Instruction Manual

MR 23i

Analyze · Detect · Measure · Control™

P/N 50116911-1

Thermo
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Jouan MR 23i

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Chapter 1 USE AND FUNCTION

DESCRIPTION

The Jouan **MR23i** is a high speed centrifuge (23 000 rpm) designed to separate substances by elevated centrifugal acceleration. It is equally suited to precise, low speed operation.

Different rotors can be fitted to the drive in order to match the sample containers and the required performance. The maximum speed (and, by consequence, the resultant centrifugal force) is a function of the rotor in use.

A control system permits the speed, acceleration and braking rates, run time and temperature to be monitored and controlled.

Refrigeration is assured by a refrigerant group charged with a CFC-free fluid. The refrigerant fluid circulates around the chamber to achieve maximum efficiency.

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.

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).

Centrifugation formulae

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.

Primary calculations	Key sequence (not valid for CASIO, HP)
$RCF(xg) = 1.118RN^2$	Nx = x1.118xR=
Speed (rpm) $= 946\sqrt{\frac{RCF}{R}}$	RCF ÷ R = $\sqrt{x946}$
Radius (mm) $= \frac{RCF}{1.118N^2}$	Nx = x1.118 = M + RCF ÷ MR=

Transformations	Key sequence
To determine actual ‘g’ achieved at a different speed:	
$RCF2 = RCF1 \left(\frac{N2}{N1}\right)^2$	Nx ÷ x1.118 = M + RCF ÷ MR=

To determine actual speed required to achieve a different ‘g’ at the same radius:

$N2 = N1 \sqrt{\frac{RCF2}{RCF1}}$	RCF2 ÷ RCF1 = $\sqrt{xN1}$=

To determine actual speed required to achieve the same ‘g’ at a different radius:

$N2 = N1 \sqrt{\frac{R1}{R2}}$	R1 ÷ R2 = $\sqrt{xN1}$=

Chapter 2 INSTALLATION PROCEDURE

LIFTING AND TRANSPORT

Due to the weight of the machine, all lifting and transporting must be carried out using proper handling equipment (eg: fork lift trolley) that complies with current regulations, and by people having undergone the necessary training.

The machine must be supported from underneath. If it has to be transported without its pallet, for example on a staircase, professional handling assistance is required.

UNPACKING

Delivery should include the following items:

- 1 Centrifuge
- 1 Tool kit
- 1 User’s manual

Unscrew the 4 wing nuts situated at the base of the packaging. Lift off the upper part of the packaging.

With the aid of a Philips headed screwdriver, unscrew the holding screw from each side of the instrument.

IMPORTANT: AT LEAST 2 PEOPLE ARE REQUIRED TO LIFT THE CENTRIFUGE FROM THE PALETTE AND PLACE IT ON THE BENCH.

The bench must be of a rigid construction capable of supporting the weight of the centrifuge (85 kg).

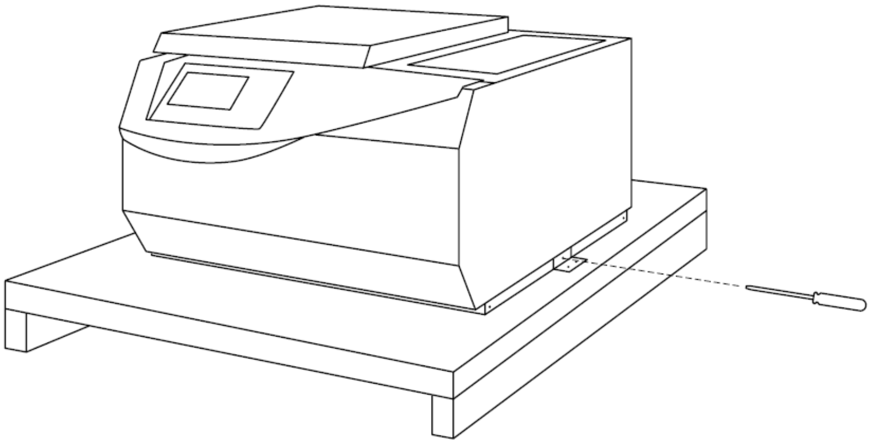


Figure 2-1. Unpacking

MAINS SUPPLY

The Jouan **MR23i** requires a single phase supply:

11174729	**220/240 V**	**50 Hz**	**6 A**	**+ earth**
11174730	120 V	60 Hz	11 A	+ earth
11174731	230 V	60 Hz	6 A	+ earth

Maximum power requirement : 1300 VA (average: 1000 VA). The centrifuge should be connected to a 3 wire earthed outlet.

Remember that in order to respect the electrical safety standards related to protection of operators against indirect contact, the supply of power to the instrument must be via a power socket fitted with a protection device ensuring automatic cut-off in the case of an insulation fault.

A supply fitted with a cicuit breaker of the correct rating complies with this requirement.

ENVIRONMENTAL CONDITIONS

This instrument is designed to operate safely under the following conditions:

- Indoor use.
- Temperature: 5° to 40°C.
- Maximum relative humidity of 80% for temperatures up to 22°C.
- Maximum altitude: 2000 m.

Maximum performance is assured across the following temperature range: 15°C to 25°C.

POSITIONING

Place the centrifuge on a bench-top, able to support its weight of 85 kg and vibrations, in a clean, noncorrosive environment. Position the centrifuge. Leave a 30 cm space free on each side of the machine and behind.

LID OPENING

When the centrifuge is switched on, wait until display returns to the stand-by mode then pull forwards the latch lever located on the right hand side of the unit: the lid is automatically unlocked and opens.

MANUAL LID UNLOCKING

In the case of a mains power cut, opening of the lid is prevented by the lid locking safety device.

It is recommended to wait for the mains to be switched back on so that this safety device enables the lid to be unlocked.

During rotation, the slightest leak from a sample is enough to create an aerosol. Rotation of the rotor can only be detected when the machine is switched on.

Opening the lid manually if the rotor is still rotating, would disperse the aerosol in the environment.

Rotating parts are also a risk as these could come in contact with the user or be ejected. There is particularly high risk of injury if:

- The user tries to manually stop the rotor,
- Any object falls inside the centrifugation chamber.

Manual lid opening procedure:

Manual lid unlocking must only be done by someone informed of the danger and of the necessary precautions to be undertaken.

If the machine has stoppped because of a mains power cut, the rotor could still be rotating. Wait 10 minutes before opening the lid. In spite of the absence of noise, the rotor could still be rotating when you need to open the lid manually.

Even in the case of a mains power cut, always set the mains switch to the OFF position before carrying out this operation.

- Lift up the rubber mat.
- Insert the unlocking device into the hole on the top right of the instrument by piercing the protection sticker.
- While pressing down on the unlocking device, pull the lid lever forward.
- The lid opens upwards automatically.

The protection sticker must be replaced after it has been pierced.

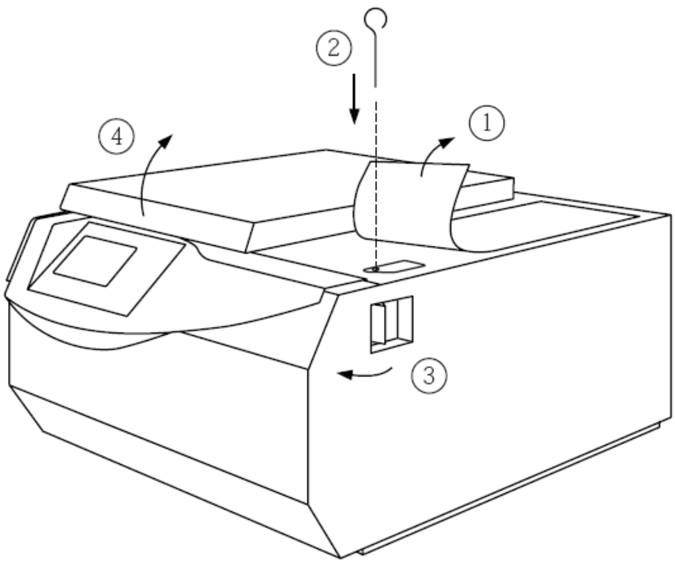


Figure 2-2. Lid unlocking

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.

Check that the central hole of the rotor and the drive spindle are clean and undamaged. Remove any particles with a soft cloth.

PREPARATION

Lubricate the drive shaft and drive shaft “O” ring with a light oil or silicone spray to prevent sticking.

Pre-cool the rotor to the same temperature as the chamber. The installation will be easier and there will not be any tendency for the drive head to stick.

Check that the rotor lid (if any) screws on easily and that its thread is lightly lubricated.

SAMPLE LOADING

The contents of each rotor pocket including sample, tube, cap and adaptor (where used) must be of the same weight as the one diametrically opposite.

Maximum weight difference accepted:

DRM 6.14	2 g	FAJM 2.15C	2 g	AM 100.13	6 g
AM 2.23	1 g	AM 10.17	2 g	SWM 180.5	6 g
AM 2.18	2 g	AM 38.15	3 g	MTM 6.4	5 g
AM 2.19	2 g	AM 50.14	6 g		

CAUTION: Imbalance of the rotor may cause major damage to the rotor and centrifuge.

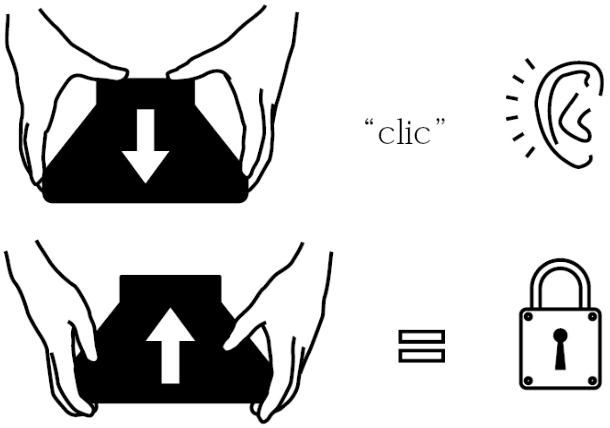
Do not attempt to introduce liquids into rotor pockets or into tubes or bottles sitting in the pockets.

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

ROTOR INSTALLATION

Carefully lower the rotor onto the drive shaft. Press down on the rotor until a click is heard. Try to lift the rotor. When correctly placed, it will not move, being automatically locked onto the drive.

It is not necessary to orientate the rotor relative to the drive shaft in order to achieve locking. The AUTOLOCK rotor mounting system allows rotors to be placed in any orientation.



YOU ARE STRONGLY ADVISED TO USE SEALED LIDS ON ROTORS IN ORDER TO BE PROTECTED AGAINST THE BIOLOGICAL HAZARDS RESULTING FROM BROKEN OR LEAKING TUBES AND BOTTLES.

ROTOR REMOVAL

For rotors with accessible centres press a thumb against the spring locking device and lift with the fingers while pulling with the other hand supporting the rotor.

For rotors with inaccessible centres, press the unlocking device (stored beneath the centrifuge lid) into the centre of the rotor and then lift out the rotor using both hands. Replace the device beneath the lid.

SEALED ROTORS MAY BE REMOVED WITH THE LIDS STILL IN POSITION AND MOVED TO A SAFETY CABINET FOR MANIPULATION OF HAZARDOUS MATERIAL.

Chapter 3 SPECIFICATIONS

DIMENSIONS AND WEIGHT

Dimensions (H x W x D)	360 x 585 x 635 mm (16.5 x 23 x 25 in.)
Packed (H x W x D)	510 x 720 x 790 mm (22.4 x 28.4 x 31.1 in.)
Weight - uncrated / crated	85 kg (188 lb) / 100 kg (221 lb)

ELECTRICAL SPECIFICATIONS

Catalogue number	11174729	Mains supply	220-240 VAC 50 Hz
	11174730		120 VAC 60 Hz
	11174731		230 VAC 60 Hz
Max power	1 300 VA		
Average power	1 000 VA		
Refrigeration	500 W		

PERFORMANCE

Max speed	Swing-out: 4 400 rpm	Angle: 23 000 rpm
Max RCF (8 x 50 ml)	Swing-out: 3 074 x g	Angle: 36 668 x g
Max capacity	Swing-out: 4 x 200 ml	Angle: 6 x 100 ml
Microprocessor controlled		
Display	Graphic screen 240 x 128 pixels	
Memory size	32 programs	
Program protection	Individual password	
Self diagnostic function		
Speed	Range	500 to 23 000 rpm
	Step	10 rpm
	Accuracy	± 20 rpm
RCF	Range	20 x g to 36 668 x g
	Step	1 x g at low speed, 3 x g at max speed
Radius	31 to 142 mm	
Timer	Range	0 to 99 h 59 min + hold position
	Step	1 min

Integrator	Range	100 to 281 x 10^{12} m. rd^2/s
	Step	1 m. rd^2/s
Acceleration rates	10	
Braking rates	10	
Temperature	Range	-8°C to +40°C
	Step	1°C
	Accuracy	± 1.5°C
Typical performance	-5°C at 4400 rpm, 3074 x g (4 x 200 ml swing-out)	
	1°C at 23000 rpm, 34780 x g (12 x 1.5 ml angle)	
Max. density	1,2 g/ml	
Max. load on drive shaft	5.4 kg	
Max. energy	26900 J	

The maximum rotational energy is not systematically that obtained with the maximum permissible load on the drive shaft.

Acceleration rate control

The selection of the rate acts on the acceleration time between 0 and 2 000 rpm. Above 2 000 rpm a max rate is applied. However, the total acceleration time depends upon the inertia of the rotor.

Range 10 rates (0 to 9)

Duration (± 15%) 0 to 90% of maximum speed (slope 9)[1]:

DRM 6.14	45 sec.	AM 38.15	90 sec.
AM 2.23	35 sec.	AM 50C.13	260 sec.
AM 2.18	55 sec.	AM 50.14	120 sec.
AM 2.19	50 sec.	AM 100.13	150 sec.
FAJM 2.15C	125 sec.	SWM 180.5	30 sec.
AM 10.17	70 sec.	MTM 6.4	30 sec.

Braking rate control

Maximum braking rate is applied until the rotor reaches 2 000 rpm below which the chosen rate comes into effect. Above 2 000 rpm there would be no gain in quality of separation if a slower rate of braking could be applied.

Range 10 rates (0 to 9)

Duration (± 15%) from maximum speed to 0 rpm (slope 9)[1]:

[1]Typical acceleration and braking times with an empty rotor.

DRM 6.14	45 sec.	AM 38.15	70 sec.
AM 2.23	30 sec.	AM 50C.13	155 sec.
AM 2.18	35 sec.	AM 50.14	140 sec.
AM 2.19	40 sec.	AM 100.13	170 sec
FAJM 2.15C	45 sec.	SWM 180.5	60 sec.
AM 10.17	60 sec.	MTM 6.4	60 sec.

Note The performance figures indicated below are those of the rotors. Their use at these speeds necessitates that the sample containers can support the corresponding forces.

Rotor selection table

Catalogue number	Rotor	Description	Capacity	Tube dim. mm	Rad. mm	Max speed r.p.m.	Max RCF (xg)	Angle deg.
11174703	DRM 6.14	Drum Rotor	6 racks	-	72	14300	16461	90
11174561		1 Rack	10 x 1.5-2ml	ø11	-	-	-	90
11174573		1 Rack	20 x 500-800 µl	ø 8	-	-	-	90
11174574		1 Rack	20 x 700 µl	ø 6	-	-	-	90
11174563		1 Rack	1 x 600 µl	ø 6	-	-	-	90
11174562		1 Rack	32 x 250 - 400 µl	ø 6	-	-	-	90
11174704	AM 2.23	Unsealed angle rotor	12 x 1.5 - 2 ml	11 x 39	62	23000	36668	45
11174728	AM 2.18	Sealed angle rotor	24 x 1.5 - 2 ml	11 x 39	84	18750	33016	45
11174706	AM 2.19	Sealable angle rotor	28 x 1.5 - 2 ml	11 x 39	73	19200*	30086*	45
-	-	-	-	-	63	19200**	25965**	45
11174722		Trans. sealing lid	-	-	-	-	-	-
11177523	FAJM 2.15C	Sealable angle rotor	48 x 1.5 - 2 ml	11 x 39	97	15000*	24400*	45
-	-	-	-	-	85	15000**	21382**	45
41174928		Set of 20 adaptors	1 x 500 / 800 µl	ø 8	-	-	-	45
11174631		Set of 20 adaptors	1 x 200 µlPCR	ø 6.5	-	-	-	45
41174938		Set of 20 adaptors	1 x 250 / 400 / 700 µl	ø 6	-	-	-	45
11174707	AM 10.17	Sealable angle rotor	10 x 10 ml	16 x 80	85	16600	26186	40
11174722		Trans. sealing lid	-	-	-	-	-	-
11174607		Set of 10 adaptors	1 x 6 ml	13 x 100	80	16600	24646	40
11174603		Set of 10 adaptors	1 x 1.5-2 ml	11 x 39	64	16600	19717	40
11174708	AM 38.15	Sealable angle rotor	8 x 38 ml	25.5 x 92	89	15300	23292	30

Catalogue number	Rotor	Description	Capacity	Tube dim. mm	Rad. mm	Max speed r.p.m.	Max RCF (xg)	Angle deg.
11174722		Trans. sealing lid	-	-	-	-	-	-
11174611		Set of 8 adaptors	1 x 16 ml	18 x 100	86	15300	22507	30
11174601		Set of 8 adaptors	1 x 13 ml	17 x 85	84	15300	21984	30
11174602		Set of 8 adaptors	1 x 10 ml	16 x 80	80	15300	20937	30
11174610		Set of 8 adaptors	1 x 5 ml	12.5 x 75	74	15300	19367	30
11174732	AM 50C.13	Angle rotor*** + con/round adaptor	6 x 50 ml con.	29.5 x 118	112	13000	21160	40
11174606		Set of 4 adaptors	1 x 15 ml con.	17 x 122	112	13000	21160	40
11177378		Set of 4 adaptors	1 x 10 ml	16 x 80	91	13000	17194	40
11174709	AM 50.14	Angle rotor	8 x 50 ml	29 x 104	97	14000	21255	28
11174599		Set of 8 adaptors	1 x 30-38 ml	25.5 x 92	88	14000	19283	28
11174604		Set of 8 adaptors	1 x 15 ml con.	18 x 122	88	14000	19283	28
11174710	AM 100.13	Angle rotor	6 x 100 ml	38 x 101	98	13000	18516	28
11174713		Set of 6 adaptors	1 x 50 ml	29 x 103	93	13000	7572	28
11174714		Set of 6 adaptors	1 x 50 ml con.	30 x 116	93	13000	17572	28
11174724		Set of 6 adaptors	1 x 30 ml COREX	25.5 x 92	93	13000	17572	28
11174726		Set of 6 adaptors	1 x 15 ml COREX 16 ml OR	17.5 x 102	92	13000	17383	28
11174715		Set of 6 adaptors	1 x 30-38 ml	25.5 x 92	88	13000	16627	28
11174716		Set of 6 adaptors	1 x 15 ml con.	17 x 122	93	13000	17572	28
11174717		Set of 6 adaptors	2 x 10 ml	16 x 80	83	13000	15682	28
11174718		Set of 6 adaptors	4 x 1.5-2 ml	11 x 39	79	13000	14926	28
11174711	SWM 180.5	Swing-out rotor	4 x 200 ml		142	4400	3074	90
11174720		Set of 4 standard buckets	180 ml	Ø 57	142	4400	3074	90
11174721		Set of 4 sealed buckets	180 ml	Ø 57	142	4400	3074	90
41193271		6 PP bottles with cap	200 ml flat bottom****	56,5 x 112	142	4400	3074	90
11174181		Set of 4 inserts	1 x 100 ml	Ø 45	142	4400	3074	90
11174501		Set of 4 inserts	1 x 50 ml	Ø 33	142	4400	3074	90
11174528		Set of 4 inserts	1x 50 ml con. ± skirt*****	30 x 116	142	4400	3074	90
11174526		Set of 4 inserts	1 x 25 ml glass Univ or 1x50ml con. with skirt****	29 x 85 30 x 116	142 142	4400 4400	3074 3074	90 90
11174527		Set of 4 inserts	1 x 25 ml plastic Univ.	25 x 85	142	4400	3074	90
11174502		Set of 4 inserts	3 x 20 ml	Ø 22	142	4400	3074	90
11174723		Set of 4 inserts	1 x 15 ml con.****	17 x 122	142	4400	3074	90
11174183		Set of 4 inserts	7 x 15 ml	Ø 17	142	4400	3074	90
11174509		Set of 4 inserts	3 x 12 ml	Ø 17.5	142	4400	3074	90
11174503		Set of 4 inserts	5 x 10 ml	Ø 16	142	4400	3074	90
11174534		Set of 4 inserts	5 x Z5/Z10, 5/10 ml	17x60/105	142	4400	3074	90

Catalogue number	Rotor	Description	Capacity	Tube dim. mm	Rad. mm	Max speed r.p.m.	Max RCF (xg)	Angle deg.
11174533		Set of 4 inserts	5 x Z5, 5 ml	17 x 60	142	4400	3074	90
11174504		Set of 4 inserts	5 x 5-7 ml	Ø 13.5	142	4400	3074	90
11174505		Set of 4 inserts	9 x 5-6 ml	Ø 13.5	142	4400	3074	90
11174577		Set of 4 inserts	12 x 5 ml open	Ø 12.5	142	4400	3074	90
11174506		Set of 4 inserts	12 x 3-5 ml	Ø 12	142	4400	3074	90
11174508		Set of 4 inserts	6 x 1.5-2 ml	11 x 39	142	4400	3074	90
11174210		Set of 4 sealed carriers	1 x 50 ml con.	30 x 116	142	4400	3074	90
11174209		Set of 4 sealed carriers	1 x 15 ml con.	17 x 122	142	4400	3074	90
11174606		Set of 4 adaptors	15 ml con. in 11174210	17 x 122	142	4400	3074	90
11174712	MTM 6.4	Swing-out rotor	6 x microplates or 2 x blocks	-	115	4500	2604	90
11174207		Rubber cushion for flexible microtitre plates		-	115	4500	2604	90

* Outer ring
** Inner ring
*** Accepts adaptors of AM50.14 when con/round adaptor is fitted
**** In open buckets only
***** In open buckets only

Optimized perfomance of AM50C.13 rotor (fixed angle rotor 6 x 50 ml conical and round)

This rotor is rated 13 000 rpm which achieves high performance of 21 200 x g with the conical tubes (Falcon, Corning, Greiner,…).

As this rotor is very big, it has the highest windage of all Jouan **MR23i** rotors and as a consequence it uses the whole power from both the motor and the refrigeration system. Ultimate running temperature at 13 000 rpm ranges from 8 to 10 °C while other Jouan **MR23i** rotors can spin at their max speed at 4°C or even below.

8 to 10°C is still an excellent performance. However, if 4°C is mandatory, AM50C.13 can maintain a sample temperature of 3°C to 4°C at a maximum speed of 11500 rpm during a cycle of up to 1 h 30 min, given an ambient temperature of 22°C.

When running AM50C.13 at 13 000 rpm and 4°C setting, you will notice some unusual conditions:

- As air is very dense at 4°C, it increases friction with the rotor which leads to an increase in the acceleration time (up to 8 minutes).
- If the chamber was at 4°C before the run, the AM50C.13 will never reach 13 000 rpm.

- If the chamber was more than 10°C, but temperature setting at 4°C and speed at 13 000 rpm, chamber temperature will never decrease.

When running at ultimate conditions (13 000 rpm and temperature below 8°C) cycling speed variations can be observed of about ±200 rpm which does not affect the efficiency of centrifugation.

Chapter 4 OPERATING PRINCIPALES

DRIVE SYSTEM

The rotor is driven by a three phase asynchronous motor. The rotor is situated in the centre of a virtually hermetically sealed and armour plated centifugation chamber. A control system ensures the correct drive speed.

The shape of the rotor is a primary load factor: a horizontal rotor presents a greater load than a fixedangle rotor. The larger the diameter of a rotor, with accessories, the greater the load, and the lower the maximum r.p.m. The machine cannot spin the rotors at a speed higher than that which they can resist mechanically.

Relative centrifugal force (RCF), at the circumference of a rotor and bucket combination, is directly proportional to the square of the speed (r.p.m.) and radius of the rotor.

Therefore, a greater r.p.m. and/or a larger radius produces a greater R.C.F. and increases the speed of separation of the substances.

SAFETY INTERLOCK SYSTEM

The Jouan **MR23i** is equipped with an interlock system that prevents opening of the centrifuge lid when the rotor is spinning.

The centrifuge will not operate until the lid is closed and latched in place. The lid remains latched until the rotor stops spinning.

When the rotor has stopped spinning, the stand-by screen will be displayed. The lid cannot be opened while any screen showing live and set values is displayed, nor if a fault screen showing a TIME OUT is displayed.

Note If a power failure occurs, access to the samples in the centrifuge is possible. For this it is necessary to use a special tool. Follow the lid opening procedure (Chapter 2: “INSTALLATION PROCEDURE” Section “MANUAL LID UNLOCKING”).

Perform bypass only under emergency conditions as the rotor could still be rotating.

IMBALANCE DETECTION SYSTEM

The Jouan **MR23i** is equipped with an imbalance system that contacts a switch when an unacceptable imbalance is present in the rotor load. When it is activated the brake is applied immediately.

The imbalance condition is displayed with the message “IMBALANCE”. The display shows the actual speed and a TIME OUT delay. The operator cannot open the lid until the rotor has stopped spinning and he has pressed the ENTER key. When the motor stops, opening and correctly loading the rotor allows the unit to be restarted. The tolerated imbalance depends upon the rotor in use. Carefully balance the sample load to avoid actuating the imbalance detection system.

REFRIGERATION SYSTEM

The Jouan **MR23i** is equipped with a CFC-free refrigeration system which allows the rotor chamber temperature to be controlled at a constant temperature. The refrigeration system injects cold gas around the evaporator of the bowl in order to achieve the desired temperature rapidly.

Avoid leaving the lid open in order to preserve good temperature regulation and avoid the build-up of ice.

The temperature measurement of the air in the bowl is displayed and the temperature is monitored by the microprocessor which controls the cooling unit.

The operator can use a temperature compensation procedure so that the sample temperature can be more accurately controlled allowing for its original temperature.

Empirical tests by the user will enable him to know what air temperature to select compared to the normal temperature of the protocol. For example, suppose samples at 20°C need to be spun at 4°C.

It might be found with a protocol temperature (T) of 3°C that the samples are cooled to 7°C. The temperature compensation ($\triangle$ T) of the air in the bowl has to be set at 3°C (telling the control unit that the result is 3°C too high) in order that the samples average 4°C during the run. The air will be maintained at 1°C. Of course, this compensation is not possible if the refrigerant group is already working at maximum power or if the run time is too short.

It is also possible to choose between refrigeration or not between cycles in order to maintain the environment at the desired temperature. If active refrigeration is selected, this will only cease to operate if the lid is opened.

INTEGRATION

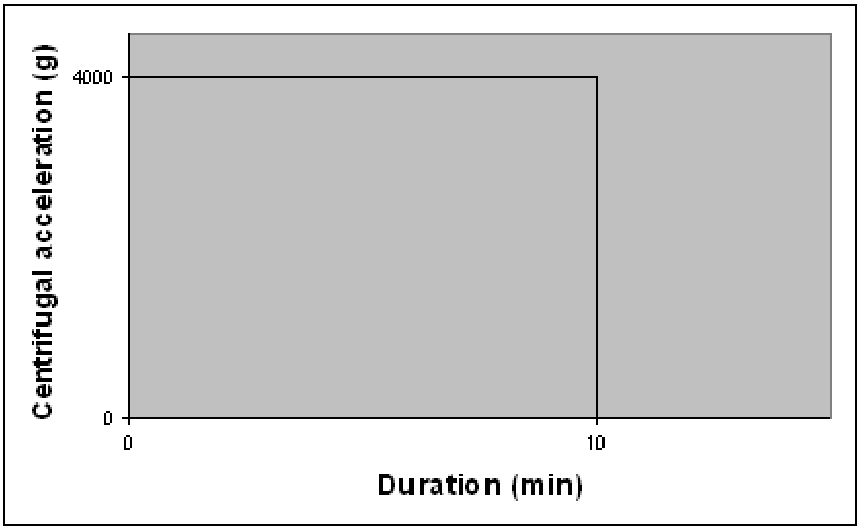
CENTRIFUGAL ACCELERATION AND DURATION

Setting centrifugation parameters consists of determining the time during which the sample is submitted to the selected centrifugal acceleration. In practical terms, centrifugal acceleration is set in terms of motor rotation speed (rpm). A given rotation speed corresponds to centrifugal acceleration which is directly proportional to the centrifugation radius, in keeping with the following equation:

Number of „g“	=	1.118	x	R	x	N^2
Acceleration				Centrifugation radius (mm)		Speed in thousands of rpm

For example, a given separation may be described as obtainable by centrifuging the sample in a given machine (which determines the accessory, thus the centrifugation radius) for 10 minutes (duration) at 4000 x g (R.C.F.) (Fig. 4.1).

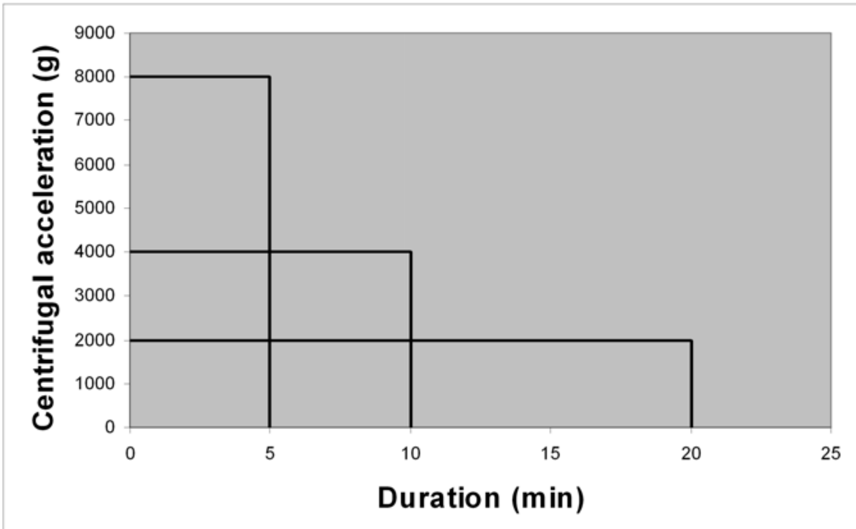
The centrifugation curve is as follows:



Theoretically, if the centrifuge instantly attains the set point speed and brakes instantly, and if the requested speed attained is constant, reproducibility of results is guaranteed from one centrifugation to the next.

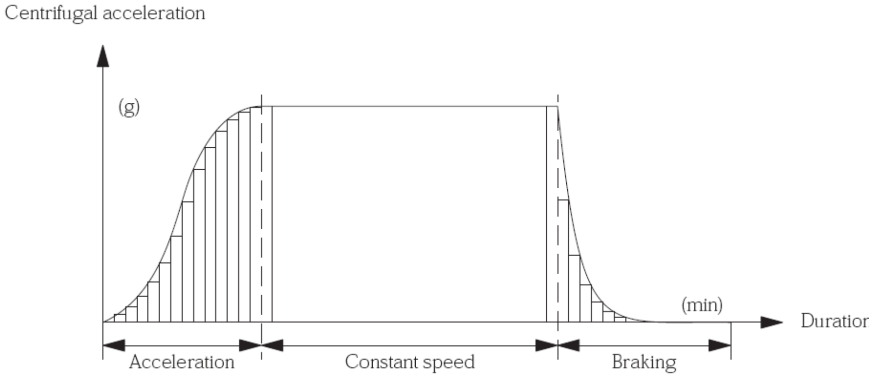
It is thus obviously equivalent to centrifuge a sample at 4000 g during 10 minutes as to centrifuge it at 2000 g for 20 minutes (or 8000 g for 5 minutes) (Fig. 4.2).

In other words, centrifugations yield the same results when the product: DURATION X CENTRIFUGAL ACCELERATION remains constant. This product corresponds to the area of the curve.



INTEGRAL OF THE CURVE

The integral of the curve is the value of its area. The area represents the total amount of separating force applied to the sample. Under the previous conditions, calculation of this integral is very simple. In reality, the centrifugation curve appears as follows:



The integral of this curve is calculated by adding the elementary areas obtained by calculating the product (elementary time interval x acceleration applied during this time interval).

The curve of two successive centrifugations for which the same speed and duration are applied are not identical. Indeed, according to sample weight, temperature, atmospheric moisture in the chamber, mains voltage fluctuations and motor wear, the acceleration rate, as well as constant speed phase, may vary.

When constant speed durations are very limited or very long, the previously described fluctuations may give rise to 5 to 10% variations in value of the integral. The quality of the resultant separations is sometimes considerably modified, as for example when preparing sub cellular fractions.

Integration control allows suppression of the effect of the various potential fluctuations. Indeed, rather than programming a given duration of centrifugation, it is possible to set the desired value of the integral for a given speed or centrifugal acceleration level (R.C.F.).

Upon attainment of that value, the centrifuge braking phase is started automatically.

The centrifuge calculator always provides values of the centrifugation integral over time (see “TO MODIFY A PROGRAM” on Seite 5-8). Thus, the optimization of centrifugation and determination of integrals to be entered is considerably simplified.

HOW TO APPLY THE INTEGRATOR

Determination of the value of the integration factor is very simple. Carry out an ordinary run using time and speed or “g” force control. The integral value is automatically calculated during every run.

Choose MODIFY from the stand-by screen and select the timer using △▽, press DETAILS. The autocalculated integral value from the previous run of this application is indicated. Press ENTER to select control by integral instead of time and, once saved, the program will give guaranteed run-to-run reproducibility for the life of the centrifuge for this protocol.

Thermo Fisher Scientific makes it easy to use the most accurate control method.

However, there is another very practical advantage. You can make major time savings. This translates into faster results and/or more samples processed in the same time. This is also equivalent to having a larger centrifuge in the lab. How do you achieve this? It’s easy with the Thermo Fisher Scientific programmable instruments.

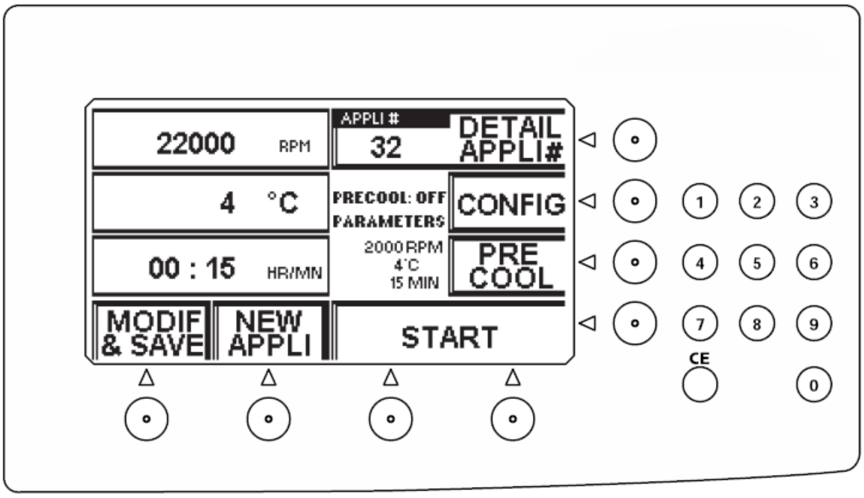
Reprogram choosing the fastest speed/RCF the rotor and samples can accept and select integral instead of time (You can program the maximum speed (or RCF) of the rotor without needing to know its actual value.

Providing that the rotor has been selected from the menu, choose MODIFY from the stand-by. With the cursor on Speed or RCF choose DETAILS, MAX, ENTER and the instrument is ready to give the top performance for the rotor).

Now the unit will give the shortest possible run time but the result will be identical because the integrator will automatically reduce the time to apply the same total separating force to the sample and the braking rate will be the same.

Chapter 5 INSTRUCTIONS FOR USE

CONTROLS AND INDICATORS



The mains switch is located on the lower left side of the front panel.

The control system includes a dot-matrix graphic LCD screen, able to display numbers, letters, and special characters in addition to animated graphics.

Eight keys, surrounding 2 sides of the screen, have their functions determined according to the name displayed on the adjacent part of the screen. Not all keys are necessarily operational at any one time and more than one key can operate the same function when the name of the function is displayed across a wide area of the screen next to these keys.

In addition, a standard numeric keypad (0 to 9 and CE, clear entry) enables parameter values to be keyed in directly when required.

Certain key functions are very common: others are found only on a dedicated screen. They operate as follows:

+	Increases the value of the indicated parameter. Sustaining pressure on the key causes a rapid increase.
+/-	Changes the arithmetical sign of the current figure (from positive to negative or vice versa).
-	Decreases the value of the indicated parameter. Sustaining pressure on the key causes a rapid decrease.
▽	Moves the highlight bar down a list in order to make a selection.

△▽	Moves the ▷ indicator from one parameter to another to allow values to be altered.
ABOUT INTEGRAL	Shows a graphical representation of the integral, together with values calculated from the previous run (where possible).
ACC	Enables the acceleration rate to be altered between the 10 choices from 0 (slowest) to 9 (fastest).
BASIC DISPLAY	Switches the display from the fully detailed run screen to the basic run screen with 3 fundamental parameters.
BRK	Enables the braking rate to be altered between the 10 choices from 0 (weakest) to 9 (strongest).
CONFIG	Provides access to fundamental set-up choices, such as language selection.
DETAILS	Gives access to those parameters associated with the indicated parameter.
DISPLAY APPLI #	Displays all preselected values of the program whose basic parameters are on screen.
END MODIF	Returns to the original run screen after temporary values have been entered.
END PROG	Returns to the stand-by screen, keeping currently selected values in volatile memory ready for use but not in permanent memory for later recall.
ENTER	Returns to a previous screen, memorizing all changes in parameter values.
ESC	Returns to a previous screen, without memorizing any changes in parameter values.
EXPAND DISPLAY	Switches the display from the basic run screen to the detailed run screen which displays all parameters.
HOLD	Selects continuous operation for the time parameter value.
MAX	Directly chooses the highest possible speed or “g” force taking into account the selected rotor and radius (cannot operate without prior rotor selection).
MODIF & SAVE	Enables parameter values to be changed and saved if the current application has not been already saved.
MODIF(Y)	Enables parameter values to be changed (Values changed during a run other than PRE COOL will not be memorized).
MORE INFO	Provides a more detailed explanation of the current parameter, e.g., definition of the integral value.
NEW APPLI	Gives access to the selection of new parameter values starting from a set of default values.

NONE	Selects “NO PASSWORD PROTECTION” when memorizing an application.
PRE COOL	Starts a predetermined precooling cycle (2000 rpm, 4°C, 15 min). During this cycle all other programming facilities are operational.
RADIUS	Enables the effective radius of a selected rotor to be modified in order to allow for the use of an adaptor or to select a boundary at which a set “g” force can be applied.
ROTOR	Lists the available rotors from which a selection can be made with their capacity and performance.
SAVE APPLI	Allows the current set of parameter values (complete or incomplete) to be stored in one of 32 memories, with or without an individual password.
SCROLL APPLI #	One press displays all parameter values of next used memory. Continued presses will display the values for all memorised applications. Also acts as application (program) selection key.
START	Starts the run.
STOP	Stops the run, overiding any programmed time or integral.

Note If the instrument remains switched on, but not used, then 5 minutes after the end of the last run the screensaver operates. The backlight is extinguished although the display can still be read. Press any key to light up the screen then continue with normal operation.

USE

INTRODUCTION

The VIDEOset graphics based control software is designed to combine power with simplicity. Unlike usual programming systems, where the user is obliged to follow a linear parameter input from beginning to end,VIDEOset enables the operator to go directly to those parameters of interest, neglecting unrelated parameters.

No previous operational knowledge is necessary; the programming is really intuitive. On-screen guidance is given to enable the user to optimise the capabilities of the instrument.

The screens presented in this manual could differ slightly according to the version of the software.

SWITCHING ON

Immediately after switching on, the screen displays Thermo Electron Corporation, then the stand-by screen is displayed showing the number of the last application program used and its basic parameters.

PRECOOLING

A keypress on CE will cause the display of the value of the actual temperature of the air in the bowl to the left of the set value during the time that the CE key is pressed.

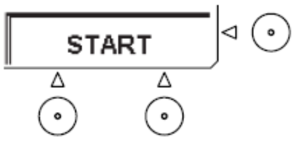
If the operator wishes to precool the bowl and rotor, he simply selects PRE COOL having installed the rotor, and the Jouan **MR23i** runs according to the pre-set values which are indicated on the stand-by display.

The display now indicates PRECOOL ON. The remaining precool time, real temperature and the dynamic rotation symbol are displayed.

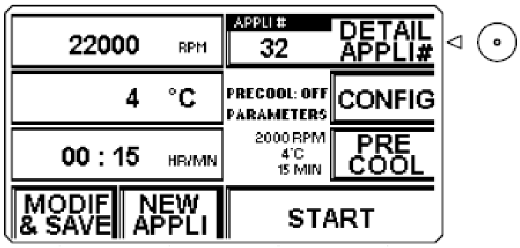
Uniquely, during a PRECOOL run, it is possible to access all programming facilities. The precool run can be halted at any time using the STOP keys.

STANDARD USE

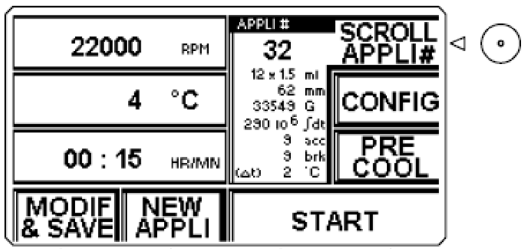
If the program which is currently displayed is the one desired, press a START key to run the program.



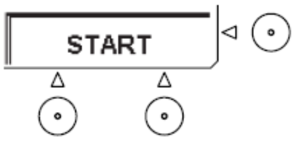
Otherwise, another program can be recalled by selecting DISPLAY APPLI # which first shows all details of the current program, then SCROLL APPLI # (same key) to scroll through the memorized application programs whose parameters are thus indicated on the screen. Sustained pressure on the key causes rapid scrolling.



STANDBY SCREEN

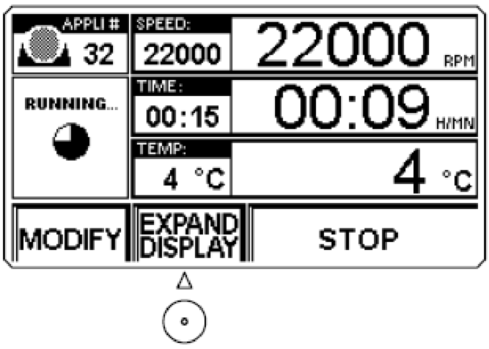


Once the required program is displayed, simply press a START key to run the program.

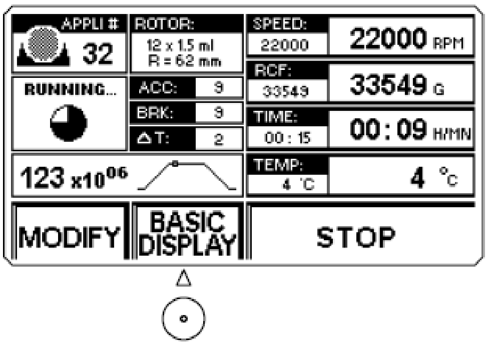


During a run, the basic screen displays the 3 basic parameters with both set and live values.

A keypress on EXPAND DISPLAY presents a detailed screen showing all possible run parameters and the values of those selected, both set and live. A keypress on BASIC DISPLAY returns the basic screen.



BASIC SCREEN DURING A RUN



DETAILED SCREEN DURING A RUN

PROGRAMMING OF PARAMETERS

Basic parameters - speed, temperature, time

The values of the 3 basic parameters, usually speed, temperature and time, are quickly introduced after selecting NEW APPLI on the stand-by display to show the simple programming screen.

Speed is indicated by a flashing arrowhead ▷. Use the keypad to write a new speed value (if required).

Move to temperature using △▽. Use the keypad to write a new temperature value. If required, use the +/- to change the sign of the value.

Move to time using △▽. Use the keypad to write a new time value (if required). HOLD is achieved by entering a value of 0 min.

After making the required modification(s), either select END PROG to return to the stand-by screen, ready to run but without storing the values, or select SAVE APPLI (see Chapter 5: “INSTRUCTIONS FOR USE” Section “SAVING AN APPLICATION / PASSWORD PROTECTION”) to store the values first.

Note If they had been programmed previously, RCF could replace speed and integral could replace time in the basic parameter menu.

Note In either case, the new values are held in a buffer memory (identified by - -) where they remain until the next time END PROG or NEW APPLI is used.

Advanced parameters

A) Speed related : RCF, acceleration, braking, rotor, radius

To program any of the speed related parameters, select DETAILS from the simple programming screen when the flashing cursor ▷ indicates SPEED. A screen appears with the speed related parameters and the flashing arrowhead indicates RCF. A value can be input via the keypad so long as a rotor has already been selected. (No selection of rotor makes it impossible for the software to control by "g" force since this is directly linear with the radius of the base of the sample tube from the centre of the drive axis - see Chapter 1: "USE AND FUNCTION" Section "RELATIVE CENTRIFUGAL FORCE")

To choose a rotor, select ROTOR and use ▽ to move the cursor down the list of rotors to that which will be used. If an adaptor will be used in the rotor select RADIUS and use the - & + keys to choose the effective radius (see accessory table, Chapter 3: "SPECIFICATIONS" Section "Rotor selection table") and select ENTER. During operation with - &+ the dynamic radius arrow moves and the related RCF is changed in real time.

If the user wishes to modify the acceleration and/or braking rates, he selects ACC or BRK and uses the - & + keys to choose the rate(s) indicated on the dynamic graphic screen Select ENTER to return to the speed related parameter screen.

After selection of ROTOR (and maybe RADIUS, ACC, BRK) the operator has the option to select MAX.

Without requiring any knowledge on the part of the operator, selection of MAX causes the instrument to program the top speed of the rotor and the related RCF allowing for actual radius.

After all the required parameter changes for this screen have been made, select ENTER to save the changes and return to the simple programming screen (which could indicate control by RCF).

B) Temperature related: Temperature compensation (△T), negative temperature

On the simple programming screen, use △▽ to move the flashing arrowhead ▷ to indicate the temperature, then select DETAILS.

The flashing arrowhead indicates △T (For an explanation of △T see Chapter 4: “OPERATING PRINCIPALES” Section “REFRIGERATION SYSTEM”). Use the keypad to input a value and then (if required) the +/- key to change the mathematical sign of the value.

Alternatively, the user has the choice of directly selecting one of the most popular operating temperatures (4, 20 or 37°C) and/or using +/- to introduce a negative value.

If wished use △▽ to first indicate temperature selection then select the temperature. Select ENTER to return to the simple programming screen.

C) Time related : Integral, hold

On the simple programming screen, use △▽ to move the flashing arrowhead ▷ to indicate the time then select DETAILS.

The flashing arrowhead indicates integral selection. For more information on integral select ABOUT INTEGRAL and also MORE INFO for an accurate definition.

Select ESC/ESC to return to the time / integral screen. If this application has just been used, VIDEOset will indicate the recently totalled integral value.

Selection of ENTER will return the user to the simple programming screen but with control by integral instead of time, ensuring the highest possible run-to-run reproducibility (see Chapter 4: “OPERATING PRINCIPALES” Section “INTEGRATION”).

Note This will only be possible if a rotor has already been selected, the integral value being linked to the ‘g’ force which is calculated from the centrifugation radius of the rotor.

Alternatively, use △▽ to indicate time and enter a value or press HOLD for operation with no time limit.

Selection of ENTER makes a return to the simple programming screen.

To use the modified parameter changes without permanently storing them select END PROG.

During a run controlled by the integrator, the preset value for time will indicate REPROducible, the integral value will count down and the timer will count up the corresponding time.

SAVING AN APPLICATION / PASSWORD PROTECTION

From the simple programming screen select SAVE APPLI (if the flashing curser ▷ is on temperature, it will be necessary to select △▽ to make SAVE APPLI reappear). The application save screen appears, proposing the next available empty memory. If required, use ◁ and ▷ to review other memories whose application program parameter values are indicated at the right hand side of the screen.

Select ENTER to save the application in the indicated file.

The user is offered the opportunity to enter an individual password for this application (accepts 0 to 9999 inclusive, via the keypad, then select ENTER) or to select NONE for no password protection to save the application.

If the user chooses to store his application in a used but unprotected memory, the old values will be replaced by the new values. If he chooses to store his application in a used but protected memory he must first enter the password to gain access, to the memory. In both cases he can password protect the new application.

Note The SAVE APPLI function will only operate if one or more parameter values have been modified.

OVERWRITING PASSWORD PROTECTION / ERASING A PROGRAM

The unit is delivered without any passwords installed. The use of a password prevents easy overwriting of a protected application program.

CAUTION: We suggest that you write down the password in case you forget it.

In the case of problems there is a special procedure to enable the protection to be overridden. This same procedure is used to clear one or more memories to eliminate unwanted applications.

After SAVE APPLI has been selected , the file screen is displayed.

To eliminate the password protection and erase a program use the ◁ and ▷ keys to move to the required memory (closed file icon) and select CE. Use ◁/▷and CE to clear any other memories. Moving the cursor back over selected memories will then show them to be EMPTY as indicated in the right hand side of the screen.

Now either select ESC to return to the standby screen or ENTER to save the modified application in the indicated file memory. The user can decide whether or not to password protect the new protocol which can now be stored in this memory.

TO MODIFY A PROGRAM

A) From the stand-by screen

With an application program on the stand-by screen, select MODIF.

Now alter program parameters exactly as in programming a NEW APPLIcation.

To SAVE select SAVE APPLI from the simple programming screen and continue as under Chapter 5: “INSTRUCTIONS FOR USE” Section “SAVING AN APPLICATION / PASSWORD PROTECTION”. A new memory will be proposed. To save in the original memory (erasing original values) use ◁ or ▷ to move the cursor and enter the password if requested.

B) During a run

From the basic or detailed run display, select MODIFY. The three main control parameters (speed or RCF/ temperature/time or integral) will be displayed together with the current set values.

Use △▽ to move the cursor ▷ to the parameter to be modified and enter the value via the keypad.

Select END MODIF to return to the original run screen. Values modified during a run cannot be stored (such a randomly modified run would be impossible to reproduce) but remain in the volatile memory until the end of the run.

Note It is not possible to modify the integral value during a run.

CONFIGURATION

The Jouan **MR23i** can be configured to operate in set ways. To set up the instrument, select CONFIG from the stand-by screen.

A) Language programming

Having selected CONFIG, the screen highlights LANGUAGE SELECTION then select ENTER.

Select 1 for ENGLISH or 2 for FRENCH.

The stand-by screen will be displayed in the selected language.

B) Selection of refrigeration stand-by

Having selected CONFIG use ▽ to highlight STAND-BY REFRIGERATION ON/OFF then select ENTER.

Choose 1 for active refrigeration during stand-by and 2 for refrigeration OFF during stand-by.

C) Service

A special code, reserve

SAFETY

At any time when the instrument is able to detect and inform the operator of a fault condition the screen will display a special message from among the following.

IMBALANCE: Important vibrations which can damage the accessories, the unit and the samples have been detected. The cause is the bad balancing of the inserts. As soon as the motor stops, open the centrifuge and redistribute the samples to produce an equal weight on diametrically opposite sides of the rotor and, for swing-out rotors, on each side of the trunnion for each bucket.

Using the grease supplied ensure that the trunnions are regularly lubricated removing the old grease first with a clean tissue.

NOTE: Never mix buckets from different sets on the same rotor.

If the message persists, call an engineer.

LID UNLOCKED: Displayed if the lid was not correctly shut. The instrument will inform you to close it correctly in order that it can start the requested run.

TACHOMETER FAILURE: Displayed when an unrealistic speed situation is detected.

For example, if the measured speeds in two sequential measurement steps are very different, or if a power cut occured or if the unit was switched off momentarily during a run, in which case speed would be detected immediately upon switch-on. If speed is readable (certainly true in the later case) its real value will be displayed and in every case a TIME OUT safety lock will be applied, preventing the user from opening the lid for a set period after the speed reaches zero, or at least effects this lock-out period in the case of no detected speed.

MOTOR OVERTEMPERATURE: When using the centrifuge in bad conditions (e.g.: motor failing) a sensor detects an overtemperature in the motor and the run is automatically stopped.

CHAMBER OVERTEMPERATURE: When using the centrifuge in bad conditions or if the refrigeration system is failing, the chamber temperature can seriously increase depending on the speed level and the heat can damage the samples. At 45°C the run is automatically stopped.

Other safety features are also included in the centrifuge. There is no corresponding message but these features ensure safe use of your centrifuge:

- overspeed safety
- current limitation
- armour plating

Chapter 6 HAZARDS, PRECAUTIONS AND LIMITATIONS OF USE

CAUTIONS

- Never try to bypass the lid lock safety while the rotor is spinning.
- Do not try to open the lid until display returns to the stand-by mode shown when machine is switched on.
- Only use correctly grounded mains source.

Special attention is required to the following:

- Installation of the unit : proper ventilation, levelling of the centrifuge.
- Accessory handling : rotor, buckets.
- Rotor installation: check the rotor is locked in position before use (see Chapter 2: “INSTALLATION PROCEDURE” Section “ROTOR INSTALLATION”).
- Cleaning of the accessories, of the rotor chamber, lubrication of the trunnions.
- Centrifuge ware: shape, material and quality of the vessels must be in accordance with the performance of the centrifuge.
- Load balancing.
- Samples: cleaning of the accessories is particularly necessary when using corrosive products in the samples (saline, acids, bases).

ROTOR AND ACCESSORY PRECAUTIONS

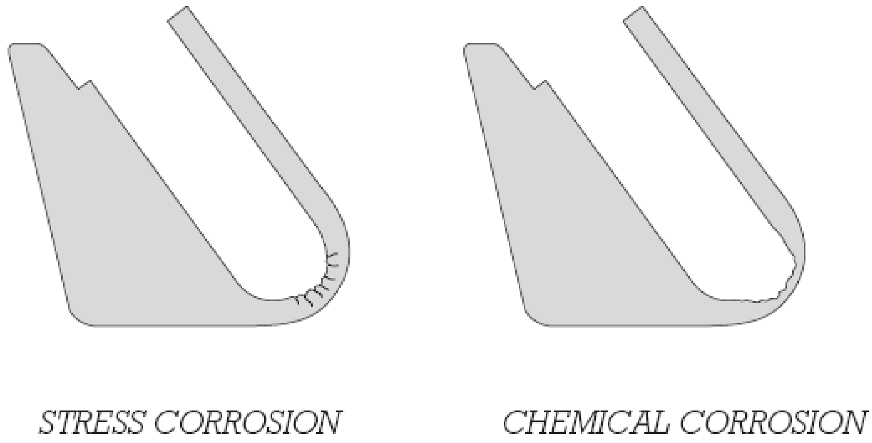
CORROSION INFORMATION

Thermo Fisher Scientific 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.



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. Aluminium is a metal which easily reacts with ionic solutions. Anodisation produces a protective layer on the surface of the rotor.

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.

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.

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.

CONTAMINATION HAZARDS

Our centrifuges are likely to be used in medical research where hazardous substances, including radioactive chemicals, are frequently found (see also Chapter 6: “HAZARDS, PRECAUTIONS AND LIMITATIONS OF USE” Section “BIOLOGICAL RISKS”).

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.

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.

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.

Thermo Fisher Scientific makes no claims as to the effectiveness of proprietary brands of decontaminating solutions.

PREVENTATIVE MAINTENANCE

In the interests of prolonging metallic accessory life it is advisable to smear the pockets with a silicone based grease such as SILICONE GREASE 500 from KF or to use a LANOLIN based grease.

Thermo Fisher Scientific is able to supply cans of Anti Corrosion Spray, catalogue N° 11175399, whose propellant drives out water-based moisture and leaves a protective lanolin film on the surface.

STORAGE OF ROTORS

It is strongly recommended that rotors not in use should be stored upside down on a non-metallic 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 with silicone grease.

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.

S = Satisfactory
D = Discoloration but OK
P = Pure chemical OK
M= Moderate resistance
U = Unsatisfactory
X = Explosion risk !!!
O= No information
d = Less resistance if T > 50°C
t = Unsatisfactory if T >50°C

Chemical / Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO) *	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Acetaldehyde	S	U	U	U	O	O	O	O	M	U	M	M	O	S	S	M	S	U	O
Acetamide	O	O	O	O	O	O	O	O	S	U	S	S	S	O	O	O	O	O	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 (20 %)	S	O	O	O	O	O	O	O	S	M	S	S	S	O	O	O	O	O	O
Acetic Acid (60%)	S	U	U	U	U	S	S	M	S	U	M	D	S	S	S	S	S	U	S

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO) *	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Acetic Acid (80 %)	S	O	O	O	O	O	O	O	S	U	St	S	M	O	O	O	O	O	O
Acetic Acid (Glacial)	S	U	U	U	U	S	O	O	S	U	M	D	M	S	S	S	S	U	S
Acetic Anhydride	S	O	O	O	O	O	O	O	Sd	U	U	Sd	U	O	O	O	O	O	O
Acetone	S	U	U	U	M	M	O	U	S	U	S	M	U	S	S	M	S	U	M
Acetonitrile	O	O	O	O	O	O	O	O	Mt	U	S	Mt	U	O	O	O	O	O	O
Acetylene	S	O	O	O	O	O	O	O	S	O	S	S	U	O	O	O	O	O	O
Adipic Acid	O	O	O	O	O	O	O	O	S	S	St	S	S	O	O	O	O	O	O
Alanine	S	O	O	O	O	O	O	O	S	S	U	S	U	O	O	O	O	O	O
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
Aluminium Hydroxide	S	O	O	O	O	O	O	O	S	Mt	Sd	S	S	O	O	O	O	O	O
Aluminium Nitrate	M	O	O	O	O	O	O	O	S	O	O	S	O	O	O	O	O	O	O
Aluminium Sulphate	S	O	O	O	O	O	O	O	Sd	O	S	Sd	O	O	O	O	O	O	O
Amino Acids	S	O	O	O	O	O	O	O	S	S	S	S	S	O	O	O	O	O	O
Ammonia	S	O	O	O	O	O	O	O	S	U	S	S	Sd	O	O	O	O	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	O	S	S	S	S	S	S	S	O	S
Ammonium Chloride	M	O O	O	O	O	O	O	O	St	O	St	St	O	O	O	O	O	O	O
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 Oxalate	O	O	O	O	O	O	O	O	Sd	S	S	Sd	S	O	O	O	O	O	O
Ammonium Phosphate	U	O	O	O	O	O	O	O	S	M	S	S	O	O	O	O	O	O	O
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
n-Amyl Acetate	S	O	O	O	O	O	O	O	Sd	U	Sd	Sd	U	O	O	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
Amyl Chloride	S	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
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
Barium Chloride	U	O	O	O	O	O	O	O	S	O	S	S	O	O	O	O	O	O	O

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO)*	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Barium Hydroxide	U	O	O	O	O	O	O	O	S	O	S	S	O	O	O	O	O	O	O
Barium Sulphate	S	O	O	O	O	O	O	O	S	O	St	S	O	O	O	O	O	O	O
Benzaldehyde	S	O	O	O	O	O	O	O	Sd	Mt	S	Sd	M	O	O	O	O	O	O
Benzene	S	U	P	O	M	O	O	S	U	U	U	U	U	S	S	S	S	S	M
Benzoic Acid, Sat	St	O	O	O	O	O	O	O	Sd	Sd	S	Sd	M	O	O	O	O	O	O
Benzyl Acetate	O	O	O	O	O	O	O	O	Sd	Mt	S	sD	U	O	O	O	O	O	O
Benzyl Alcohol	S	U	U	O	M	O	O	U	U	U	U	U	O	O	S	S	S	S	O
Boric Acid	U	O	O	O	O	O	O	O	S	U	Sd	S	U	O	O	O	O	O	O
Bromine	U	O	O	O	O	O	O	O	U	Mt	U	U	U	O	O	O	O	O	O
Bromobenzene	U	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Bromoform	U	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Butadiene	S	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Butane	S	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
n-Butanol	S	S	U	O	S	O	O	U	O	M	S	S	M	O	S	S	S	S	S
n-Butyl Acetate	S	O	O	O	O	O	O	O	S	U	S	S	U	O	O	O	O	O	O
Butylene	S	O	O	O	O	O	O	O	O	O	S	O	O	O	O	O	O	O	O
Butyl Chloride	O	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Butyric Acid	S	O	O	O	O	O	O	O	U	Mt	U	U	S	O	O	O	O	O	O
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 Formiate	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 Trifluoracetate	M	O	M	U	O	O	O	O	S	S	S	S	S	M	S	O	O	O	O
Calcium Carbonate	U	O	O	O	O	O	O	O	S	O	St	S	O	O	O	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
Calcium Sulphate	M	O	O	O	O	O	O	O	S	O	St	S	O	O	O	O	O	O	O
Carbazole	O	O	O	O	O	O	O	O	S	U	S	S	U	O	O	O	O	O	O
Carbon Sulphide	S	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Carbon Tetrachloride	X	U	S	S	M	S	O	S	U	U	U	U	S	M	S	S	S	S	S
Cedarwood Essence	O	O	O	O	O	O	O	O	U	St	U	U	M	O	O	O	O	O	O
Chlorine, dry	M	O	O	O	O	O	O	O	St	Sd	St	St	O	O	O	O	O	O	O

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO) *	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Chlorine, moist	U	O	O	O	O	O	O	O	Mt	Sd	St	Mt	O	O	O	O	O	O	O
Chloroacetic Acid	U	O	O	O	O	O	O	O	Sd	Mt	S	Sd	U	O	O	O	O	O	O
p-Chloroacetopheno ne	O	O	O	O	O	O	O	O	S	U	S	S	U	O	O	O	O	O	O
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
Chlorosulphonic	M	O	O	O	O	O	O	O	M	O	M	M	O	O	O	O	O	O	O
Chromic Acid (5 %)	U	O	O	O	O	O	O	O	S	M	S	S	O	O	O	O	O	O	O
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
Cinnamon Essence	O	O	O	O	O	O	O	O	U	St	U	U	M	O	O	O	O	O	O
Citric Acid (10%)	S	S	S	O	M	S	S	M	S	S	S	S	S	S	S	S	S	S	S
Copper Nitrate	U	O	O	O	O	O	O	O	S	O	S	S	O	O	O	O	O	O	O
Copper Sulphate	U	O	O	O	O	O	O	O	S	O	St	S	O	O	O	O	O	O	O
Croesol	S	O	O	O	O	S	O	U	S	U	S	S	O	O	S	M	S	O	O
Cyclohexane	S	O	O	O	O	O	O	O	Mt	Sd	Mt	Mt	U	O	O	O	O	O	O
Cyclohexanol	S	O	U	O	O	O	O	S	S	M	S	S	O	O	S	O	S	O	O
Cyclohexanone	O	O	O	O	O	O	O	O	Mt	U	U	U	U	U	O	O	O	O	O
Cyclopentane	O	O	O	O	O	O	O	O	Mt	U	U	U	U	U	O	O	O	O	O
Decane	O	O	O	O	O	O	O	O	Mt	Mt	Mt	Mt	Sd	U	O	O	O	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
Diacetone Alcohol	S	O	O	O	O	O	O	O	S	O	S	S	O	O	O	O	O	O	O
o-Dichlorobenzene	O	O	O	O	O	O	O	O	Mt	U	Mt	Mt	U	O	O	O	O	O	O
p-Dichlorobenzene	O	O	O	O	O	O	O	O	Mt	U	Mt	Mt	U	O	O	O	O	O	O
Dichloroethane	O	U	U	U	S	O	S	S	U	U	U	U	O	O	S	S	S	S	M
Dichlorophenol	O	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Diethylamine	S	O	O	O	O	O	O	O	St	U	U	St	Sd	O	O	O	O	O	O
Diethyl Benzene	O	O	O	O	O	O	O	O	U	Mt	U	U	U	O	O	O	O	O	O
Diethylene Glycol	S	S	S	S	S	S	O	U	S	S	S	S	S	O	S	S	S	S	S
Diethylene Glycol Ethyl Ether	O	O	O	O	O	O	O	O	S	Mt	S	S	M	O	O	O	O	O	O
Diethyl Ether	S	O	O	O	O	O	O	O	U	U	O	U	O	O	O	O	O	O	O
Diethyl Ketone	S	O	U	U	M	O	O	U	U	U	M	M	O	O	S	M	S	O	M
Dimethylacetamide	O	O	O	O	O	O	O	O	S	U	St	S	U	O	O	O	O	O	O

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO)*	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
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
Diphenyloxide	S	O	O	O	O	O	O	O	U	O	O	U	O	O	O	O	O	O	O
Dipropylene Glycol	O	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O
Distilled Water	S	S	S	S	S	O	S	S	S	S	S	S	S	S	S	S	S	S	S
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
Ethyl Acetate	M	U	U	U	M	S	O	U	M	U	S	U	U	O	S	S	S	U	M
Ethyl Benzene	O	O	O	O	O	O	O	O	Mt	U	St	Mt	U	O	O	O	O	O	O
Ethyl Benzoate	O	O	O	O	O	O	O	O	Sd	M	S	Sd	U	O	O	O	O	O	O
Ethyl Butyrate	O	O	O	O	O	O	O	O	St	U	St	St	U	O	O	O	O	O	O
Ethyl Chloride	S	O	O	O	O	O	O	O	St	U	St	St	U	O	O	O	O	O	O
Ethylene Chloride	S	O	O	O	O	O	O	O	St	U	St	St	U	O	O	O	O	O	O
Ethylene Glycol	S	S	S	S	S	S	O	U	S	S	S	S	S	O	S	S	S	S	S
Ethylene Oxide	O	O	O	O	O	O	O	O	M	Mt	M	M	S	O	O	O	O	O	O
Ethyl Ether	S	O	U	U	O	O	O	O	M	U	M	M	O	O	S	M	S	O	O
Ethyl Lactate	O	O	O	O	O	O	O	O	O	S	St	S	S	M	O	O	O	O	O
Ethyl Malonate	O	O	O	O	O	O	O	O	O	S	Mt	S	S	M	O	O	O	O	O
Fatty Acids	S	O	O	O	O	O	O	O	O	Sd	Sd	Sd	S	O	O	O	O	O	O
Ferric Chloride	U	S	O	O	M	S	S	S	S	O	S	S	O	U	S	S	S	S	S
Ferric Nitrate	M	O	O	O	O	O	O	O	S	O	St	S	M	O	O	O	O	O	O
Ferric Sulphate	S	O	O	O	O	O	O	O	S	O	S	S	O	O	O	O	O	O	O
Ficoll Paque	M	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Fluorine	M	O	O	O	O	O	O	O	Mt	Sd	St	Mt	U	O	O	O	O	O	O
Fluorhydric Acid (10%)	U	U	M	M	U	S	O	S	S	M	S	S	S	U	S	S	U	O	S
Fluorhydric Acid (50%)	U	U	U	U	U	S	O	O	S	U	S	S	M	U	S	S	U	M	U
Formaldehyde (20%)	S	O	O	O	O	O	O	O	S	Sd	S	S	Sd	O	O	O	O	O	O
Formaldehyde (40%)	M	M	O	S	O	S	S	S	S	S	S	D	S	S	S	S	S	S	M
Formaldehyde (50%)	S	O	O	O	O	O	O	O	S	Sd	S	S	Sd	O	O	O	O	O	O
Formic Acid (100%)	S	M	U	O	U	S	S	U	S	M	S	S	O	U	S	S	S	U	S
Freon TF	U	O	O	O	O	O	O	O	Sd	Sd	Sd	Sd	Sd	O	O	O	O	O	O
Fuel Oil	O	O	O	O	O	O	O	O	Sd	Sd	Mt	Sd	Sd	O	O	O	O	O	O
Glucose	S	O	O	O	O	O	O	O	S	O	S	S	O	O	O	O	O	O	O

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO)*	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Glutaraldehyde	O	O	O	O	O	O	O	O	Sd	Sd	S	Sd	Sd	O	O	O	O	O	O
Glycerine	S	O	O	O	O	O	O	O	S	S	S	S	S	O	O	O	O	O	O
Glycerol	S	O	O	S	O	S	S	O	S	S	S	S	S	S	S	S	S	O	O
Heptane	S	O	O	O	O	O	O	O	M	O	S	M	O	O	O	O	O	O	O
Hexane	S	O	O	O	O	O	O	O	S	O	M	S	O	O	O	O	O	O	O
Hydrazine	O	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Hydrochloric Acid (5%)	U	O	O	O	O	O	O	O	S	S	S	S	S	O	O	O	O	O	O
Hydrochloric Acid (37 %)	U	O	O	O	O	O	O	O	Sd	U	S	Sd	S	O	O	O	O	O	O
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
Hydrofluoric Acid (10%)	U	U	M	M	U	S	O	S	S	M	S	S	S	U	S	S	U	O	S
Hydrofluoric Acid (50%)	U	U	U	U	U	S	O	O	S	U	S	S	M	U	S	S	U	M	U
Hydrogen Peroxide (3%)	S	M	S	S	S	O	S	S	S	S	S	D	S	S	S	S	S	S	S
Hydrogen Peroxide (100%)	S	U	S	S	U	O	S	O	S	S	S	D	S	S	S	S	U	M	M
Iodine, Crystals	S	O	O	O	O	O	O	O	Mt	U	U	Mt	U	O	O	O	O	O	O
Isobutyl Alcohol	O	M	U	O	S	O	O	U	S	S	S	S	O	O	S	S	S	S	S
Isopropyl Alcohol	O	M	U	U	S	O	S	U	S	M	S	S	M	O	S	S	S	S	S
Isopropylbenzene	O	O	O	O	O	O	O	O	Mt	U	Mt	Mt	U	O	O	O	O	O	O
Kerosene	S	O	O	O	O	O	O	O	Sd	S	Mt	Sd	St	O	O	O	O	O	O
Lactic Acid (20%)	O	S	O	O	O	O	S	O	S	S	S	S	S	S	S	S	S	S	S
Lactic Acid (100%)	O	S	O	O	O	O	O	O	S	S	S	S	O	S	S	S	S	S	S
Lead Acetate (aq.)	U	O	O	O	O	O	O	O	S	S	St	S	O	O	O	O	O	O	O
Lemon Essence	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Lime, (conc).	M	O	O	O	O	O	O	O	S	U	S	S	S	O	O	O	O	O	O
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
Magnesium Nitrate	M	O	O	O	O	O	O	O	S	O	Sd	S	O	O	O	O	O	O	O
Magnesium Sulphate	S	O	O	O	O	O	O	O	S	O	St	S	O	O	O	O	O	O	O
Manganese Salts	M	O	S	O	O	O	O	O	S	O	S	S	O	O	S	O	S	O	O

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO) *	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Mercury	O	O	O	O	O	O	O	O	S	U	S	S	S	O	O	O	O	O	O
Methanol (100%)	S	S	U	U	M	S	O	U	S	M	S	D	S	S	S	S	S	U	S
Methyl Acetate	S	O	O	O	O	O	O	O	M	U	M	M	U	O	O	O	O	O	O
Methyl Alcohol (100%)	S	S	U	U	M	S	O	U	S	M	S	D	S	S	S	S	S	U	S
Methyl Butyl Ketone	O	O	O	O	O	O	O	O	O	U	O	O	O	O	O	O	O	O	O
Methyl Ethyl Ketone	S	U	U	U	M	M	O	U	S	U	S	S	U	O	S	M	S	U	M
Methyl Isobutyl Ketone	St	O	O	O	O	O	O	O	S	U	S	S	U	O	O	O	O	O	O
Methyl Isopropyl Ketone	O	O	O	O	O	O	O	O	U	U	S	U	U	O	O	O	O	O	O
Methylene Chloride	X	U	U	U	S	S	O	U	U	U	M	U	U	S	S	S	S	M	U
Mineral Oil	O	O	O	O	O	O	O	O	Mt	U	Mt	Mt	Mt	O	O	O	O	O	O
Nickel Chloride	U	O	O	O	O	O	O	O	S	O	St	S	O	O	O	O	O	O	O
Nickel Salts	M	S	S	O	O	O	O	S	S	S	S	S	O	S	S	S	S	S	S
Nickel Sulphate	U	O	O	O	O	O	O	O	S	S	St	S	O	O	O	O	O	O	O
Nitric Acid (10%)	M	U	S	S	U	S	S	M	D	S	S	S	S	D	S	S	S	S	S
Nitric Acid (20%)	U	O	O	O	O	O	O	O	S	Sd	S	S	St	O	O	O	O	O	O
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
Nitric Acid (conc.)	St	O	O	O	O	O	O	O	U	U	Mt	U	U	O	O	O	O	O	O
Nitrobenzene	O	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Octane	O	O	O	O	O	O	O	O	S	Sd	S	S	Sd	O	O	O	O	O	O
Octyl Alcohol	S	O	O	O	O	O	O	O	O	O	S	O	O	O	O	O	O	O	O
Oleic Acid	S	U	S	S	S	S	O	S	S	S	S	S	S	S	S	S	S	M	S
Orange Essence	S	O	O	O	O	O	O	O	Mt	M	Mt	Mt	M	O	O	O	O	O	O
Oxalic Acid	M	M	S	S	O	S	O	S	S	S	S	S	S	S	S	S	M	S	S
Oxygenated Water (20%)	S	O	O	O	O	O	O	O	S	S	S	S	S	O	O	O	O	O	O
Oxygenated Water (50%)	S	O	O	O	O	O	O	O	S	S	S	S	S	O	O	O	O	O	O
Oxygenated Water (90%)	S	O	O	O	O	O	O	O	S	S	S	S	S	O	O	O	O	O	O
Ozone	O	O	O	O	O	O	O	O	Sd	Sd	S	Sd	S	O	O	O	O	O	O
Paraffin	S	O	O	O	O	O	O	O	S	O	S	S	O	O	O	O	O	O	O
Pentane	S	O	O	O	O	O	O	O	U	O	U	U	O	O	O	O	O	O	O
Perchlorethylene	S	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO)*	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Perchloric Acid	X	O	O	O	O	O	O	O	St	U	St	St	U	O	O	O	O	O	O
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
Petrol	S	O	O	O	O	O	O	O	St	M	St	St	M	O	O	O	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
Phenol, crystals	U	O	O	O	O	O	O	O	St	U	St	St	U	O	O	O	O	O	O
Phenol, liquid	U	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	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
Picric Acid	S	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Pine Oil	O	O	O	O	O	O	O	O	Sd	St	St	Sd	M	O	O	O	O	O	O
Potash, conc.	U	O	O	O	O	O	O	O	S	U	S	S	S	O	O	O	O	O	O
Potassium Bromide	U	O	O	O	O	O	O	O	S	S	S	S	O	O	O	O	O	O	O
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 Nitrate	S	O	O	O	O	O	O	O	S	O	S	S	O	O	O	O	O	O	O
Potassium Permanganate	S	O	O	O	O	O	O	O	S	S	S	S	D	O	S	S	O	O	O
Propane Gas	S	O	O	O	O	O	O	O	U	St	U	U	M	O	O	O	O	O	O
Propionic Acid	O	O	O	O	O	O	O	O	Sd	U	M	Sd	S	O	O	O	O	O	O
Propyl Alcohol	S	O	O	O	O	O	O	O	S	O	St	S	O	O	O	O	O	O	O
Propylene Glycol	S	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O
Propylene Oxide	O	O	O	O	O	O	O	O	S	St	S	S	S	O	O	O	O	O	O
Pyridine	U	O	O	O	O	O	O	O	M	U	S	M	O	O	O	O	O	O	O
Resorcinol, Sat'd., Sol	O	O	O	O	O	O	O	O	S	Sd	S	S	U	O	O	O	O	O	O
Rubidium Bromide	M	O	O	O	O	O	O	O	S	S	O	S	O	O	O	O	O	O	O
Saccharose	U	O	O	O	O	O	O	O	S	S	S	S	S	O	O	O	O	O	O

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO)*	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Salycylic Acid, Sat	O	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O
Serum	S	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Silver Acetate	O	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O
Silver Nitrate	U	O	O	O	O	O	O	O	S	S	S	S	S	O	S	S	O	O	O
Sodium Acetate	S	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O
Sodium Bisulphate	M	O	S	S	O	S	S	S	S	S	S	S	O	S	S	O	S	O	O
Sodium Borate	M	O	O	O	O	O	O	O	S	S	Sd	S	O	O	O	O	O	O	O
Sodium Bromide	U	O	O	O	O	O	O	O	S	S	O	S	O	O	O	O	O	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 Iodide	M	O	O	O	O	O	O	O	S	S	O	S	O	O	O	O	O	O	O
Sodium Nitrate	S	O	O	O	O	O	O	O	S	O	Sd	S	O	O	O	O	O	O	O
Sodium Sulfate	S	O	O	O	O	O	O	O	Sd	O	Sd	Sd	O	O	O	O	O	O	O
Sodium Sulphide	S	S	S	O	O	S	O	S	S	U	S	S	O	S	S	S	M	S	S
Stearic Acid	S	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O
Sulphuric Acid (10%)	M	U	S	S	U	S	S	S	S	M	S	S	S	U	S	S	S	S	S
Sulphuric Acid (20%)	U	O	O	O	O	O	O	O	Sd	Sd	S	Sd	S	O	O	O	O	O	O
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
Sulphuric Anhydride, dry or moist	S	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O
Tetrachloroethane	M	O	O	O	O	O	O	O	M	O	O	M	O	O	O	O	O	O	O
Tetrachlorethylene	O	O	O	O	O	O	O	O	U	O	S	U	O	O	O	O	O	O	O
Tannic Acid	M	O	O	O	O	O	O	O	S	O	Sd	S	O	O	O	O	O	O	O
Tartaric Acid	M	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O

Material	Aluminium	Buna N	Cellulose acetate butyrate	Cellulose Nitrate	Delrin	Kynar	Noryl	Nylon	Polyallomer (= PPCO) *	Polycarbonate	Polyethylene	Polypropylene	Polysulfone	Stainless steel	Teflon	Tefzel	Titanium	Viton A	Velox
Tetrahydrofuran	S	O	O	O	O	O	O	O	U	U	U	U	U	O	S	S	O	O	O
Thionyl Chloride	O	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	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
Trichloroacetic Acid	U	O	O	O	O	O	O	O	Mt	Mt	Mt	Mt	S	O	O	O	O	O	O
1,2,4 - Trichlorobenzen	O	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	O	O
Trichloroethane	S	U	S	O	M	S	O	S	U	U	U	U	M	O	S	S	S	S	S
Triethylamine	O	O	O	O	O	O	O	O	U	O	O	U	O	O	O	O	O	O	O
Triethylene Glycol	O	O	O	O	O	O	O	O	S	Sd	S	S	S	O	O	O	O	O	O
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-10	S	O	O	O	O	O	O	O	S	S	S	S	S	O	S	M	O	O	O
Turpentine	S	O	O	O	O	O	O	O	Sd	Mt	St	Sd	U	O	O	O	O	O	O
Undecyl Alcohol	O	O	O	O	O	O	O	O	Sd	Sd	St	Sd	M	O	O	O	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
Vinylidene chloride	O	O	O	O	O	O	O	O	U	U	U	U	U	O	O	O	O	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
Zinc Hydrosulphite	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Zinc Sulphate	U	O	O	O	O	O	O	O	Sd	O	S	Sd	O	O	O	O	O	O	O

*Polypropylene Copolymer

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.

IEC 1010-2-020 STANDARD

The IEC 1010-2-020 standard relative to laboratory centrifuges recommends the user :

- To mark out a clearance envelope 30 cm around the centrifuge or establish special procedures for the non entry of all persons or all dangerous materials into this space during the operation of the centrifuge.
- To provide an emergency stop switch enabling the mains power to be cut in the case of a malfunction. This switch should be placed at a safe distance from the centrifuge, preferably in a different room from that in which the centrifuge is situated.

OPERATIONAL LIMITATIONS

The Jouan **MR23i** 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.

CAUTION: THE Jouan **MR23i** CENTRIFUGE IS NOT EXPLOSION PROOF.

Using this centrifuge with explosive samples is entirely at the user's own risk.

ELECTRICAL

High voltage is present behind the panels of the centrifuge.

DO NOT remove these panels unless the centrifuge has been first disconnected from the power outlet.

IMPROPER USE

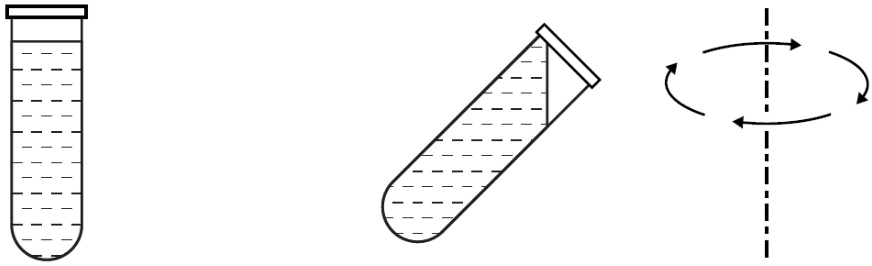
- Use only rotors and accessories designed for use in the Jouan **MR23i** .
- Do not attempt to override the lid interlock assembly.
- Load and lock the rotor only in the recommended way (Chapter 2: "INSTALLATION PROCEDURE" Section "SAMPLE LOADING" and Chapter 2: "INSTALLATION PROCEDURE" Section "ROTOR INSTALLATION"). As the centrifuge starts to spin, an improperly loaded rotor could cause enough force to damage the drive shaft and the rotor chamber.

BIOLOGICAL RISKS

By the action of the turbulence created in the bowl a centrifuge is an aerosol generator. In the case of products presenting a biological risk you must take suitable precautions to prevent or reduce this risk and also train operators in the use of this instrument and its accessories in the context of their applications.

The following information should be given to all users including those persons using the equipment infrequently:

- A ventilated centrifuge (without built-in refrigeration) permanently exhausts into the room air which has passed through its bowl while a refrigerated (or thermostated) centrifuge contains a relatively sealed bowl. Thus the risks from the spread of aerosols are minimised in a refrigerated centrifuge and significant in a ventilated centrifuge.
- Aerosols are produced naturally when using uncapped tubes or bottles. They are also produced when a container deforms or breaks provoking a smaller or greater sample leak. We draw your attention to the use of tubes used in angle rotors. Even if the liquid level does not touch the cap when in a static state, it could do so during centrifugation and leak. You should therefore follow the instructions of the tube supplier concerning the fill level and sealing of the tube.



Once a biological risk is known or suspected, samples should be placed in a sealed container. Should such containers not be available, sealed accessories should be used such as buckets or angle rotors with sealed lids.

- Duration of aerosol presence: when aerosols are created in a centrifuge bowl it persists in the air for a period of 3-5 minutes after the rotor stops moving. Indeed, the action of opening the lid itself provokes the dispersion of aerosols in the environment.
- When an elevated risk of aerosols or of breakage is perceived the accessories should be handled using gloves and opened in an environment ensuring the protection of the operator (safety cabinet, glove chamber, wearing a mask ...), even if they are apparently sealed.

Chapter 7 SERVICING AND PREVENTATIVE MAINTENANCE

CAUTION: All cleaning should be performed with the centrifuge disconnected from the power outlet.

CLEANING

Daily

No daily cleaning is required, except for accidental glass breakage, or a large amount of spillage in the rotor chamber.

Weekly

Clean the rotor chamber and the accessories with a cotton wool pad dipped in 70% alcohol.

The centrifuges are equipped with a drain hose, attached to the chamber to allow flushing of the chamber if necessary. Do not forget to replace the bung in the drain hole in the bowl before the next run.

Note Never use metallic implements to clean anodised buckets.

After cleaning the accessories, always rinse them with clean water and dry.

Ideally, spray with Thermo Fisher Scientific Anti-Corrosion Spray (Cat N°. 11175399).

Lubricate the drive shaft and drive shaft “O” ring with a light oil or silicone spray to prevent sticking.

PERIODIC PREVENTATIVE MAINTENANCE

We suggest you perform the following preventative maintenance measures on your centrifuge:

- Every 60 days, check that the centrifuge can attain the maximum r.p.m. possible for your rotor and accessories, as specified in table of section Chapter 3: “SPECIFICATIONS” Section “PERFORMANCE”.
- Every 60 days, check that rotor chamber air temperature is within 1°C of temperature readout.

CIRCUIT BREAKER

If the main circuit breaker cuts off the power to the instrument, do not attempt to switch on before a service engineer has checked over the unit.

Annex A GUARANTEE TERMS

Thermo Fisher Scientific guarantees that this unit is free from defects in materials and workmanship when it leaves the factory, and undertakes to replace or repair the unit if it proves defective in normal use or during servicing for a period of ONE YEAR from the delivery.

Our liability under this guarantee is limited to repairing the defective unit or any part of the unit providing it is sent, carriage paid, to an authorized service centre or Thermo Fisher Scientific.

This guarantee is invalidated if the unit is incorrectly used, poorly serviced or neglected, mis-used or accidentally damaged.

There is no explicit guarantee other than as stated above.

Annex B Declaration of conformity

Great Britain

WEEE Conformity This product is subject to the regulations of the EU Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96 It is marked by the symbol opposite. Thermo Fisher Scientific has entered into agreements with recycling and disposal companies in all EU Member States for the recycling and disposal of this device. For information on recycling and disposal companies in Germany and on the products of Thermo Fisher Scientific, which fall under the RoHS Directive (Restriction of the use of certain hazardous substances in electrical and electronic equipment), please visit the website www.thermo.com/WEEERoHS

Deutschland

WEEE Konformität. Dieses Produkt unterliegt den Bestimmungen der EU-Richtlinie für Elektro- und Elektronik-Altgeräte (WEEE-Richtlinie 2002/96. Es ist durch das nebenstehende Symbol gekennzeichnet. Thermo Fisher Scientific hat mit Verwertungs- und Entsorgungsbetrieben in allen EU-Mitgliedstaaten Vereinbarungen zur Wiederverwertung oder Entsorgung dieses Gerätes getroffen. Angaben zu Verwertungs- und Entsorgungsbetrieben in Deutschland sowie Informationen zu Produkten von Thermo Fisher Scientific, die unter die RoHS-Richtlinie fallen (engl. Restriction of the use of certain hazardous substances in electrical and electronic equipment: „Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten“), finden Sie im Internet unter www.thermo.com/WEEERoHS

France

Conformité DEEE Ce produit est soumis aux dispositions de la directive UE pour les déchets d’équipements électriques et électroniques (directive DEEE 2002/96. Ceci est caractérisé par le symbole ci-contre. Thermo Fisher Scientific a signé des conventions avec les entreprises de recyclage et d’élimination dans tous les pays membres de l’UE en ce qui concerne le recyclage ou l’élimination de l’appareil. Indications concernant les entreprises de recyclage et d’élimination en Allemagne et informations sur les produits de Thermo Fisher Scientific, qui sont concernés par la directive RoHS (angl. Restriction of the use of certain hazardous substances in electrical and electronic equipment: « Restriction de l’utilisation de certaines substances dangereuses dans les équipements électriques et électroniques »), que vous pouvez consulter sur Internet à l’adresse www.thermo.com/WEEERoHS

España

Conformidad con WEEE. Este producto cumple con las disposiciones de la Directiva europea sobre equipos eléctricos y electrónicos usados (Directiva WEEE 2002/96). Ello se indica con el símbolo al margen. Thermo Fisher Scientific tiene firmados acuerdos con varias empresas de reciclaje y eliminación de residuos de todos los estados miembros de la U.E. respecto a la reutilización y la eliminación de este aparato. Para obtener información sobre las empresas de reciclaje y eliminación de residuos en Alemania, así como sobre los productos de Thermo Fisher Scientific afectados por la Directiva RoHS (del inglés „Restriction of the use of certain hazardous substances in electrical and electronic equipment“ - „Restricción de ciertas sustancias peligrosas en aparatos eléctricos y electrónicos“), visite la página Web www.thermo.com/WEEERoHS

Italia

Conformità RAEE. Questo prodotto è soggetto alle disposizioni della direttiva CE sui rifiuti di apparecchiature elettriche ed elettroniche (Direttiva RAEE 2002/96). È contrassegnato tramite il simbolo a lato. Thermo Fisher Scientific ha preso accordi con aziende per la valorizzazione, smaltimento e trattamento in tutti gli stati membri della UE per il riutilizzo o smaltimento e trattamento di questi dispositivi. Indicazioni su aziende per la valorizzazione, smaltimento e trattamento in Germania così come informazioni su prodotti di Thermo Fisher Scientific, che rientrano sotto la direttiva RoHS (in ingl. Restriction of the use of certain hazardous substances in electrical and electronic equipment: „Restrizione dell’uso di determinate sostanze pericolose negli apparecchi elettrici ed elettronici“), sono disponibili su Internet sotto www.thermo.com/WEEERoHS

Nederland

AEEA-conformiteit. Dit product is voorwerp van de bepalingen van de EU-richtlijn betreffende afgedankte elektrische en elektronische apparatuur (AEEA-richtlijn 2002/96. Dit wordt aangeduid door het symbool hiernaast.Thermo Fisher Scientific is met afvalverwerkende bedrijven in alle EU-Lidstaten overeengekomen om dit apparaat te recyclen of veilig te verwijderen.Gegevens over de afvalverwerkende bedrijven in Duitsland evenals informatie over producten van Thermo Fisher Scientific, die onder de RoHS-richtlijn vallen (engl. Restriction of the use of certain hazardous substances in electrical and electronic equipment: „Beperking van het gebruik van bepaalde gevaarlijke stoffen in elektrische en elektronische apparaten“), vindt u op het Internet terug onder www.thermo.com/WEEERoHS.

Portugal

Conformidade com a Diretiva Européia REEE. Este produto está sujeito às determinações da Diretiva Européia de Resíduos de Equipamentos Elétricos e Eletrônicos (Diretiva REEE 2002/96). Isto é caracterizado pelo símbolo ao lado. Thermo Fisher Scientific A fechou um acordo com todas as empresas de reciclagem e de eliminação de resíduos em todos os Estados-Membros da UE para que o produto seja reciclado ou eliminado. Quaisquer informações sobre as empresas de reciclagem e de eliminação de resíduos na Alemanha, bem como sobre produtos da Thermo Fisher Scientific, que estão sujeitos à Norma RoHS (em inglês: „Restriction of the use of certain hazardous substances in electrical and electronic equipment") „Restrição do Uso de Substâncias Nocivas nos equipamentos elétricos e eletrônicos" podem ser encontradas no site www.thermo.com/WEEERoHS

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Dans les autres pays: Contactez votre concessionaire local des produits **Thermo Fisher Scientific** ou leur representant.

In anderen Ländern: Wenden Sie sich an Ihren örtlichen **Thermo Fisher Scientific** Vertreter.

*E-mail Technical Service Representative for **Thermo Fisher Scientific** brand products at techsupport.led.asheville@thermofisher.com*

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