018
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