K SERIES

HIGH SPEED ROTORS

USER'S MANUAL

Ref. No. 89000256-c

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CAREFULLY READ THIS MANUAL BEFORE OPERATING YOUR INSTRUMENT.

THE VALIDITY OF THE GUARANTEE IS SUBJECT TO THE OBSERVATION OF THE INSTRUCTIONS AND PRECAUTIONS DESCRIBED IN THIS DOCUMENT.

WARRANTY

JOUAN K series High Speed Rotors are warranted for a period of seven (7) years against defects in materials or workmanship. JOUAN agrees to repair, or, at its option, replace the defective article subject to the conditions specified below and to the terms and conditions of sale in effect at the time of sale.

1. The period of warranty starts on the date of shipment by JOUAN or its recognised distributor to the original buyer.

2. This warranty is valid only for the original purchaser and may not be assigned to any other party without the express written consent of JOUAN.

3. Evaluation and inspection at a JOUAN factory shall disclose that any defect had developed under normal use.

4. Normal use includes limiting the operation to the maximum speed of the rotor which speed shall be reduced for certain fluid densities, fluid gradients, tube assemblies and adaptors as described in the operating instructions.

5. Apart from any specific exception detailed herein the rotor alone is covered by the warranty which shall not include damage to accessories and ancilliary items including but not limited to
   (a) tubes,
   (b) tube caps,
   (c) tube adaptors,
   (d) tube contents or
   (e) seals.

6. Swing-out rotor buckets purchased either
   (a) as part of the original rotor purchase or
   (b) subsequent to the rotor purchase are warranted only for a term concurrent with that of the rotor for which they were supplied.

7. This warranty is void if the rotor
   (a) has been misused such as being operated or maintained in a manner contrary to the instructions in the JOUAN manual for the rotor or centrifuge
   (b) has been used in a JOUAN centrifuge that has been improperly repaired or disassembled or modified without the express written permission of JOUAN
   (c) has been operated in a centrifuge with a drive unit unmatched to the rotor characteristics.

8. Should a JOUAN centrifuge be damaged due to the failure of a rotor covered by this warranty, JOUAN will supply free of charge
   (a) all centrifuge parts required for repair and
   (b) provided that the centrifuge is under warranty or covered by a service contract, all labour necessary to repair the centrifuge.

9. Should a JOUAN rotor fail during the warranty period and a HERAEUS or SORVALL high speed centrifuge compatible with the rotor is damaged by a defect of the rotor, under the conditions of this warranty JOUAN shall either repair the said centrifuge or, at its option, provide a compatible JOUAN high speed centrifuge discounted in accordance with the remaining value of the damaged centrifuge subject to JOUAN's final confirmation.

Disclaimer

IT IS EXPRESSLY AGREED THAT THE ABOVE WARRANTY SHALL BE IN LIEU OF ALL OTHER OBLIGATIONS OR WARRANTIES OF FITNESS, MERCHANTABILITY OR OTHERWISE, EXPRESS OR IMPLIED IN FACT OR BY LAW AND THAT JOUAN SHALL NOT BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER ARISING FROM THE PRODUCTION, SALE, HANDLING, MAINTENANCE, REPAIR OR REPLACEMENT OF THE PRODUCT AND ITS LIABILITY IN NO EVENT WILL EXCEED THE PRORATED PRICE FOR GOODS FOR WHICH LIABILITY IS CLAIMED.

FOR FURTHER INFORMATION, ASSISTANCE OR SERVICING

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PACKING LIST

ROTOR	AK 16.20	AK 50.22	AK 100.21	AK 250.14	AK 500.11	SWK 100.13
Tools & accessories supplied with the rotor						
Rotor support	85240534	85240534	85240534	85240534	85240534	85240534
Silicone spray	86000935	86000935	86000935	86000935	86000935	86000935
Nylon pin	86000936	86000936	86000937	86000938	86000938	86000937
Rack kit + assembly instructions	11177365	11177366	11177367	-	-	11177367
User manual	89000256	89000256	89000256	89000256	89000256	89000256
'O'rings :						
21.3 x 3.6 mm	26436079	26436079	26436079	26436079	26436079	-
13.1 x 2.7 mm	26436035	26436035	26436035	26436035	26436035	-
4.9 x 1.9 mm	26436052	26436052	26436052	26436052	26436052	-
10.5 x 2.7 mm	26436803	26436803	26436803	26436803	26436803	-
164.7 x 3.53 mm	86000646	-	86000646	-	-	-
128 x 4 mm	-	26436066	-	-	-	-
212 x 6.3 mm	-	-	-	26436077	-	-
230 x 5 mm	-	-	-	-	26436067	-
Speed limiting disc (2)	85240419	85220252	85240418	85240417	85220253	85220254

CONTENTS

CHAPTER 1

USE AND FUNCTION

1.1. DESCRIPTION

The rotors and accessories described in this manual are designed to be used in the JOUAN KR 22*i* high capacity, high speed centrifuge for separation of sub-cellular and other particles contained in t... s or bottles designed to withstand high Relative Centrifugal Force.

Designed mainly for use in the fields of molecular and cell biology, the JOUAN K series of rotors offers the user the opportunity to carry out a wide variety of tasks. The applications for each rotor are outlined here.

ANGLE ROTORS	
AK 16.20 32 x 16 ml	Large sample capacity rotor with two rows of tubes. Ideal for plasma membranes, cell organelles and particles with sedimentation coefficient of 100S or greater.
AK 50.22 8 x 50 ml	High RCF rotor for general preparative work on medium volumes. Used for processing tissue homogenates, harvesting bacteria, cell membranes and density gradient runs for plasma membranes, cell nuclei, mitochondria.
AK 100.21 8 x 100 ml	High performance combined with good capacity. For pelleting cell membranes, bacteria, organelles, processing cell homogenates, yeast cells.
AK 250.14 6 x 250 ml	General purpose, large volume rotor for primary separation of bacteria, cells, subcellular particles. Can be adapted for multi-tube use.
AK 500.11 6 x 500 ml	Largest volume rotor. Used for harvesting cells and initial processing of large particles, tissue homogenates.
SWING-OUT ROTORS	
SWK 100.13 4 x 100 ml	High performance combined with good capacity for a swing-out rotor. Designed for density gradient separation of proteins, cell nuclei, nucleic acid precipitates and mitochondria. Equally suited for chloroplasts, lymphocytes, viruses, yeast cells.

1.2. USE IN OTHER INSTRUMENTS

They may also be used in the following instruments :

HERAEUS :
Suprafuge 22 - The correct speed limiting disc must be fitted (see chapter 7.1.1).

SORVALL :
RC-2, RC-2B, RC-5B, RC-5C, RC-24, RC 28S - the recommended rotor code must be keyed in (see chapter 5.3).

1.3. ACCESSORIES

Every JOUAN high speed rotor accepts a range of tubes and bottles. These can be made from a variety of plastics, glass and metal.

For each rotor there exists a selection of adaptors to reduce the effective size of the rotor pocket in order to permit it to accept one or a number of smaller sample containers.

A chemical compatibility guide is provided in chapter 6.

Carefully balanced sample containers are put into the rotor pockets and the rotor is spun creating a separation of the suspended particles in the liquid by Relative Centrifugal Force (RCF).

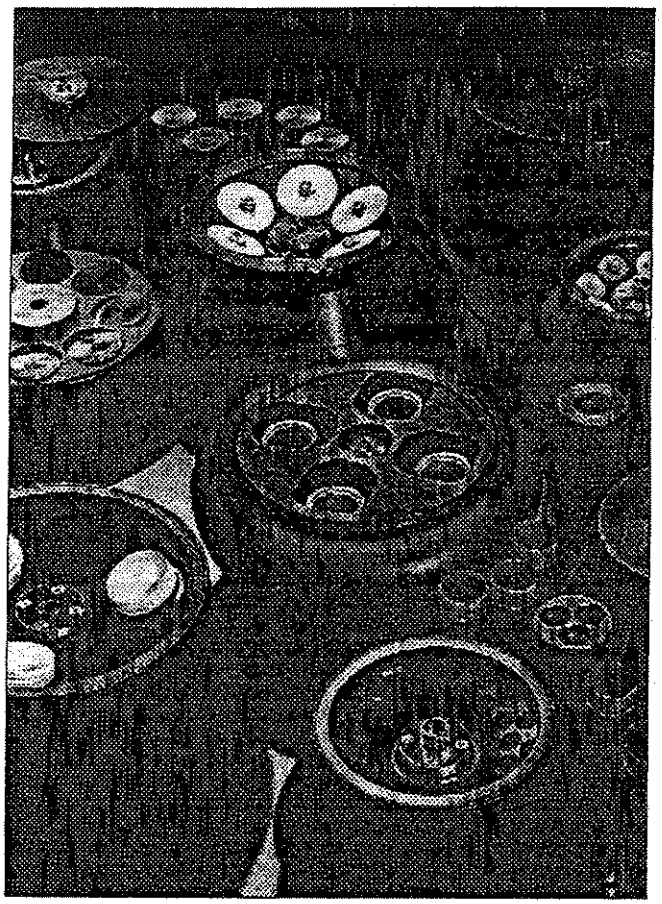


Fig. 1.1 - GENERAL VIEW

CHAPTER 2

INSTALLATION PROCEDURE

2.1. INSPECTION

Before installation, the rotor should be thoroughly inspected for corrosion and cleanliness.

Chemical and stress corrosion will eventually lead to disruption of the rotor with potential severe damage to the centrifuge.

Particles stuck inside the pockets can cause breakage of tubes and lead to major imbalance and / or loss of sample and contamination.

The central conical hole of the rotor and the drive spindle should also be clean and undamaged. These parts should be wiped over before each use.

Check that the speed limiting disc is in good condition with no scratches, tears or wrinkles.

2.2. ROTOR PREPARATION

Ensure that the 'O'rings are in good condition and lubricate with a little silicone lubricant.

Check that the lid and rotor mounting bolts swivel freely and that their threads are lightly lubricated. Lubricate the drive head with silicone vacuum grease to prevent sticking.

NOTE : Pre-condition the rotor to the same temperature as the bowl. This will prevent the rotor seizing onto the drive head and will provide the best conditions for installation.

2.3. SAMPLE LOADING

The contents of each rotor pocket including sample, tube, cap and adaptor (where used) must be balanced within the tolerance indicated in the specifications.

ATTENTION : Imbalance of the rotor may cause major damage to the rotor and centrifuge. Do not attempt to introduce liquids into rotor pockets or into tubes or bottles sitting in the pockets.

If less than the maximum complement of samples is loaded, the tubes must be placed in opposite pockets. An odd number of tubes requires a blank, water filled tube to balance the rotor.

2.4. ROTOR INSTALLATION

ANGLE ROTORS :

Place the lid on the rotor and screw on firmly in an anti-clockwise direction using the large diameter knob of the lid locking bolt.

Lower the rotor carefully into place with the drive pins on the underside of the rotor at 90° to the pins on top of the drive and do the tilt test. Try to tilt or rock the rotor from side to side.

CHAPTER 3

SPECIFICATIONS

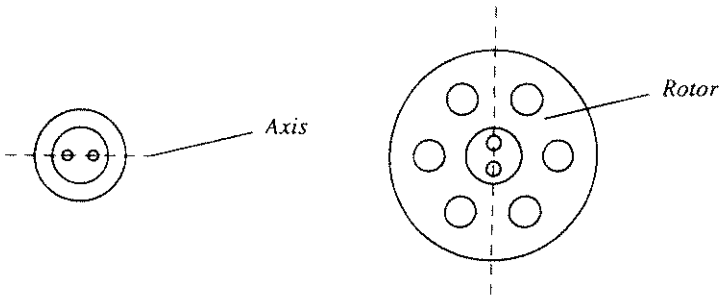
3.1. SPECIFICATIONS

The basic specifications of the high speed rotors are given in table 3.1. Additional operational data is supplied in table 3.2. Rotor performance may be limited by the maximum RCF sustainable by the tubes as stated by the manufacturer.

TABLE 3.1 - ROTOR SPECIFICATIONS

Catalogue number	Rotor	Description	Capacity	Total volume	Tube Ø mm	Rad. mm	Max speed r.p.m	Max RCF x g	Angle deg.
11177350	AK 16.20	Angle rotor	32 x16 ml	512 ml	18 x 110[3]	98[4] 115[5]	20500	46040[4] 54030[5]	23
11177357		set of 8 adaptors[1]	1 x 5 ml	160 ml	12 x 75	86[4] 103[5]	20500	40400[4] 48390[5]	23
11177356		set of 8 adaptors[1]	1 x 1.5 ml	48 ml	11 x 39	85[4] 102[5]	20500	39930[4] 47920[5]	23
11177351	AK 50.22	Angle rotor	8 x 50 ml	400 ml	29 x 110[3]	112	22500	63400	34
11174599		set of 8 adaptors	1 x 30/38 ml	304 ml	25.5 x 92	102	22500	57730	34
11177373		set of 8 adaptors	1 x 30 ml	240 ml	24 x 106	108	22500	61130	34
11177371		set of 8 adaptors	1 x 25 ml Corex	200 ml	24 x 102	108	22500	61130	34
11177370		set of 8 adaptors	1 x 15 ml Corex	120 ml	18 x 102	106	22500	57730	34
11174600		set of 8 adaptors	1 x 10 ml	80 ml	16 x 80	99	22500	56030	34
11177352	AK 100.21	Angle rotor	8 x 100 ml	800 ml	38 x 110[3]	104	21000	51270	20
11174596		set of 4 adaptors[2]	1 x 50 ml	400 ml	29 x 103	100	21000	49300	20
11177359		set of 4 adaptors[2]	1 x 50 ml con.	400 ml	30 x 116	99	21000	48810	20
11174597		set of 4 adaptors[2]	1 x 30/38 ml	304 ml	25.5 x 92	95	21000	46840	20
11177358		set of 4 adaptors[2]	1 x 15 ml con.	120 ml	17 x 120	92	21000	45360	20
11174598		set of 4 adaptors[2]	2 x 10 ml	160 ml	16 x 80	98	21000	48320	20
11177353	AK 250.14	Angle rotor	6 x 250 ml	1500 ml	61.7 x 131[3]	147	14000	32210	28
11177369		set of 6 adaptors	1 x 100 ml	600 ml	38 x 102	131	14000	28700	28
11177362		set of 6 adaptors	1 x 50 ml con.	300 ml	30 x 116	128	14000	28050	28
11177361		set of 6 adaptors	4 x 15 ml con.	360 ml	17 x 120	137	14000	30020	28
11177354	AK 500.11	Angle rotor	6 x 500 ml	3000 ml	69.8 x169[3]	155	11000	20970	20
11177368		set of 6 adaptors	1 x 250 ml	1500 ml	61.5 x125	150	11000	20290	20
11177364		set of 6 adaptors	1 x 50 ml con.	300 ml	30 x 116	132	11000	17850	20
11177363		set of 6 adaptors	4 x 15 ml con.	360 ml	17 x 120	142	11000	19210	20
11177355	SWK100.13	Swing-out rotor	4 x 100 ml	400 ml	38 x 104[3]	144	13000	27200	-
11174596		set of 4 adaptors	1 x 50 ml	200 ml	29 x 103	140	13000	26450	-
11174597		set of 4 adaptors	1 x 30/38 ml	152 ml	25.5x 92	130	13000	24560	-
11174598		set of 4 adaptors	2 x 10 ml	80 ml	16 x 80	124	13000	23400	-
11177372		set of 4 adaptors	4 x 1.5 ml	24 ml	11 x 39	131	13000	24750	-
11177365		1 test tube rack	16 x 16 ml	-	19 mm dia.	-	-	-	-
11177366		1 test tube rack	8 x 50 ml	-	30 mm dia.	-	-	-	-
11177367		1 test tube rack	8 x 100 ml	-	39 mm dia.	-	-	-	-
11177380		Vice + adaptors	50,100, 250, 500 ml	-	-	-	-	-	-

1 - Rotor accepts 4 sets 2 - Rotor accepts 2 sets 3 - Max Dims 4 - Inner row 5 - Outer row



This will only be possible if the rotor is badly seated. If tilting occurs, lift the rotor slightly then turn it through a few degrees before lowering into place again.

Lock the rotor onto the drive head by firmly screwing in the small knob of the rotor mounting bolt in an anti-clock wise direction. Ensure that the rotor is well mounted by trying to lift it. It must not move vertically.

SWING-OUT ROTOR :

The SWK 100.13 swing-out rotor is lowered into place without lid and the tilt test is performed. The lid is then placed in position and the rotor locked onto the drive head by the single knob of the rotor and lid locking bolt.

ATTENTION : With any rotor never attempt to operate the centrifuge without **first locking the lid and secondly locking the rotor**. (Done simultaneously in one operation in the SWK 100.13).

Run the centrifuge according to the instructions in the user manual.

NOTE : The first time a rotor is installed after moving the centrifuge, place the spirit level supplied with the centrifuge on top of the rotor lid. The level should show horizontal when placed in both front-to-back and side-to-side positions. Otherwise, adjust the feet of the centrifuge.

2.5. ROTOR REMOVAL

To remove the rotor from the drive shaft : Unscrew the rotor mounting bolt in a clockwise direction.

If the centre of the rotor and drive head were clean and lubricated, it should now be possible to lift off the rotor with both hands.

If the rotor will not lift off easily, unscrew the rotor lid (clockwise) and screw in the rotor removing tool supplied with the centrifuge. For the 6 x 500 ml rotor, drop in the extension piece before inserting the tool.

Continue screwing in an anti-clockwise direction until the rotor lifts away from the drive. Then lift up and away holding on to the T-bar.

CHAPTER 3

SPECIFICATIONS

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11174596		set of 4 adaptors[2]	1 x 50 ml	400 ml	29 x 103	100	21000	49300	20
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11177361		set of 6 adaptors	4 x 15 ml con.	360 ml	17 x 120	137	14000	30020	28
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11177372		set of 4 adaptors	4 x 1.5 ml	24 ml	11 x 39	131	13000	24750	-
11177365		1 test tube rack	16 x 16 ml	-	19 mm dia.	-	-	-	-
11177366		1 test tube rack	8 x 50 ml	-	30 mm dia.	-	-	-	-
11177367		1 test tube rack	8 x 100 ml	-	39 mm dia.	-	-	-	-
11177380		Vice + adaptors	50,100, 250, 500 ml	-	-	-	-	-	-

1 - Rotor accepts 4 sets 2 - Rotor accepts 2 sets 3 - Max Dims 4 - Inner row 5 - Outer row

TABLE 3.2 - ADDITIONAL OPERATIONAL DATA

Function \ Rotor	AK16.20	AK50.22	AK100.21	AK250.14	AK500.11	SWK100.13
Maximum imbalance tolerated in opposite pockets/buckets (g)	10	10	10	15	15	10
Temperature at max. speed (°C)	17	19	17	8	0	4
Speed at 4°C (rpm)	17000	18000	18000	13000	11000	13000
RCF at 4°C (x g)	31665 37160	40600	37670	27770	20970	27200
Total mass when empty (g)	9000	7720	7540	16800	21800	6900
Total mass permitted in each rotor pocket (g)	30	80	180	390	740	180
Natural resonance speed (rpm)	from 750 to 1500					
K Factor at maximum speed	362/442	553	577	1712	2730	1844
Min. radius (sealed tubes) (mm)	42	37	38	39	42	42
Min. radius (open tubes) (mm)	58/75	56	71	90	102	42
Average radius (sealed tubes) (mm)	70/78.5	74.5	71	93	98.5	93
Average radius (open tubes) (mm)	79/96	87	90	119	129	93
Maximum radius (mm)	98/115	112	104	147	155	144
RCF at min. radius (sealed tubes) (x g)	19733	20942	18735	8546	5682	7936
RCF at min. radius (open tubes) (x g)	27247 35233	31690	35000	19720	13800	7936
RCF at ave. radius (sealed tubes) (x g)	32889 36882	42166	35006	20379	13325	17572
RCF at ave. radius (open tubes) (x g)	37112 45100	49230	44368	26070	17450	17572
RCF at max. radius (x g)	46040 54030	63400	51270	32210	20970	27200

CHAPTER 4

OPERATING PRINCIPLES

4.1. RELATIVE CENTRIFUGAL FORCE

Suspended solids are separated by the Relative Centrifugal Force (RCF) applied to the sample. The effective force increases with the square of the speed of rotation and the distance from the axis of rotation.

The following formulae permit the calculation of primary parameters and of transformations relating to changes in primary parameters.

In fact, the control system of the instrument carries out and displays the results of all calculations between speed, radius and RCF.

NOTE : The value introduced for the radius can be adjusted to allow for position within the tube such as at a boundary. Maximum radii are quoted in the specifications tables (chapter 3).

TABLE 4.1 - CENTRIFUGATION FORMULAE

Legend : R = radius (in millimetres) N = speed (in r.p.m.) ÷ 1000 RCF = gravitational acceleration 'g'

M+ = add to memory MR = memory recall

Note : To calculate actual results, press the keys on a pocket calculator in the order shown (Not valid for calculators using Polish notation).

Primary calculations		**Key sequence**
RCF (x g)	$= 1.118\ R\ N^2$	N x = x 1.118 x R =
Speed (r.p.m.)	$= 946 \sqrt{\frac{RCF}{R}}$	RCF ÷ R = √ x 946 =
Radius (mm)	$= \frac{RCF}{1.118\ N^2}$	N x = x 1.118 = M+ RCF ÷ MR =

Transformations	**Key sequence**
To determine actual 'g' achieved at a different speed :	
$RCF2 = RCF1 \left(\frac{N2}{N1}\right)^2$	N2 ÷ N1 = x = x RCF1 =
To determine actual speed required to achieve a different 'g' at the same radius :	
$N2 = N1 \sqrt{\frac{RCF2}{RCF1}}$	RCF2 ÷ RCF1 = √ x N1 =
To determine actual speed required to achieve the same 'g' at a different radius :	
$N2 = N1 \sqrt{\frac{R1}{R2}}$	R1 ÷ R2 = √ x N1 =

4.2. ROTOR SPEED LIMITATION

Rotors are rated for operation at maximum speed for solutions with a density no greater than 1.2. g/ml. For solutions with a greater density the rotor must be limited to the calculated speed according to the following formula.

$$\text{Max. Allowable Speed (r.p.m.)} = \text{Max. Rated Speed} \sqrt{\left(\frac{\text{max compartment mass}^*}{\text{actual compartment mass}^{**}}\right)}$$

* see table 3.2 (weight of tube/bottle + liquid + adaptor)
** sample to be centrifuged (weight of tube/bottle + liquid + adaptor)

4.3. SEDIMENTATION TIME

An estimation of the sedimentation time for a particle which passes through the maximum path length (i.e. maximum radius minus minimum radius) in water at 20°C can be made as follows :

$$t = \frac{k}{S_{20,w}}$$

t = time (in hours)
k = clearing factor
s = Svedberg coefficient

$$k = 253300 \left\{ ln \left(\frac{r\ max}{r\ min} \right) \right\} \div \left[\frac{\text{speed (r.p.m.)}}{1000} \right]^2$$

The sedimentation time will be longer for a more viscous or dense solution.

4.4. DIFFERENTIAL TEMPERATURE DETERMINATION

In the KR 22*i* it is not necessary to carry out tedious rotor and chamber measurements to produce data for sample / set temperature graphs.

Run the rotor with a typical load at the usual sample temperature for a typical time. Measure the sample temperature at the end of the run. Note any difference between sample and set temperatures.

In the program, enter a positive value into the temperature compensation parameter for samples which remain too warm and vice versa.

For full details see the KR 22*i* User Manual. (4.4. Refrigeration system).

CHAPTER 5

INSTRUCTIONS FOR USE

5.1. PARAMETERS AND ADJUSTMENTS

There are no selectable parameters or adjustments to be made on the JOUAN High Speed Rotors.

Refer to Chapter 2. Installation procedure for introduction of rotors into a centrifuge.

5.2. STORAGE OF ROTORS

It is strongly recommended that rotors not in use should be stored upside down on a nonmetallic grid or other support which allows free movement of air. Any moisture contained in the pockets will then be eliminated by gravity and evaporation.

If the rotors are to be stored for a long period then we advise that they are dried perfectly and greased as explained in 7.1. Preventative Maintenance.

High speed rotors are frequently preconditioned by storing in a cold room or refrigerator. This tends to advance the onset of corrosion. We recommend, therefore, that such rotors are stored (dismantled) sealed inside plastic bags from which the air has been evacuated.

5.3. USE IN OTHER BRANDS OF CENTRIFUGE

When using JOUAN K series rotors in SORVALL centrifuges which require a rotor code to be entered, choose a code for a rotor of the same brand as the centrifuge and which has an equal or lower maximum rated speed. In practice, this will often be the directly equivalent rotor.

JOUAN K series rotors may be used in the HERAEUS Suprafuge 22 with JOUAN speed limiting disc since HERAEUS uses an almost identical detection system.

CHAPTER 6

HAZARDS, PRECAUTIONS AND LIMITATIONS OF USE

6.1. CORROSION INFORMATION

JOUAN rotors made of aluminium alloy are designed to operate at their rated RCF for many years. With careful use they will resist corrosion, lessening the possibility of excessive imbalance, disruption and subsequent damage to the instrument. The primary conditions for the initation of corrosion exist in every laboratory during daily use of the centrifuge. For this reason it is essential that due care and attention be paid to inspection and cleaning.

6.1.1 - CHEMICAL CORROSION

This corrosion is characterised by chemical reactions due to the existence of an electrolyte liquid on the surface of the item. If these substances are allowed to remain on the surface the corrosion will almost certainly occur. This produces first a discoloration of the anodisation then pitting of the metal.

Acidic and alkaline solutions sustaining their pH level will create problems of corrosion in aluminium rotors. Chlorides, present in salts or even in skin contact with the rotor are among the most aggressive and harmful substances commonly found in the laboratory.

The chemical products which are the origin of this corrosion do not necessarily originate from broken tubes - for example they could come from :

- Chemical vapours present in the laboratory which are dissolved in the residual humidity, in condensed water (refrigerated centrifuges) present at the base of the rotor pockets.

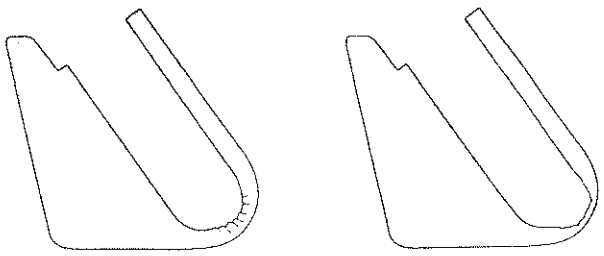
- Corrosive liquids originating from overfilled uncapped tubes (the liquid overflowing during centrifugation).

- Inserts, adaptors, racks, bottles whose exterior has been soiled by a chemical product or poorly rinsed after decontamination (with bleach, for example).

Note: If the products are very corrosive, simply rinsing is insufficient. Residual traces dissolve little by little in the humidity present in the bottom of the pocket, in the condensed water (such as occurs when putting an ambient temperature insert in a cold rotor).

BEWARE of the presence of solid particles beneath tubes, inserts, racks or adaptors. These particles are crushed by the centrifugal force and penetrate the protective, anodised layer of buckets and rotors, thus creating easy pathways for corrosion.

Fig. 6.1



STRESS CORROSION *CHEMICAL CORROSION*

6.1.2 - STRESS CORROSION

This term relates to the phenomenom of accelerated corrosion due to the effect of centrifugation when a corrosive chemical is in contact with the alloy. From the time when the aluminium alloy has been attacked by chemicals, stress corrosion begins to appear. As it is on a microscopic scale it is even more dangerous than a macroscopic scale since it is invisible.

During centrifugation, chemicals responsible for corrosion are also submitted to the tremendous "g" force which pushes them against the alloy. This close contact facilitates the chemical reaction which occurs much faster than in a static situation. Moreover, centrifugal force is very directional thus corrosion under stress creates, with a very small amount of corrosive product, straight microscopic fissures. Each centrifugation run makes the chemical migrate further and further.

A fissure, although it is microscopic, is a cut in the metal, breaking the cohesion of the material. As one weak link in a chain allows the chain to break, so the microfissures break the chain of resistance of the accessory to centrifugal force.

As accessories are designed with high levels of safety, rupture does not occur as soon as the first microfissures are produced. Depending upon the location of the fissure, disruption may occur before it reaches the external surface of the accessory. The fissure creates a weakness which makes the accessory less and less resistant to mechanical fatigue.

The corrosion by a small amount of corrosive product does not disrupt the accessory but makes it mechanically weaker and weaker until it disrupts due to both centrifugal effort and number of cycles.

Because stress corrosion is largely invisible, it is essential that rotors are scrutinised regularly paying particular attention to susceptible parts such as the base of the pockets, the outer edges and the base of the rotor. If fissures are suspected, it is forbidden to use the rotor until it has been examined by a specialist.

6.2. PRECAUTIONS

6.2.1 - CLEANING

Ideally, rotors should be washed after every use but at least weekly in warm water containing a few drops of mild non alkaline detergent (domestic washing up liquid is ideal) and EVERY TIME AFTER A SPILLAGE HAS OCCURRED.

Do not forget to wash the core of the rotor which comes into contact with the drive spindle. Each pocket of the rotor must be washed thoroughly using a small nylon brush.

DO NOT USE METAL WIRE BRUSHES.

Once the rotor is clean, rinse it in running water, preferably distilled. Dry the rotor with a soft absorbant non-woven cloth or tissue. Drying may be finished off with warm air jet (e.g. a hair dryer).

MAKE CERTAIN THAT THE POCKETS ARE WELL DRIED.

For swing-out rotors, be sure to clean the grease from the trunnions and replace it with a small amount of fresh grease. This will ensure that the buckets swing freely. The vast majority of apparent imbalance problems arise from the failure of the user to clean and grease the trunnions and not from instrument error. Pay particular attention that no deposit remains in the bottom of the pocket because the pressure of a flask or tube from above during centrifugation will significantly increase the chances of corrosion.

NEVER LEAVE A DAMP ROTOR ON A METAL SURFACE, PARTICULARLY STAINLESS STEEL because an electrochemical reaction could take place with the aluminium or magnesium in the rotor.

6.3. HAZARDS

Our centrifuges are likely to be used in medical research where hazardous substances, including radioactive chemicals, are frequently found.

ALWAYS USE THE APPROPRIATE DECONTAMINATION PROCEDURES WHERE THE ROTOR IS EXPOSED TO THESE CHEMICALS.

Examples of commonly used techniques are outlined below. The information is given as a guide only. It is the responsibility of the owner to use the most suitable procedure.

The rotor should always be completely disassembled before being subjected to heat and after external chemical cleaning.

Seals, tubes and plastic components should be decontaminated with the method most suitable for them which might not be the same as for the rotor.

6.3.1 - DISINFECTION

Alcohol (70% ethanol or isopropanol) applied for 10 minutes is ideal for bacteria and viruses.

Autoclave rotors for 20 minutes at 120°C to destroy micro-organisms.

Rotor lids must be disassembled from rotor bodies. 'O' rings, autoclaved separately, should be replaced when deformed.

ANY PART WHICH HAS BEEN SUBJECTED TO TEMPERATURES ABOVE 130°C MUST BE DISCARDED.

Hypochlorite "bleach" used at 0.1% concentration with 10 minutes immersion is effective against bacteria, spores and viruses but, as an oxidising agent, is corrosive to metal alloys and must be thoroughly rinsed off and dried. It should never be used if there is surface damage to the rotor. Note that the black colour on the surface of the rotor will be gradually washed out if the rotor is regularly autoclaved or bleached. This does not necessarily denote a degradation in the anodization.

Formalin (37% formaldehyde in water) in contact for 10 minutes has a similar effect to chlorine bleaches. Rotors should be thoroughly rinsed under running water for 5 minutes to remove all traces of formalin then dried completely.

NOTE : FORMALDEHYDE IS TOXIC.

Gluteraldehyde 2%, sold under many brand names such as Cidex and Glutarex, requires total immersion for 10 minutes to ensure sterility. Thorough rinsing and drying is essential to protect users.

CAUTION : GLUTERALDEHYDE BUILDS UP TO A TOXIC LEVEL IN THE FATTY TISSUES OF THE BODY.

Phenols are very corrosive and should never be used.

6.3.2 - RADIOACTIVE DECONTAMINATION

We recommend that all radioactive contamination be referred to your Radioactivity Safety Officer. Rotors may be decontaminated by a mixture of equal volumes of :

a) Distilled water,
b) SDS diluted to 10%,
c) Ethanol diluted to 70%.

The rotor should then be rinsed with ethanol followed by distilled water and then dried completely. JOUAN makes no claims as to the effectiveness of proprietary brands of decontaminating solutions.

6.4. CHEMICAL COMPATIBILITY FOR ROTORS, TUBES AND ACCESSORIES

S = Satisfactory
D = Discoloration but OK
P = Pure chemical OK
M = Moderate resistance
U = Unsatisfactory
X = Explosion risk!!!
O = No information

AL = Aluminium BN = Buna N CAB = Cellulose Acetate Butyrate CN = Cellulose Nitrate
DL = Delrin KY = Kynar NO = Noryl NY = Nylon PA = Polyallomer(PPCO) PC = Polycarbonate
PE = Polyethylene PP = Polypropylene PPCO = Polypropylene Copolymer PS = Polysulphone
SS = Stainless steel TF = Teflon TZ = Tefzel TI = Titanium VA = Viton A VX = Velox

Material / Chemical	AL	BN	CAB	CN	DL	KY	NO	NY	PA PPCO	PC	PE	PP	PS	SS	TF	TZ	TI	VA	VX
Acetaldehyde	S	U	U	U	O	O	O	O	M	U	M	M	O	S	S	M	S	U	O
Acetic Acid (5%)	S	M	S	S	M	S	S	S	S	S	S	D	S	S	S	S	S	M	S
Acetic Acid (60%)	S	U	U	U	U	S	S	M	S	U	M	D	S	S	S	S	S	U	S
Acetic Acid (Glacial)	S	U	U	U	U	S	O	O	S	U	M	D	M	S	S	S	S	U	S
Acetone	S	U	U	U	M	M	O	U	S	U	S	M	U	S	S	M	S	U	M
Allyl Alcohol	O	O	U	O	S	O	O	U	O	S	S	S	O	O	S	S	S	O	S
Aluminium Chloride	O	O	S	S	O	S	O	S	S	S	S	S	O	U	S	S	S	O	O
Aluminium Fluoride	O	O	O	O	O	S	O	S	S	U	S	S	O	O	S	O	S	O	O
Ammonium Acetate	O	O	O	O	O	O	O	O	S	S	S	S	O	O	S	S	S	O	O
Ammonium Carbonate	S	U	S	S	O	S	O	S	S	U	S	S	S	S	S	S	S	O	S
Ammonium Hydroxide (10%)	O	S	U	O	O	O	O	S	D	U	S	D	S	S	S	S	S	S	S
Ammonium Hydroxide (Conc)	O	U	U	O	O	O	O	S	D	U	S	D	O	S	S	S	S	U	U
Ammonium Sulphate	S	S	O	O	U	O	O	S	S	S	S	S	O	S	S	S	S	O	O
Ammonium Sulphide	O	O	O	O	O	S	O	O	S	U	O	S	O	O	S	O	O	O	O
Amyl Alcohol	S	M	U	O	S	O	O	S	S	S	S	S	O	O	S	S	S	M	S
Aniline	S	O	O	O	O	S	O	O	U	O	S	M	O	O	S	S	S	O	O
Aqua Regia	U	U	U	O	U	O	O	O	U	U	U	U	O	O	S	S	S	M	M
Benzene	S	U	P	O	M	O	O	S	U	U	U	U	U	S	S	S	S	S	M
Benzyl Alcohol	S	U	U	O	M	O	O	U	U	U	U	U	O	O	S	S	S	S	O
n – Butanol	S	S	U	O	S	O	O	U	O	M	S	S	M	O	S	S	S	S	S
Caesium Acetate	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Caesium Bromide	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Caesium Chloride	M	O	S	S	O	O	O	O	S	S	S	S	S	S	S	S	S	O	O
Caesium Formate	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Caesium Iodide	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Caesium Sulphate	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Caesium Trifluoroacetate	M	O	M	U	O	O	O	O	S	S	S	S	S	M	S	O	O	O	O
Calcium Chloride	M	S	S	O	S	O	O	S	S	M	O	D	S	S	S	O	S	S	S
Calcium Hypochlorite	M	U	O	O	M	S	O	S	S	M	S	S	S	U	S	O	S	S	S
Carbon Tetrachloride	X	U	S	S	M	S	O	S	U	U	U	U	S	M	S	S	S	S	S
Chlorobenzene	O	O	U	U	O	S	O	O	U	U	U	U	O	O	S	O	S	O	O
Chloroform	X	U	M	S	M	S	O	U	U	U	U	U	U	S	S	M	S	S	S
Chromic Acid (10%)	M	U	U	U	U	S	S	O	S	M	S	S	U	U	S	S	S	S	M
Chromic Acid (50%)	U	U	U	S	U	S	O	O	D	U	S	S	U	U	S	S	M	S	M
Citric Acid (10%)	S	S	S	O	M	S	S	M	S	S	S	S	S	S	S	S	S	S	S
Cresol	S	O	O	O	O	S	O	U	S	U	S	S	O	O	S	M	S	O	O
Cyclohexanol	S	O	U	O	O	O	O	S	S	M	S	S	O	O	S	O	S	O	O
Dextran Sulphate	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Diacetone	S	O	U	O	O	O	O	O	S	O	S	S	O	O	S	O	S	O	O
Diethyl Ether	S	O	U	U	O	O	O	O	M	U	M	M	O	O	S	M	S	O	O
Diethyl Ketone	S	O	U	U	M	O	O	U	U	U	M	M	O	O	S	M	S	O	M
Dimethylformamide	S	O	O	O	O	O	O	O	S	U	S	S	O	O	S	M	S	O	O
Dimethylsulphoxide	S	O	O	O	O	O	O	O	S	U	O	S	O	S	S	M	S	O	O
Dioxane	S	U	U	O	M	S	O	O	M	U	M	M	O	O	S	S	S	U	O
Distilled Water	S	S	S	S	S	O	S	S	S	S	S	S	S	S	S	S	S	S	S
Ethyl Acetate	M	U	U	U	M	S	O	U	M	U	S	U	U	O	S	S	S	U	M
Ethanol (50%)	S	S	S	S	M	S	S	U	S	M	S	S	S	S	S	S	S	S	S
Ethanol (95%)	S	S	U	U	M	S	S	U	S	U	S	S	S	S	S	S	S	S	S
Ethylene Dichloride	O	U	U	U	S	O	S	S	U	U	U	U	O	O	S	S	S	S	M
Ethylene Glycol	S	S	S	S	S	S	O	U	S	S	S	S	S	O	S	S	S	S	S

Material / Chemical	AL	BN	CAB	CN	DL	KY	NO	NY	PA PPCO	PC	PE	PP	PS	SS	TF	TZ	TI	VA	VX
Ferric Chloride	U	S	O	O	M	S	S	S	S	O	S	S	O	U	S	S	S	S	S
Ficoll Paque	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Formaldehyde (40%)	M	M	O	S	O	S	S	S	S	S	S	D	S	S	S	S	S	S	M
Formic Acid (100%)	S	M	U	O	U	S	S	U	S	M	S	S	O	U	S	S	S	U	S
Glycerol	S	O	O	S	O	S	S	O	S	S	S	S	S	S	S	S	S	O	O
Hydrochloric Acid (10%)	U	U	S	S	U	S	S	S	S	S	S	S	S	U	S	S	S	S	S
Hydrochloric Acid (50%)	U	U	U	U	U	S	S	O	M	U	S	M	O	U	S	S	S	M	S
Hydrochloric Acid (Conc.)	U	U	U	O	U	O	O	O	S	U	O	S	O	U	S	S	S	O	S
Magnesium Chloride	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Magnesium Hydroxide	U	O	U	O	O	S	S	O	S	U	S	S	O	O	S	O	S	O	O
Manganese Salts	M	O	S	O	O	O	O	O	S	O	S	S	O	O	S	O	S	O	O
Methanol (100%)	S	S	U	U	M	S	O	U	S	M	S	D	S	S	S	S	S	U	S
Methyl Ethyl Ketone	S	U	U	U	M	M	O	U	S	U	S	S	U	O	S	M	S	U	M
Methylene Chloride	X	U	U	U	S	S	O	U	U	U	M	U	U	S	S	S	S	M	U
Nickel Salts	M	S	S	O	O	O	O	S	S	S	S	S	O	S	S	S	S	S	S
Nitric Acid (10%)	M	U	S	S	U	S	S	M	D	S	S	S	S	D	S	S	S	S	S
Nitric Acid (50%)	M	U	M	M	U	S	S	M	D	M	M	M	O	D	S	S	S	S	M
Nitric Acid (95%)	M	U	U	O	U	O	O	U	M	U	U	M	U	S	S	S	S	S	U
Oleic Acid	S	U	S	S	S	S	O	S	S	S	S	S	S	S	S	S	S	M	S
Oxalic Acid	M	M	S	S	O	S	O	S	S	S	S	S	S	S	S	S	M	S	S
Perchloric Acid (10%)	U	O	O	O	U	S	O	O	S	U	M	M	O	U	S	S	S	S	S
Perchloric Acid (70%)	X	O	O	O	O	O	O	O	M	U	M	M	U	O	S	S	O	O	O
Phenol (5%)	S	U	O	O	U	S	O	U	M	U	S	M	U	S	S	S	U	S	U
Phenol (50%)	U	O	O	O	O	O	O	O	U	U	U	U	U	O	S	M	O	O	O
Phenyl Ethyl Alcohol	O	O	U	O	O	O	O	S	S	O	S	S	O	O	S	O	S	O	O
Phosphoric Acid (10%)	O	M	S	S	U	S	S	O	S	S	S	S	S	S	S	S	O	S	S
Phosphoric Acid (Conc.)	O	U	M	M	U	S	O	O	S	U	S	S	S	M	S	S	M	S	U
Potassium Carbonate	M	O	S	S	O	S	S	S	S	U	S	S	O	S	S	S	S	O	O
Potassium Chlorate	M	O	S	S	O	S	S	S	S	S	S	S	O	S	S	O	S	O	O
Potassium Chloride	U	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Potassium Hydroxide (5%)	U	M	S	M	U	O	O	S	S	U	S	S	S	S	S	S	M	S	S
Potassium Hydroxide (Conc.)	U	M	U	U	U	O	O	O	S	U	S	S	O	S	S	S	U	M	U
Potassium Permanganate	S	O	O	O	O	O	O	O	S	S	S	S	D	O	S	S	O	O	O
Serum	S	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Silver Nitrate	U	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Sodiuum Bisulphate	M	O	S	S	O	S	S	S	S	S	S	S	O	S	S	O	S	O	O
Sodium Carbonate (2%)	M	S	S	S	S	S	S	S	S	S	S	D	O	S	S	S	S	S	S
Sodium Chloride (10%)	S	S	S	S	S	O	O	S	S	S	S	S	S	S	S	S	M	S	S
Sodium Chloride (Sat'd.)	S	S	O	O	S	O	O	S	S	O	S	S	O	S	S	S	S	S	S
Sodium Hydroxide (>1%)	U	M	S	S	U	S	O	S	S	U	S	S	S	S	S	S	S	S	S
Sodium Hydroxide (10%)	U	M	U	U	U	S	O	S	S	U	S	S	S	S	S	S	S	S	S
Sodium Hydroxide (Conc.)	U	M	U	U	U	O	O	O	M	U	S	M	O	S	S	S	M	U	U
Sodium Hypochlorite (5%)	M	M	S	S	U	S	S	S	D	S	S	S	S	M	S	S	S	S	S
Sodium Sulphide	S	S	S	O	O	S	O	S	S	U	S	S	O	S	S	S	M	S	S
Sulphuric Acid (10%)	M	U	S	S	U	S	S	S	S	M	S	S	S	U	S	S	S	S	S
Sulphuric Acid (50%)	U	U	U	U	U	S	S	U	S	S	S	S	S	U	S	S	M	S	M
Sulphuric Acid (Conc.)	U	U	U	U	U	S	O	U	D	U	M	D	U	M	S	S	U	S	U
Tetrahydrofuran	S	O	O	O	O	O	O	O	U	U	U	U	U	O	S	S	O	O	O
Toluene	S	U	P	S	M	S	O	U	U	U	U	U	U	S	S	S	M	M	S
Trichlorethylene	S	U	O	O	O	S	O	U	U	U	U	U	U	U	S	S	M	S	M
Trichloroethane	S	U	S	O	M	S	O	S	U	U	U	U	M	O	S	S	S	S	S
Tris Buffer (neutral)	S	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Trisodium Phosphate	O	O	S	O	M	O	O	S	S	O	S	S	O	O	S	S	S	S	O
Triton X-100	S	O	O	O	O	O	O	O	S	S	S	S	S	O	S	M	O	O	O
Urea	M	O	S	S	S	O	O	S	S	S	S	S	S	S	S	S	S	O	O
Urine	O	O	S	O	S	O	O	S	S	S	S	S	O	O	S	S	S	O	O
Xylene	S	U	P	O	M	S	O	U	U	U	U	U	U	S	S	S	S	S	M
Zinc Chloride	M	S	S	O	O	O	O	S	S	S	S	S	S	M	S	S	S	S	S

* This table is intended as a guide only because of the difficulty in quantifying, cross-checking and monitoring the results under different conditions of temperature, pressure and purity relating to the solvents and samples dissolved therein. It is strongly recommended that you carry out your own trials, particularly before protracted work periods.

6.5 LIMITATIONS OF USE

The JOUAN KR22i and its rotors offer oustanding performance. In some cases the maximum possible RCF will exceed that which can be sustained by the sample container.

THE ROTOR PERFORMANCE MAY BE DIMINISHED BY THE SAMPLE CONTAINERS PLACED THEREIN. IN ANY CASE, THE MAXIMUM RCF WHICH MUST BE USED IS TO BE DETERMINED BY THE MANUFACTURER OF THE SAMPLE CONTAINER.

7.3. SPARE PARTS

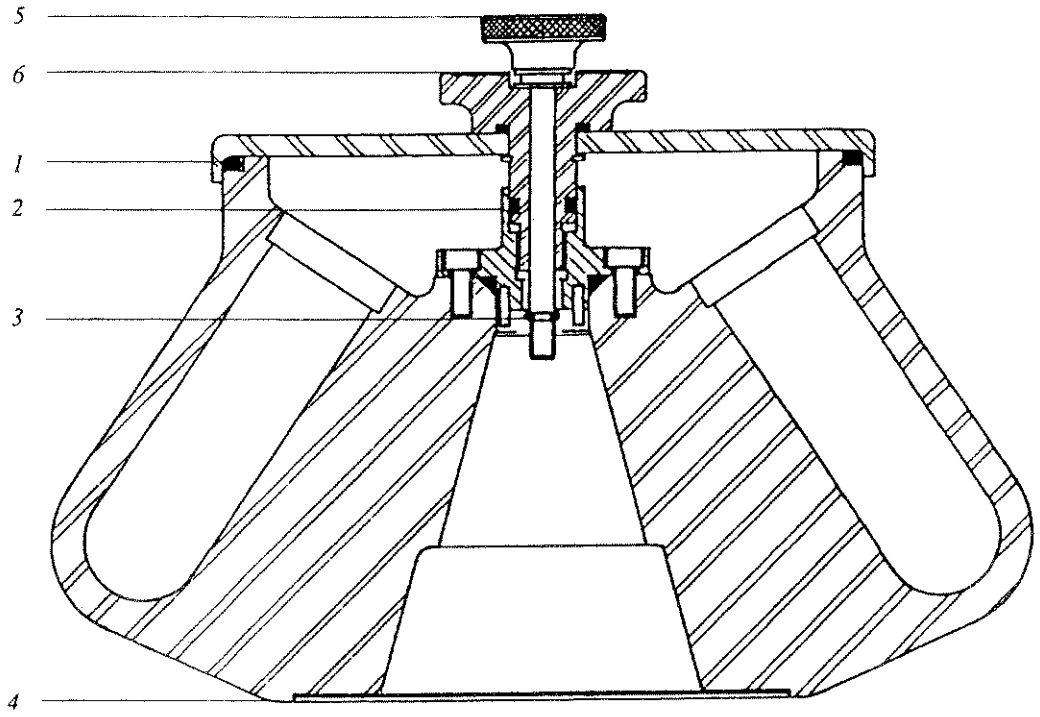


Fig. 7.1 - ANGLE ROTOR CONSTRUCTION- USER REPLACEABLE PARTS

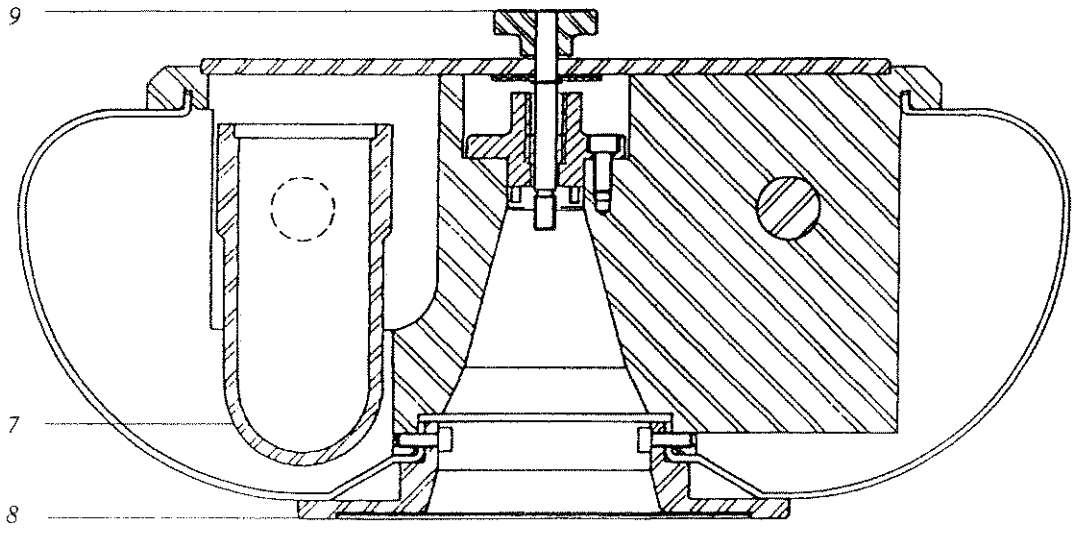


Fig. 7.2 - SWING-OUT ROTOR CONSTRUCTION - USER REPLACEABLE PARTS

Item	Description	CATALOGUE NUMBERS				
		AK 16.20	AK 50.20	AK 100.21	AK 250.14	AK 500.11
1	Lid 'O'ring	86000646	26436066	86000646	26436077	26436067
2	Locking bolt'O'ring (lower)	26436803	26436803	26436803	26436803	26436803
3	Mounting bolt'O'ring	26436052	26436052	26436052	26436052	26436052
4	Speed limiting disc	85240419	85220252	85240418	85240417	85220253
5	Locking bolt label	85240360	85240360	85240360	85240360	85240360
6	Mounting bolt label	85240359	85240359	85240359	85240359	85240359

Item	Description	CATALOGUE NUMBERS
		SWK 100.13
7	Bucket	86230305
8	Speed limiting disc	85220254
9	Mounting bolt label	85240360

CERTIFICATE OF DECONTAMINATION CLEANING & STERILITY

NAME .....

DEPARTMENT .....

ESTABLISHMENT .....

ADDRESS .....

.....

.....

COUNTY .....

POST / ZIP CODE .....

STATE / COUNTRY .....

INSTRUMENT :	*Model N°*	*Serial N°* .....
ROTOR :	*Model N°*	*Serial N°* .....
ROTOR :	*Model N°*	*Serial N°* .....
ROTOR :	*Model N°*	*Serial N°* .....
ACCESSORY :	*Description*	*Cat. N°* .....
ACCESSORY :	*Description*	*Cat. N°* .....
ACCESSORY :	*Description*	*Cat. N°* .....

NATURE OF CONTAMINATION : .....

.....

DECONTAMINATION PROCEDURE USED (If not a procedure listed in the JOUAN manual then a full protocol must accompany this certificate) :

.....

.....

.....

DECONTAMINATION CERTIFIED BY :

Signature : .....

Block capitals : .....

Date : .....