

# IEC CL31 - CL31R Multispeed User's Manual



Analyze • Detect • Measure • Control™

# IEC CL31 - CL31R Multispeed User's Manual



## IEC CL31 - CL31R Multispeed

Carefully read this manual before operating your instrument.

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The validity of the guarantee is subject to the observation of the instructions and precautions described in this document.

## MANUAL NUMBER

[illegible]

## Packing List

|                          |          |                      |               |
|--------------------------|----------|----------------------|---------------|
| <input type="checkbox"/> | 11210913 | Centrifuge IEC CL31  | 230V 50/60 Hz |
| <input type="checkbox"/> | 11210914 | Centrifuge IEC CL31  | 120V 60 Hz    |
| <input type="checkbox"/> | 11210915 | Centrifuge IEC CL31  | 100V 50/60 Hz |
|                          |          |                      |               |
| <input type="checkbox"/> | 11210917 | Centrifuge IEC CL31R | 230V 50/60 Hz |
| <input type="checkbox"/> | 11210918 | Centrifuge IEC CL31R | 120V 60 Hz    |
| <input type="checkbox"/> | 11210919 | Centrifuge IEC CL31R | 100V 50 Hz    |
| <input type="checkbox"/> | 11210920 | Centrifuge IEC CL31R | 100V 60 Hz    |

| Item number |                                 | Quantity | Check                    |
|-------------|---------------------------------|----------|--------------------------|
|             | Centrifuge                      | 1        | <input type="checkbox"/> |
|             | User manual                     | 1        | <input type="checkbox"/> |
|             | Manual lid opening instructions | 1        | <input type="checkbox"/> |
| 64227001    | Mains cord                      | 1        | <input type="checkbox"/> |
|             | Toolbox:                        |          |                          |
| 11202979    | Rotor removal tool              | 1        | <input type="checkbox"/> |
| 25535010    | Emergency unlocking tool        | 2        | <input type="checkbox"/> |
| 26387032    | Spare fuses (CL31 only)         | 1        | <input type="checkbox"/> |

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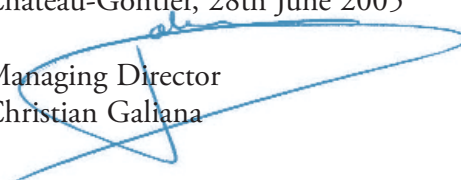


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Château-Gontier, 28th June 2005

Managing Director  
Christian Galiana



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

This guarantee is invalid 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.

# For further information, assistance or service

## **United States of America**

Tel.: +1 800 522 77 46

Fax: +1 866 984 37 66

## **Canada or Latin America**

Tel.: +1 800 522 77 46

Fax: +1 866 984 37 66

## **China (Shanghai)**

Tel.: +86 21 68 65 45 88

Fax: +86 21 6445 7907, +86 21 6445 7830

## **India (Mumbai)**

Tel.: +91 22 5542 9494

Fax: +91 22 5542 9495

## **Japan**

Tel.: +81 454 53 9220

Fax: +81 454 53 9222

## **Other Asia-Pacific Countries**

Tel.: +852 28 85 46 13

## **Austria**

Tel.: +43 (1) 80 14 00

## **France**

Tel.: +33 1 69 18 77 77

+33 2 28 03 20 00

## **Belgium**

Tel.: +32 24 82 30 30

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Tel.: +49 61 84 90 69 40

Fax: +49 61 03 40 81 012

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Tel.: +35 89 32 91 00

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Tel.: +7 09 52 25 11 15

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Tel.: +34 9 32 23 31 54

## **Switzerland**

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## **United Kingdom and Ireland**

Tel.: +44 87 06 09 92 03

## **Other Europe, Middle East, or Africa**

Tel.: +49 61 8490 6940

Tel.: +33 2 2803 2000

## **In Other Countries:**

Contact your local THERMO products distributor or agent.

## **E-mail Technical Service Representative for products at:**

[techsupport.led.asheville@thermo.com](mailto:techsupport.led.asheville@thermo.com)

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## Chapter 1 Use and Function

### User Manual

The user manual is part of the centrifuge, and contains important information for your safety and for the best use of the equipment

Always keep the manual close to the appliance and in a safe place, so that it is always available. Thermo strongly recommends that all users read this manual carefully.

### Warning Symbols

The following symbols are provided to help the operator take advantage of the protection afforded by the equipment and to warn of potential danger.



On the main switch, allows centrifuge to operate. ▲



On the main switch, disconnects the centrifuge from the main power supply. ▲



Only **authorized personnel** can touch the parts close to this symbol and, in any case, only after switching off the main power supply. **Coming in contact with high voltages could cause severe injuries.** ▲



In this manual, this symbol means that you will find important **information for safety**, which if unobserved could result in damage to the appliance and/or harm to the operator. ▲



In this manual, this symbol means that you will find **important information about minimizing biological risk**: if unobserved the result could be harm to the operator. ▲

### Description

The CL31 and CL31R centrifuges are designed for laboratory use.

They will separate the components of fluids into layers of varying density by subjecting them to high forces.

Centrifugal force provided by the centrifuge can also be used to drive solvents and low molecular weight solutes through the membrane of a filtering device. Retained macrosolutes will therefore be found above the membrane.

Relative Centrifugal Force (RCF) generated by a rotor is directly

proportional to its sedimentation useful radius and to the value of its speed squared.

A control system permits the user, through an extremely intuitive control panel, to set and control the speed, the g-force, the temperature (on the thermostated and refrigerated versions) and the run time, as well as to view different messages and warnings.

## Refrigeration Systems

The CL31 is a ventilated unit. A permanent air circulation reduces the heat level in the bowl.

However the temperature in the bowl can reach 10 °C above the ambient temperature after hours of continuous operation.



The CL31R is equipped with a powerful refrigeration system that allows samples to be processed at low temperature. The refrigerant, R134a, is free of CFC (Chloro-Fluoro-Carbons) in accordance with the Montreal Protocol directions for preservation of the ozone layer in the atmosphere.

The actual temperature in the bowl is continuously displayed on the front panel of the centrifuge. Under certain conditions (high speed, long duration runs) the sample temperature can be higher than the bowl temperature on the display. In this case, the user may compensate manually after empirical determination of the temperature differential.

### Condensation drain on refrigerated units

The lid should remain closed when the refrigeration system is in use to avoid condensation.



The centrifuge has a rubber hose that allows condensation to be drained from the bowl. The drain hose exits at the back of the machine. Near the drain hose you can find the following label:

To remove condensation, please follow this procedure:

- Switch off the centrifuge and disconnect the power.
- Put a small basin under the hose.
- Unplug the hose.

- Drain the centrifuge bowl.
- Insert the plug back into the hose.

**Attention** Do not remove the plug from the drain hose during centrifugation. ▲

## Drive System

A three phase brushless motor drives the rotating equipment. The rotor is contained in a sealed, armor plated centrifugation chamber.

The brushless motor requires **no maintenance**. A control system ensures the correct drive speed, which is continuously monitored.

## Safety Interlock System

The CL31 and CL31R centrifuges are equipped with an interlock system that assures two basic safety features:

- The run **cannot be started** if the lid is not correctly closed.
- The centrifuge lid **cannot be opened** if the rotor is running.



Current safety regulations allow the centrifuge lid opening when rotor speed is below a certain defined level (very few rpm). This conditions is therefore not to be considered a fault or risky for the operator. ▲

The centrifuge will not operate until the lid is closed and latched in place.

The lid remains latched until the rotor stops spinning. The lid access lamp indicates when the rotor has stopped: consequently the handle on the right hand side of the centrifuge can be used to open the lid.

If a power failure occurs, access to the samples in the centrifuge is possible via a manual lid opening procedure (see appropriate paragraph). For this operation a special tool (supplied with the centrifuge) is required.



Bypass the interlock system only under emergency conditions as the rotor could still be rotating. ▲

## Imbalance Detection System

The CL31 centrifuge is equipped with a load imbalance detector.

In case of excessive imbalance, the load imbalance indicator LED is illuminated and the brake is applied immediately. The rotor will be decelerated to rest in few seconds.

As soon as the motor stops, open the centrifuge and redistribute the samples to produce an equal weight on diametrically opposite sides.

If the message persists, despite your efforts to balance the load, call your Thermo Service representative.

**Note** Imbalance tolerance depends upon the rotor in use. The centrifuge will tolerate 10 gr. of imbalance with the 4 x 280 mL rotor equipped with standard buckets. Carefully balance the sample load to avoid actuating the imbalance detection system. ▲

## Relative Centrifugal Force

Relative Centrifugal Force (RCF), at the circumference of a rotor and bucket combination, is directly proportional to the speed (r.p.m.) and radius of the rotor. Therefore, a greater r.p.m. and/or a larger radius produces a greater RCF and improved faster separation of substances. The centrifuge control system carries out and displays the results of all calculations related to 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. Use of improper radius will adjust the speed setting, automatically applying the wrong RCF. ▲

### Configuration formule

| 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. ▲

| Primary calculations                                                              | Key sequence (not valid for CASIO, HP)            |
|-----------------------------------------------------------------------------------|---------------------------------------------------|
| RCF (x g) = $1.118 R N^2$                                                         | $N \times x = x 1.118 \times R =$                 |
| Speed (r.p.m.) = $946 \sqrt{\frac{RCF}{R}}$                                       | $RCF \div R = \sqrt{\phantom{x}} \times 946 =$    |
| Radius (mm) = $\frac{RCF}{1.118 N^2}$                                             | $N \times x = x 1.118 = M+ RCF \div MR =$         |
| Transformations                                                                   | Key sequence                                      |
| To determine actual 'g' achieved at a different speed:                            |                                                   |
| $RCF2 = RCF1 \left( \frac{N2}{N1} \right)^2$                                      | $N2 \div N1 = x = x RCF1 =$                       |
| To determine actual speed required to achieve a different 'g' at the same radius: |                                                   |
| $N2 = N1 \sqrt{\frac{RCF2}{RCF1}}$                                                | $RCF2 \div RCF1 = \sqrt{\phantom{x}} \times N1 =$ |
| To determine actual speed required to achieve the same 'g' at a different radius: |                                                   |
| $N2 = N1 \sqrt{\frac{R1}{R2}}$                                                    | $R1 \div R2 = \sqrt{\phantom{x}} \times N1 =$     |

## Chapter 2 Specifications

### Dimensions and Weight

|                          | CL31               | CL31R              |
|--------------------------|--------------------|--------------------|
| Dimensions (HxWxD)       | 375 x 400 x 500 mm | 380x 575 x 620 mm  |
| Packed (HxWxD)           | 600 x 580 x 640 mm | 630 x 730 x 750 mm |
| Weight - uncrated/crated | 40 kg / 52 kg      | 72 kg / 85 kg      |

### Electrical Specifications

|                                  | CL31              | CL31R                      |
|----------------------------------|-------------------|----------------------------|
| Operating Voltage ( $\pm 10\%$ ) | 230 V<br>50/60 Hz | 120 V<br>60 Hz<br>50/60 Hz |
| Operating current (steady)       | 2,8 Arms          | 4,3 Arms                   |
| (acceleration)                   | 5,5 Arms          | 9,5 Arms                   |
| Power max (steady)               | 350 W             | 600 W                      |
| (acceleration)                   | 1000 W            | 1300 W                     |
| Heat dissipation                 | 1195 BTU/h        | 2050 BTU/h                 |

### Performance

|               | CL31  | CL31R |
|---------------|-------|-------|
| Max power     | 500 W | 800 W |
| Average power | 350 W | 550 W |
| Refrigeration |       | 235 W |

| CL31 CL31R                |                                 |                                  |
|---------------------------|---------------------------------|----------------------------------|
| Max speed                 | Swing-out: 4100 rpm             | Angle: 14600 rpm                 |
| Max RCF                   | Swing-out: 3176 xg              | Angle: 23113 xg                  |
| Max capacity              | Swing-out: 4 x 280 ml           | Angle: 6 x 100 ml                |
| Microprocessor controlled |                                 |                                  |
| Display                   | High visibility digital display |                                  |
| Memory size               | 5 programs, direct access       |                                  |
| Program protection        | Recall key lock                 |                                  |
| Speed                     | Range                           | 500 to 14600 rpm                 |
|                           | Step                            | 10 -100 rpm                      |
|                           | Accuracy                        | $\pm 20$ rpm                     |
| Timer                     | Range                           | 30 sec to 99 min + hold position |
|                           | Step                            | 30 sec to 1 min                  |

| <b>CL31 CL31R</b>   |                                          |               |
|---------------------|------------------------------------------|---------------|
| Acceleration rates  | 5                                        |               |
| Braking rates       | 5                                        |               |
| Temperature (CL31R) | Range                                    | -9°C to +40°C |
|                     | Step                                     | 1°C           |
|                     | Accuracy                                 | ± 1.5°C       |
| Typical performance | 4°C at 4 000 rpm, (4 x 280 ml swing-out) |               |
|                     | 1°C at 14 000 rpm, (24 x 1.5 ml angle)   |               |
| Maximum density     | 1.2 g/cm <sup>3</sup>                    |               |
| Maximum energy      | 14 400 J                                 |               |

## Chapter 3 Installation

### Environmental Conditions

General conditions accepted for centrifuge transport and storage are:

- Ambient temperature -20°C to +50°C.
- Relative humidity up to 90%.

General conditions accepted for operating the centrifuge safely are:

- Indoor use.
- Temperature: 5 °C to 40 °C.
- Maximum relative humidity of 85%.
- Maximum altitude: 2000 m
- Installation category: II
- Pollution degree: 2

### Unpacking

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



Thermo strongly recommends that all operators comply with the local laws and regulations on safety and health in the workplace.

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. ▲

- Unpack the centrifuge, carefully removing any possible accessories and the material supplied for ordinary operations and maintenance.
- Check the contents of the package using the packing list provided above.
- Keep the packaging until the centrifuge has been tested and found fully functional.

## Positioning

The machine must be installed in a dust and corrosion free room.



Leave a 30 cm / 12 in. space free on each side of and behind the machine for safety reasons, proper ventilation and maximum cooling performances. ▲

Place the centrifuge on a bench top, which must be rigid, horizontal and sufficiently strong to support the centrifuge's weight and small vibrations.

## Mains Supply

Check mains and frequency: they must correspond to the values shown on the instrument identification label.



For your safety, check that mains wiring is effectively grounded. Thermo declines all responsibility for any damages due to non-grounding of the machine. ▲

Remember that in order to respect the electrical safety standards related to protection 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 circuit breaker of the correct rating complies with this requirement.

## Lid Opening and Rotor Checking

Ensure that the centrifuge has been switched ON. Pull the handle on the centrifuge right side towards the front of the unit : the lid is automatically unlocked and opens.

In the case of a mains power outage, opening of the lid is prevented by the lid lock safety device. It is recommended to wait for the mains power to be switched back on so that this safety device enables the lid to be unlocked (refer to 3.6 for manual lid opening).



Carefully clean the inside of the centrifugation chamber removing any packing residues.

In fact, due to air turbulence, solid particles accidentally left in the centrifugation chamber create excessive wear of the chamber itself and of the outer rotating equipment surface. ▲

### To install the rotor

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 AUTO-LOCK rotor mounting system allows rotors to be placed in any orientation.

## Manual Lid Unlocking Procedure

In the event of mains non-availability or power failure, opening of the lid is prevented by the lid locking safety device. It is recommended that the user waits for the mains to be switched back on so that this safety device enables the lid to be unlocked.

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



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

- The user attempts to manually stop the rotor
- Any object falls inside the centrifugation chamber while the rotor is running. ▲

Manual lid unlocking may be necessary under a very limited number of conditions, such as the urgent recovery of critical samples that could be damaged if left in the centrifuge rotor.

In this case the lid can be opened by using the special tool supplied with the centrifuge.



Always set the power switch to the OFF position before performing this manual procedure, even in the case of a mains power outage. ▲

Should the emergency occur due to power failure during centrifugation wait at least 10 minutes for the end of the rotor rotation. In spite of the absence of noise, the rotor could still be rotating when you need to open the lid manually. Upon opening, lift the lid by hand and observe the rotor (be careful in this operation): if it is still rotating, close the lid and wait.

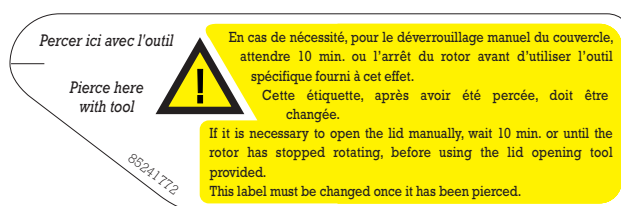


**Figure 1.** Insert the unlocking tool horizontally into the hole on the right hand side of the instrument.



**Figure 2.** While pressing up with your finger, to press down with the unlocking tool, pull the lid lever toward you: the lid opens upwards.

The protection sticker must be replaced after it has been pierced (item N° 85241772).



## Performance and Accessories

**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. ▲

| T41 High Throughput Swing-Out Rotor |                                               |                  |                 |                |                 |                  |             |           |         |
|-------------------------------------|-----------------------------------------------|------------------|-----------------|----------------|-----------------|------------------|-------------|-----------|---------|
| Cat. No                             | Description                                   | Container Volume | Capacity Insert | Capacity Rotor | Max tube ø (mm) | Max tube ht (mm) | Radius (mm) | Max speed | Max RCF |
| 11210435                            | T41 rotating head                             |                  |                 |                |                 |                  |             | 4100      |         |
| 11210436                            | Set of 4 standard buckets                     |                  |                 |                | 77              |                  |             |           |         |
| 11175712                            | Set of 4 sealing lids for 11175711 / 11175763 |                  | -               |                |                 |                  |             |           |         |
| 11175763                            | Set of 4 buckets                              | 5/7 mL vacu      | 15              | 60             | 13.5            |                  | 165         | 4100      | 3101    |
| 11175752                            | Set of 4 buckets                              | 50 mL con        | 4*              | 16*            | 33              | 120              | 169         | 4100      | 3176    |
| 11175759                            | Set of 4 buckets                              | 50 mL con        | 3*              | 12*            | 33              | 120              | 169         | 4100      | 3176    |
|                                     |                                               | Self-Standing    |                 |                |                 |                  |             |           |         |
| 11175713                            | Set of 4 inserts                              | 280 mL           | 1               | 4              | 64              | 113              | 161         | 4100      | 3026    |
| 11175714                            | Set of 4 inserts                              | 250 ml flat      | 1               | 4              | 61              | 112              | 161         | 4100      | 3026    |
| 11175715                            | Set of 4 inserts                              | 200 mL           | 1               | 4              | 55              | 110              | 156         | 4100      | 2932    |
| 11175716                            | Set of 4 inserts                              | 175 ml           | 1               | 4              | 60              | 120              | 166         | 4100      | 3120    |
| 11175717                            | Set of 4 inserts                              | 135 mL           | 1               | 4              | 43              | 121              | 161         | 4100      | 3026    |
| 11175718                            | Set of 4 inserts                              | 110 mL           | 1               | 4              | 40              | 122              | 158         | 4100      | 2969    |
| 11175719                            | Set of 4 inserts                              | 100 mL           | 1               | 4              | 38              | 123              | 161         | 4100      | 3026    |
| 11175720                            | Set of 4 inserts                              | 65 mL            | 2               | 8              | 34              | 104              | 156         | 4100      | 2982    |
| 11175722                            | Set of 4 inserts                              | 50 mL con        | 2               | 8              | 29              | 114              | 134         | 4100      | 2518    |
| 11210348                            | Set of 4 inserts                              | 50 ml Con        | 3*              | 12*            | 29              | 114              | 134         | 4100      | 2518    |
| 11175721                            | Set of 4 inserts                              | 50 mL            | 4               | 16             | 28.5            | 106              | 132         | 4100      | 2481    |
| 11175742                            | Set of 4 inserts                              | AMICON           | 1               | 4              | 28              | 135              | 160         | 4100      | 3007    |
|                                     |                                               | Centriprep       |                 |                |                 |                  |             |           |         |
| 11175723                            | Set of 4 inserts                              | 38 mL            | 5               | 20             | 25.5            | 102              | 157         | 4100      | 2951    |
| 11175724                            | Set of 4 inserts                              | 25 mL            | 5               | 20             | 24              | 104              | 155         | 4100      | 2913    |
| 11175725                            | Set of 4 inserts                              | 25 mL Corex      | 4               | 16             | 24              | 107              | 155         | 4100      | 2913    |
| 11175726                            | Set of 4 inserts                              | 16 mL            | 9               | 36             | 18              | 107              | 160         | 4100      | 3007    |
| 11175727                            | Set of 4 inserts                              | 15 mL Corex      | 12              | 48             | 17              | 107              | 160         | 4100      | 3007    |
|                                     |                                               | 10 mL vacu       |                 |                |                 |                  |             |           |         |
| 11175729                            | Set of 4 inserts                              | 15 mL con        | 7               | 28             | 17              | 107              | 161         | 4100      | 3026    |
| 11175730                            | Set of 4 inserts                              | 15 mL            | 4               | 16             | 17              | 119              | 163         | 4100      | 3063    |
| 11175731                            | Set of 4 inserts                              | 15 mL            | 5*              | 20*            | 17              | 116              | 163         | 4100      | 3063    |
| 11175747                            | Set of 4 inserts                              | 14 mL            | 4               | 16             | 15.5            | 121              | 163         | 4100      | 3063    |
|                                     |                                               | Corning          |                 |                |                 |                  |             |           |         |
| 11175732                            | Set of 4 inserts                              | 13 mL            | 12              | 48             | 16              | 115              | 160         | 4100      | 3007    |
| 11175728                            | Set of 4 inserts                              | 10 mL LP         | 9               | 36             | 16              | 112              | 160         | 4100      | 3007    |
| 11175733                            | Set of 4 inserts                              | 8 mL             | 19              | 76             | 12              | 104              | 161         | 4100      | 3026    |
| 11175734                            | Set of 4 inserts                              | 5 mL RIA         | 19              | 76             | 13              | 104              | 161         | 4100      | 3026    |
| 11175735                            | Set of 4 inserts                              | 3 mL             | 19              | 76             | 11              | 106              | 161         | 4100      | 3026    |
| 11175736                            | Set of 4 inserts                              | 1.5/2 mL         | 13              | 52             | 10              | 42               | 159         | 4100      | 2988    |
| 11175738                            | Set of 4 inserts                              | 15 mL vacu       | 4*              | 16*            | 16              | 124              | 163         | 4100      | 3063    |
| 11175749                            | Set of 4 inserts                              | 7 mL vacu        | 12              | 48             | 12.5            | 106              | 160         | 4100      | 3007    |
| 11175740                            | Set of 4 inserts                              | 5 mL vacu        | 12              | 48             | 12.5            | 75               | 160         | 4100      | 3007    |
| 11175753                            | Set of 2 cytobuckets                          |                  | 3 samples       | 12 samples     | -               | -                | 108         | 4100      | 2030    |

\* in open buckets only

#### S41 Swing-Out Rotor

| Cat. No. | Description             | Capacity                     | Max<br>Tube ø<br>(mm) | Min/Max<br>Tube Ht.<br>(mm) | Radius<br>(mm) | Max Speed<br>(rpm) | Max<br>RCF (xg) |
|----------|-------------------------|------------------------------|-----------------------|-----------------------------|----------------|--------------------|-----------------|
| 11210246 | Swing-out rotor         | 4 x 200 mL                   |                       |                             | 161            | 4100               | 3026            |
| 11175611 | Set of 4 bucket         | 200 mL                       | 57                    |                             | 161            | 4100               | 3026            |
| 11175612 | 4 sealing lids          |                              |                       |                             |                |                    |                 |
| 41193271 | 6 PP bottles with cap   | 200 mL                       | 56.5                  | 90/111                      | 161            | 4100               | 3026            |
| 11174181 | Set of 4 inserts        | 1 x 100 mL                   | 45                    | 80/121                      | 161            | 4100               | 3026            |
| 11174501 | Set of 4 inserts        | 1 x 50 mL flat bottom        | 35                    | 56/123                      | 161            | 4100               | 3026            |
| 11174528 | Set of 4 inserts        | 1 x 50 mL conical            | 30.5                  | 87/123                      | 161            | 4100               | 3026            |
| 11174526 | Set of 4 inserts        | 1 x 25 mL glass universal    | 29                    | 87/124                      | 161            | 4100               | 3026            |
| 11174527 | Set of 4 inserts        | 1 x 25 mL plastic universal  | 25                    | 86/125                      | 161            | 4100               | 3026            |
| 11174502 | Set of 4 inserts        | 3 x 20 mL                    | 22                    | 80/120                      | 161            | 4100               | 3026            |
| 11174537 | Set of 4 inserts        | 3 x 15 mL conical            | 17.5                  | 89/124                      | 161            | 4100               | 3026            |
| 11174183 | Set of 4 inserts        | 7 x 15 mL                    | 17                    | 60/117                      | 161            | 4100               | 3026            |
| 11174509 | Set of 4 inserts        | 3 x 15 mL Vac                | 17.5                  | 79/126                      | 161            | 4100               | 3026            |
| 11174503 | Set of 4 inserts        | 5 x 10 mL Vac                | 16                    | 58/121                      | 161            | 4100               | 3026            |
| 11174534 | Set of 4 inserts        | 5 x Z5/Z10 (5/10 mL)         | 17                    | 42/118                      | 161            | 4100               | 3026            |
| 11174533 | Set of 4 inserts        | 5 x Z5 (5 mL)                | 17                    | 42                          | 161            | 4100               | 3026            |
| 11210764 | Set of 4 inserts        | 7 x 5/7 mL Vac<br>w/Hemogard | 13                    | 58/121                      | 161            | 4100               | 3026            |
| 11174505 | Set of 4 inserts        | 9 x 5/6 mL Vac               | 13.5                  | 60/118                      | 161            | 4100               | 3026            |
| 11175577 | Set of 4 inserts        | 12 x 5 mL open               | 12.5                  | 72/115                      | 161            | 4100               | 3026            |
| 11174506 | Set of 4 inserts        | 12 x 3/5 mL round bottom     | 12                    | 42/116                      | 161            | 4100               | 3026            |
| 11174508 | Set of 4 inserts        | 6 x 1.5/2 mL                 | 11                    | 45/120                      | 161            | 4100               | 3026            |
| 11175613 | Set of 2<br>cytobuckets | 3 cyto samples<br>per bucket |                       |                             | 118            | 4100               | 2218            |

#### T20 High Throughput Rotor

| Cat. No. | Description                                   | Capacity                         | Max<br>Tube ø<br>(mm) | Min/Max<br>Tube Ht.<br>(mm) | Radius<br>(mm) | Max Speed<br>(rpm) | Max<br>RCF (xg) | Angle<br>(deg.) |
|----------|-----------------------------------------------|----------------------------------|-----------------------|-----------------------------|----------------|--------------------|-----------------|-----------------|
| 11175750 | Swing-out rotor<br>with carriers              | 6 x microplates<br>or 2 x blocks |                       |                             | 115            | 4100               | 2160            | 90              |
| 11175631 | 2 sealed carriers                             | 3 plates / 1 block each          |                       |                             |                |                    |                 |                 |
| 11174207 | Rubber cushion for flexible microtiter plates |                                  |                       |                             |                |                    |                 |                 |
| 11210762 | 2 adapters for<br>Cell Culture Flasks         | T-25 and T-75 Falcon® type       |                       |                             |                |                    |                 |                 |

#### AC 15.4 High Throughput Blood Tube Rotor

| Cat. No. | Description | Capacity   | Max<br>Tube ø<br>(mm) | Min/Max<br>Tube Ht.<br>(mm) | Radius<br>(mm) | Max Speed<br>(rpm) | Max<br>RCF (xg) | Angle<br>(deg.) |
|----------|-------------|------------|-----------------------|-----------------------------|----------------|--------------------|-----------------|-----------------|
| 11175755 | Angle rotor | 30 x 15 mL | 17.5                  | 100/120                     | 135            | 4100               | 2537            | 37              |

#### AC 100.10A High Capacity Angle Rotor

| Cat. No. | Description      | Capacity        | Max<br>Tube ø<br>(mm) | Min/Max<br>Tube Ht.<br>(mm) | Radius<br>(mm) | Max Speed<br>(rpm) | Max<br>RCF (xg) | Angle<br>(deg.) |
|----------|------------------|-----------------|-----------------------|-----------------------------|----------------|--------------------|-----------------|-----------------|
| 11210437 | Angle rotor      | 6 x 100 mL      | 38                    |                             | 99             | 10000              | 11066           | 25              |
| -        | directly         | 1 x 94/85/80 mL | 38                    |                             | 99             | 10000              | 11066           |                 |
| 11174713 | Set of 6 inserts | 1 x 50 mL       | 29                    |                             | 93             | 10000              | 10397           |                 |
| 11174714 | Set of 6 inserts | 1 x 50 mL con   | 30                    |                             | 93             | 10000              | 10397           |                 |

## Chapter 3

### Installation

|          |                  |                             |      |    |       |       |
|----------|------------------|-----------------------------|------|----|-------|-------|
| 11174715 | Set of 6 inserts | 1 x 30-38 mL                | 25.5 | 88 | 10000 | 9838  |
| 11174716 | Set of 6 inserts | 1 x 1.5 mL con              | 17   | 93 | 10000 | 10397 |
| 11174717 | Set of 6 inserts | 2 x 10 mL                   | 16   | 83 | 10000 | 9279  |
| 11174718 | Set of 6 inserts | 4 x 1.5-2 mL                | 11   | 79 | 10000 | 8832  |
| 11174724 | Set of 6 inserts | 1 x 30 mL Corex             | 24   | 93 | 10000 | 10397 |
| 11174725 | Set of 6 inserts | 1 x 25 mL Corex             | 24   | 93 | 10000 | 10397 |
| 11174726 | Set of 6 inserts | 1 x 15 mL Corex / Oak Ridge | 18   | 92 | 10000 | 10286 |

#### AC 50.10A High Speed Rotor

| Cat. No. | Description       | Capacity                | Max<br>Tube Ø<br>(mm) | Radius<br>(mm) | Max Speed<br>(rpm) | Max<br>RCF (xg) | Angle<br>(deg.) |
|----------|-------------------|-------------------------|-----------------------|----------------|--------------------|-----------------|-----------------|
| 11175754 | Angle rotor       | 6 x 50 mL con. / round* | 29.5 x 118            | 112            | 10000              | 12520           | 40              |
| 11174606 | Set of 4 adapters | 1 x 15 mL conical       | 17.5 x 111            | 112            | 10000              | 12520           |                 |
| 11177378 | Set of 4 adapters | 1 x 10 mL               | 17 x 75               | 91             | 10000              | 10174           |                 |
| 11174599 | Set of 8 adapters | 1 x 30/32 mL            | 26                    | 105            | 10000              | 11738           |                 |

\* Set of 6 conical to round adapter cushions supplied

#### AC 2.14 Microvolume Rotors

| Cat. No. | Description        | Capacity    | Max<br>Tube Ø<br>(mm) | Radius<br>(mm) | Max Speed<br>(rpm) | Max<br>RCF (xg) | Angle<br>(deg.) |
|----------|--------------------|-------------|-----------------------|----------------|--------------------|-----------------|-----------------|
| 11175741 | Sealed angle rotor | 24 x 1.5 mL | 1 x 39                | 84             | 14600              | 20016           | 45              |
| 11175642 | Spare sealing lid  |             |                       |                |                    |                 |                 |

#### FIBERLite Micro

| Cat. No.  | Description        | Capacity               | Max<br>Tube Ø<br>(mm) | Radius<br>(mm) | Max Speed<br>(rpm) | Max<br>RCF (xg) | Angle<br>(deg.) |
|-----------|--------------------|------------------------|-----------------------|----------------|--------------------|-----------------|-----------------|
| 41174928* | Set of 20 adapters | 1 x 500/800 µL         | 8                     |                | 14600              | 23113           | 45              |
| 11174631* | Set of 20 adapters | 1 x 200 µL PCR         | 6.5                   |                |                    |                 |                 |
| 41174938* | Set of 20 adapters | 1 x 250 / 400 / 700 µL | 6                     |                |                    |                 |                 |

\* Suitable for the AC 2.14 rotor

#### DC 6.11 Microvolume Drum Rotor

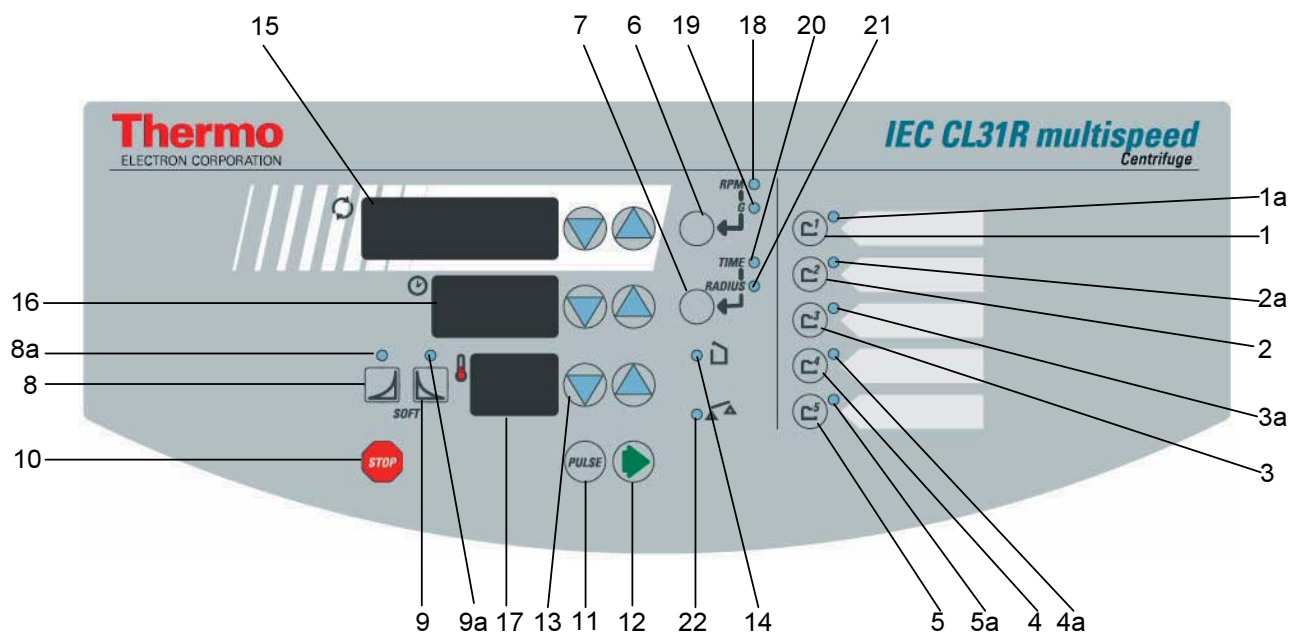
| Cat. No. | Description | Capacity        | Max<br>Tube Ø<br>(mm) | Radius<br>(mm) | Max Speed<br>(rpm) | Max<br>RCF (xg) | Angle<br>(deg.) |
|----------|-------------|-----------------|-----------------------|----------------|--------------------|-----------------|-----------------|
| 11175743 | Drum rotor  | 6 racks*        |                       | 72             | 14600              | 17156           | 90              |
| 11174561 | 1 rack      | 10 x 1.5/2 mL   | 11                    |                |                    |                 |                 |
| 11174573 | 1 rack      | 20 x 500/800 µL | 8                     |                |                    |                 |                 |
| 11174574 | 1 rack      | 20 x 700 µL     | 6                     |                |                    |                 |                 |
| 11174563 | 1 rack      | 21 x 600 µL     | 6                     |                |                    |                 |                 |
| 11174562 | 1 rack      | 32 x 250/400 µL | 6                     |                |                    |                 |                 |

\*Total rotor load is 60, 120, 120, 126 and 192 microtubes.

## Chapter 4 Instructions for Use

### Controls and Indicators

All the controls are located on the front panel. The front panel is an intuitive interface: no previous operational knowledge is necessary; every parameter can be set by pressing the cursor key continuously, from the minimum to the maximum and viceversa. All parameters can be accessed and changed both during operation and while the machine is at rest.



#### Buttons

- 1 - 5 Program Keys
- 6 Speed/RCF Toggle
- 7 Time/Radius Toggle
- 8 Acceleration rate set
- 9 Deceleration rate set
- 10 Stop Run
- 11 Pulse Run
- 12 Start Run
- 13 Temperature set (R only)

#### Display Screens

- 15 Upper Screen: speed/RCF
- 16 Middle Screen: time/radius
- 17 Lower Screen: accel./decel. rates/temp. (R mod.)

#### LED Lights

- 1a Program 1 Indicator
- 2a Program 2 Indicator
- 3a Program 3 Indicator
- 4a Program 4 Indicator
- 5a Program 5 Indicator
- 8a Acceleration Indicator
- 9a Deceleration Indicator
- 14 Lid Opening allowed Indicator
- 18 Speed Indicator
- 19 RCF Indicator
- 20 Time Indicator
- 21 Radius Input Indicator
- 22 Imbalance Indicator

## Display Screens

| Screen                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Upper screen (15)                | This screen displays the set speed (rpm) or RCF (x g) for the given program when the centrifuge is at rest, depending on which parameter is selected. During a run, this screen displays actual speed or RCF.                                                                                                                                                                                                                                                                                                                                                                                            |
| Middle screen (16)               | <p>This screen displays either the set run time or the centrifugal radius when the centrifuge is at rest, depending on which parameter is selected.</p> <p>During a run, this display shows only time remaining (timed runs) or time elapsed (during deceleration, 'hold' runs and 'pulse' runs).</p>                                                                                                                                                                                                                                                                                                    |
| Lower screen (17) on the CL31    | This screen displays either the acceleration or the deceleration profile selected for the given program. The value of the acceleration profile is displayed either during acceleration or when the acceleration set button (8) is pressed. The value of the deceleration profile is displayed either during deceleration or when the deceleration set button (9) is pressed.                                                                                                                                                                                                                             |
| Lower screen (17) on the R units | <p>This screen displays either the acceleration or the deceleration profile selected for the given program. The value of the acceleration profile is displayed either during acceleration or when the acceleration set button (8) is pressed. The value of the deceleration profile is displayed either during deceleration or when the deceleration set button (9) is pressed.</p> <p>In addition, it shows the temperature in the bowl of the centrifuge. When the centrifuge is at rest, the set bowl temperature is displayed (°C). During a run, the actual bowl temperature is displayed (°C).</p> |

## Control Panel Functions

| Function               | Keystroke sequence and description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Start cycle            | Press the start button (12).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Stop cycle, immediate  | Press the stop button (10).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Pulse                  | Press the pulse button (11) and hold. The centrifuge will accelerate the rotor to the speed setting of the active program. When the button is released, the rotor will be decelerated to rest.                                                                                                                                                                                                                                                                                                                                |
| Set speed              | When the LED next to 'RPM' (18) is illuminated, the upper display shows speed values. To increase/decrease the speed values, press on the corresponding up/down arrows.                                                                                                                                                                                                                                                                                                                                                       |
| Set RCF                | <p>When the LED next to 'G' (19) is illuminated, the upper display shows RCF values. To increase/decrease the RCF values, press on the corresponding up/down arrows.</p> <p>When using RCF as a control/display value, make sure the correct centrifugal radius is entered into the control system (see below). If an incorrect radius value is in the control system, the RCF value displayed will not be accurate.</p>                                                                                                      |
| Set run time           | When the LED next to 'TIME' (20) is illuminated, the middle display shows time values. To increase/decrease the run time values, press on the corresponding up/down arrows.                                                                                                                                                                                                                                                                                                                                                   |
| Set centrifugal radius | <p>When the LED next to 'RADIUS' (21) is illuminated, the middle display shows the value of the centrifugal radius in millimeters. To increase/decrease the centrifugal radius, press on the corresponding up/down arrows. This parameter can only be viewed and set while the centrifuge is at rest.</p> <p>It is essential that this value be correct for the RCF control/display function to be accurate. The correct value of the centrifugal radius depends on the combination of rotor/buckets/adapters being used.</p> |

| Function                      | Keystroke sequence and description                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Set acceleration profile      | When the button (8) is pressed, the lower display (17) shows the number corresponding to the acceleration profile currently registered (1 to 5 : 5 being the fastest).<br>To change the value, press the corresponding up/down arrows.                                                                                                                                                                                              |
| Set deceleration profile      | When the button (9) is pressed, the lower display (17) shows the number corresponding to the deceleration profile currently registered (1 to 5 : 5 being the fastest).<br>To change the value, press the corresponding up/down arrows.                                                                                                                                                                                              |
| Set temperature (R only)      | To increase/decrease the temperature set values, press on the corresponding up/down arrows.                                                                                                                                                                                                                                                                                                                                         |
| To pre-program the centrifuge | There are five available memory locations for pre-programmed protocols. Each corresponds to one of the five memory buttons (1-5).<br>To enter/save a program into one of the locations, press the memory button corresponding to the desired program position. The corresponding LED (1a-5a) will be illuminated. While the LED is illuminated, enter the desired parameter values. These values are automatically saved in memory. |
| To lock a program             | To lock a program, press and hold the corresponding button for several seconds until the corresponding LED begins to flash. Release the button, and the program is locked. Parameters of the program cannot be changed.                                                                                                                                                                                                             |
| To unlock a program           | To unlock a program (when a program is locked, the associated LED flashes), press and hold the corresponding button for several seconds until the associated LED stops flashing. Release the button, and the program is unlocked.                                                                                                                                                                                                   |

## Control Panel Indicators

| Indicator                                                                           | Description                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | When the lid interlock indicator LED (14) is illuminated, the lid interlock is not active. The lid can be opened. The indicator will only be illuminated when the rotor is at rest and it is safe to open the lid.<br>When the lid interlock indicator LED is not illuminated, the lid cannot be opened. The rotor is still in motion. This feature is in accordance with international safety standards. |
|  | When the load imbalance indicator LED (13) is illuminated, the centrifuge run has been automatically ended due to excessive load imbalance. The rotor will be decelerated to rest, at which time the lid can be opened and the load can be re-balanced.<br>When the lid is opened this indicator will go off.                                                                                             |

## Description of Certain Events with Respect to the Control System

### Start and acceleration phase

When the start button is pressed, the centrifuge will begin to accelerate the rotor. At this point the run timer will start and the middle display will begin to show remaining run time. The upper display will show either actual speed or actual maximum RCF values, whichever is currently selected. The lower display shows the given acceleration profile, and the LED corresponding to the acceleration button is illuminated.

### Set error

During acceleration, the centrifuge automatically detects the rotor type and, therefore, its maximum allowed speed. If the operator sets a speed exceeding this, the centrifuge stops acceleration when the maximum allowed speed is reached, ensuring the operator's safety. The display will blink and an audible alarm will invite the operator to correct the speed setting to a proper value.

### During the run

During the run, the upper display will show either actual speed or actual maximum RCF values, whichever is currently selected. The middle display will show either remaining time (timed run) or elapsed time ('hold' and 'pulse' runs).

During a run, the middle display will always show time. The user cannot change the display to show the given 'radius' value during a run.

Most set parameters can be changed during a run when the selected program is not locked. Set speed can be changed by selecting speed as the control parameter for the upper display, then by pushing the up or down arrow. Set run time can be changed by pressing the up or down arrow corresponding to the middle display. Set deceleration profile can be changed by first selecting the deceleration profile and then using the up/down arrows.

### Stop and braking (deceleration) phase

When the stop button is pressed (or when the run timer reaches zero), the centrifuge will begin to decelerate the rotor. At this point the run timer will stop and the middle display will begin to show elapsed braking time. The upper display will show either actual speed or actual maximum RCF values, whichever is currently selected. The lower display shows the given deceleration profile, and the LED corresponding to the acceleration button is illuminated.

### End of run

At the end of a run, after the rotor has been decelerated to rest, the centrifuge will produce an audible 'beep' and the middle display will show the word 'End'. Pressing any button or opening the lid will bring the displays back to their normal 'at rest' configuration (display of set parameters).

## Preparing the First Run of the Day

Before installation, the rotor should be thoroughly inspected for evidence of corrosion or other damage and for cleanliness.

Chemical and stress corrosion of metallic parts 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 hole of the rotor and the drive spindle should also be clean and undamaged. These parts should be wiped clean before each use.

The centrifuge also should be observed to verify proper appearance of screws, lid hooks, latches and for evidence of corrosion.



In case of problems contact your Thermo Service representative, because any deviation from the above mentioned advice may have serious consequences for the safety of the appliance and of the operators. ▲



Normal use of the centrifuge could require the manipulation of biohazards. Users and service personnel must have specific training for each substance they use, according to the “Laboratory Biosafety Manual” from the World Health Organization. ▲

## Sample Loading

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

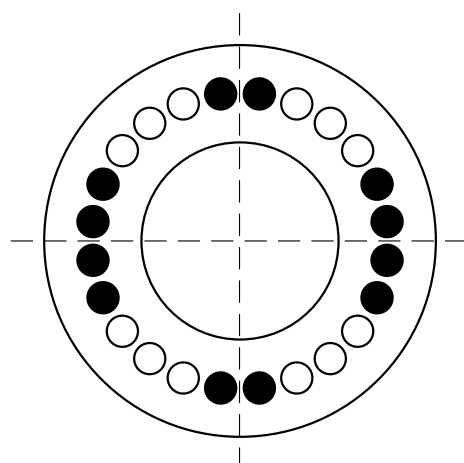


Imbalance of the rotor may cause major damage to the rotor and centrifuge.

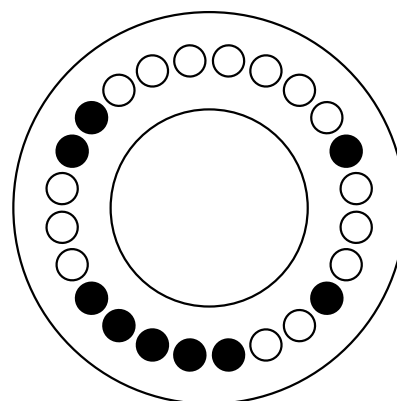
Do not attempt to introduce liquids into rotor pockets or into tubes already in the pockets. ▲

Distribute the load correctly. Loads should be inserted two by two, samples of equal weight, at 180 degrees from the rotation axis and at equal distance (radius) from the center of rotation (see pictures)

When using fixed angle rotor, weight deviation between the tubes must not exceed  $\pm 5$  grams.



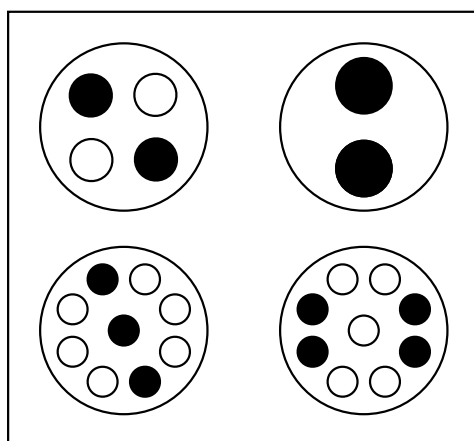
Correct



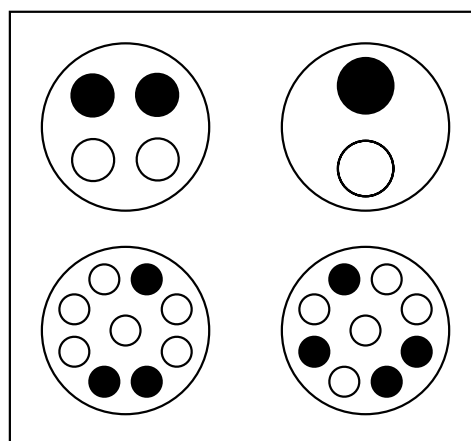
**!** Incorrect

When using a swing-out rotor, the samples are placed in plastic inserts. The load must be statically and dynamically balanced:

- *Static balancing* consists of balancing the weight of the 2 inserts which are in opposite locations in the rotor ( $\pm 8$  to 10 grams).
- *Dynamic balancing* consists of placing the tubes in each insert symmetrically according to the axis of the trunnions.



Dynamic Balancing : Correct



**!** Incorrect

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.

Significant vibrations can damage the accessories, the unit and the samples. Most vibration is caused by incorrect loading of the tubes. For this

reason, the centrifuge is equipped with an imbalance detector. In case of excessive imbalance, the load imbalance indicator LED is illuminated and the brake is applied immediately. The rotor will be decelerated to rest in few seconds.

As soon as the motor stops, open the centrifuge and redistribute the samples to produce an equal weight on diametrically opposite sides.

Also remember that the pins must be softly lubricated. Inadequate lubrication of the pins may cause incorrect swinging of the buckets resulting in imbalance phenomenon. *See chapter 6.6* for details.

If the message persists, despite your efforts to balance the load, call your Thermo Service representative.

## Chapter 5

# Hazards, Precautions and Limitations of Use

### IEC 1010-2-020

This centrifuge conforms to the IEC 1010-2-020 international standard, which specifies particular safety requirements for laboratory centrifuges.

According to the standard warnings, the operator must respect the following precautions:

- Mark a boundary area of 30 cm around the centrifuge.
- No person or hazardous material can stay within this boundary longer than necessary for operational reasons, while the centrifuge is operating.
- An emergency switch for disconnection of the mains, in case of malfunction, has to be available and familiar to all the persons operating the centrifuge. This switch has to be remote from the laboratory centrifuge, preferably outside the room in which the centrifuge is located, or adjacent to the exit from that room.

### Cautions



- Moving or shifting the machine during centrifugation is dangerous.
- Using the centrifuge with rotating equipment showing evidence of corrosion and wear marks, manipulating and/or tampering with the electronic and mechanical parts are dangerous operations.
- Never try to bypass the lid lock safety while the rotor is spinning.
- Do not try to open the lid until the display returns to the stand-by mode.
- Only use a correctly grounded power source.
- Use only rotors and accessories designed for use in these centrifuges. ▲

Pay special attention to the following:

- Installation of the unit: proper ventilation, leveling of the centrifuge, rigidity and stability of the support.
- Rotor installation: verify that the rotor is locked in position before use.
- Cleaning of the accessories and of the rotor chamber is particularly necessary when corrosive products are present in the samples (saline, acids, bases).
- Load balancing.

**If any dangerous event occurs, keep yourself far away from the instrument and switch off the main power source.**

## Speed Control

A view port located on the lid allows the measurement of the actual speed by a phototachometer.

Once a year, check for correct r.p.m. readout and speed control setting which should be within 100 r.p.m. of the actual.

## Operational Limitations

The CL31 centrifuge and its associated rotors offer a high level of RCF performance. In some cases the maximum possible RCF will exceed the one sustainable by the sample container.

The rotor RCF performance displayed is the maximum available in the rotor pockets. Depending on the sample containers or on other application needs, the maximum RCF which must be used is to be determined by the operator.



The centrifuge is not explosion proof. Using this centrifuge with explosive samples is entirely at the user's own risk. Do not under any circumstances use the centrifuge in an explosive environment. ▲

## Aerosol Risks

Due to the action of the turbulence created in the bowl, a centrifuge is an aerosol generator.

A ventilated centrifuge (like the CL31) exhausts, into the room, air which has passed through its bowl. Thus the risk of the spread of aerosols is significant in a ventilated centrifuge.

In the case of samples presenting a biological or chemical risk, the operator must take suitable precautions to prevent or reduce this risk.

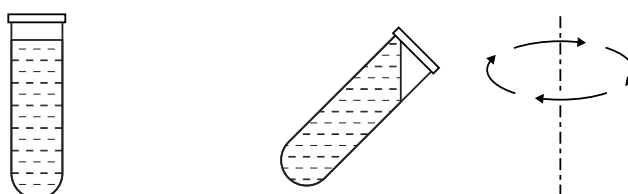


Thermo recommends the use of its sealed buckets, which are certified for bio-containment through worldwide recognized testing procedures performed in recognized external laboratories. ▲

Aerosols are produced naturally when using uncapped tubes or bottles. They are also produced when a container deforms or breaks provoking a small or large sample leak.

We draw your attention to the use of tubes 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 angle rotors with sealed lids.



### Duration of aerosol presence

When aerosols are created in a centrifuge bowl, they persist in the air for a period of 3-5 minutes after the rotor stops moving. Indeed, the action of opening the lid itself causes the dispersion of aerosols into 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. ▲

## Mechanical Risks

### Corrosion Information

Thermo rotors made of aluminium alloy are designed to operate at their rated RCF for many years.

With careful use they will resist corrosion, lowering the possibility of excessive imbalance, disruption and subsequent damage to the instrument. The primary conditions for the initiation 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 characterized by chemical reactions due to the existence of any electrolyte liquid on the surface of the rotating equipment.

If these substances are allowed to remain on the surface the corrosion will almost certainly occur. This produces first a discoloration of the anodization the pitting of the metal.

Acidic and alkaline solutions sustaining their pH level will create problems of corrosion in aluminium equipment. Chlorides, present in salts or even in skin contact with the rotating equipment 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 vapors 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, adapters, 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 with the humidity present in the bottom of the rotor pocket. ▲

**Beware** of the presence of solid particles beneath tubes, inserts, racks or adapters. These particles are crushed by the centrifugal force and penetrate the protective, anodized layer of buckets and rotors, thus creating easy pathways for corrosion. ▲

## **Stress Corrosion**

This term relates to the phenomenon 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 since it is invisible.

During centrifugation, chemicals responsible for corrosion are also submitted to the very high “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.

Fissures or cracks, although it is microscopic, are 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 micro-fissures 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 micro-fissures 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 disruption due to both centrifugal effort and number of cycles.



Because stress corrosion is largely invisible, it is essential that rotating equipment are scrutinized regularly paying particular attention to susceptible parts such as the bottom of pockets, the outer edges and the base of the rotating equipment. ▲

### Contamination Hazard



The user has the responsibility for carrying out appropriate decontamination and elimination of the handled materials. Users should be aware on the internationally recognized “Laboratory Biosafety Manual”, which gives information on decontaminants; their use; dilutions; properties; and potential applications. ▲

If decontamination procedures require the use of warming (i.e. autoclave) the rotating equipment 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 rotating equipment.

**Note** that the black color on the surface of the rotating equipment will be gradually washed out if the rotor is regularly autoclaved or bleached. This does not necessarily denote degradation on the anodization. ▲



Any part, which has been subjected to temperatures above 130°C, must be discarded. ▲



For any other unscheduled cleaning, the customer must contact the manufacturer to verify that the proposed method does not damage the appliance. ▲

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

## Chapter 6 Service and Maintenance



All cleaning operations should be performed with the centrifuge disconnected from the power outlet. ▲

### Periodic Cleaning

#### Daily

No daily cleaning is required, except in the case of accidental tube breakage, or when there is a large amount of spillage in the bowl.

#### Weekly

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

**Never use metallic brushes to clean accessories.**

- After cleaning the accessories, rinse them in running water, preferably distilled water.
- Dry the rotor with a soft absorbent non-woven cloth or tissue. Drying may be finished off with a warm air jet (e.g. a hair dryer).
- Make sure that the pockets are well dried.
- Ideally, spray with Anti-Corrosion Spray (Cat N° 11175399)
- Store unused buckets upside down on a non-metallic grid to allow free passage of air.

### Disinfection

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

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

**Polypropylene components are autoclaveable.**

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 oxidizing agent, is corrosive to metal alloys and must be thoroughly

rinsed off of metal parts and the parts dried. It should never be used if there is surface damage to the rotor.

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.



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.



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:

- Distilled water,
- SDS diluted to 10%,
- Ethanol diluted to 70%.

The rotor should then be rinsed with ethanol followed by distilled water and then dried completely.

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

## Power Supply Circuit Breaker

If the main circuit breaker of the centrifuge cuts off the power to the instrument, do not attempt to switch it on before a Thermo Service representative has checked over the unit.

## Rotor Removal

To remove the rotor from the motor shaft:

Press the unlocking device (stored in the clip on the side of the centrifuge) into the centre of the rotor and then lift out the rotor using both hands. Replace the device in the clip.

Sealed rotors may be removed with the lids still in position and moved to a safety cabinet for manipulation of hazardous material.

## Trunnion Lubrification

This operation is necessary to allow the buckets to swing freely. Clean the trunnions regularly with a dry wipe (as well as the part of the bucket that rotates on the trunnions). Then, put a very small quantity of grease on the curved face of the trunnion. Do not apply too much grease because it will eventually coat the bowl of the centrifuge as centrifugal force pulls the grease from the trunnions.



If the centrifuge is having imbalance problems, try this operation before calling Thermo service. In many cases, imbalance problems arise due to the fact that poorly maintained bucket-trunnion interfaces prevent the buckets from swinging freely. ▲

## Chemical Compatibility Table 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  
d = Less resistance if T > 50°C  
t = Unsatisfactory if T > 50°C

AL = Aluminum  
CAB = Cellulose acetate butyrate  
DL = Delrin  
NO = Noryl  
PA = Polyallomer (= PPCO)  
PE = Polyethylene  
PPCO = Polypropylene Copolymer  
SS = Stainless steel  
TZ = Tefzel  
VA = Viton A

BN = Buna N  
CN = Cellulose Nitrate  
KY = Kynar  
NY = Nylon  
PC = Polycarbonate  
PP = Polypropylene  
PS = Polysulfone  
TF = Teflon  
TI = Titanium

| Chemical                  | Material | AL   | BN | CAB | CN | DL | KY | NO | NY | PA | PC | PE | PP | PS | SS | TF | TZ | TI | VA |
|---------------------------|----------|------|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                           |          | PPCO |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Acetaldehyde              |          | S    | U  | U   | U  | O  | O  | O  | O  | M  | U  | M  | M  | O  | S  | S  | M  | S  | U  |
| Acetamide                 |          | O    | O  | O   | O  | O  | O  | O  | O  | S  | U  | S  | S  | S  | 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  |
| Acetic Acid (20 %)        |          | S    | O  | O   | O  | O  | O  | O  | O  | S  | M  | S  | S  | S  | 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  |
| Acetic Acid (80 %)        |          | S    | O  | O   | O  | O  | O  | O  | O  | S  | U  | St | S  | M  | 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  |
| Acetic Anhydride          |          | S    | O  | O   | O  | O  | O  | O  | O  | Sd | U  | U  | Sd | U  | O  | O  | O  | O  | O  |
| Acetone                   |          | S    | U  | U   | U  | M  | M  | O  | U  | S  | U  | S  | M  | U  | S  | S  | M  | S  | U  |
| Acetonitrile              |          | O    | O  | O   | O  | O  | O  | O  | O  | Mt | U  | S  | Mt | U  | O  | O  | O  | O  | O  |
| Acetylene                 |          | S    | O  | O   | O  | O  | O  | O  | O  | S  | O  | S  | S  | U  | 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  |
| Alanine                   |          | S    | O  | O   | O  | O  | O  | O  | O  | S  | S  | U  | S  | U  | 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  |
| Aluminum Chloride         |          | O    | O  | S   | S  | O  | S  | O  | S  | S  | S  | S  | S  | O  | U  | S  | S  | S  | O  |
| Aluminum Fluoride         |          | O    | O  | O   | O  | O  | S  | O  | S  | S  | U  | S  | S  | O  | O  | S  | O  | S  | O  |
| Aluminum Hydroxide        |          | S    | O  | O   | O  | O  | O  | O  | O  | S  | Mt | Sd | S  | S  | O  | O  | O  | O  | O  |
| Aluminum Nitrate          |          | M    | O  | O   | O  | O  | O  | O  | O  | S  | O  | O  | S  | O  | O  | O  | O  | O  | O  |
| Aluminum Sulphate         |          | S    | O  | O   | O  | O  | O  | O  | O  | Sd | O  | S  | Sd | 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  |
| Ammonia                   |          | S    | O  | O   | O  | O  | O  | O  | O  | S  | U  | S  | S  | Sd | 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  |
| Ammonium Carbonate        |          | S    | U  | S   | S  | O  | S  | O  | S  | S  | U  | S  | S  | S  | S  | S  | S  | S  | O  |
| Ammonium Chloride         |          | M    | O  | O   | O  | O  | O  | O  | O  | St | O  | St | St | 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  |
| Ammonium Hydroxide (conc) |          | O    | U  | U   | O  | O  | O  | O  | S  | D  | U  | S  | D  | O  | S  | S  | S  | S  | U  |
| Ammonium Oxalate          |          | O    | O  | O   | O  | O  | O  | O  | O  | Sd | S  | S  | Sd | S  | 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  |
| Ammonium Sulphate         |          | S    | S  | O   | O  | U  | O  | O  | S  | S  | S  | S  | S  | O  | S  | S  | S  | S  | O  |
| Ammonium Sulphide         |          | O    | O  | O   | O  | O  | S  | O  | O  | S  | U  | O  | S  | O  | O  | S  | O  | O  | O  |
| n-Amyl Acetate            |          | S    | O  | O   | O  | O  | O  | O  | O  | Sd | U  | Sd | Sd | U  | 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  |
| Amyl Chloride             |          | S    | O  | O   | O  | O  | O  | O  | O  | U  | U  | U  | U  | U  | O  | O  | O  | O  | O  |
| Aniline                   |          | S    | O  | O   | O  | O  | S  | O  | O  | U  | O  | S  | M  | O  | O  | S  | S  | S  | O  |

| Material                 | AL   | BN | CAB | CN | DL | KY | NO | NY | PA | PC | PE | PP | PS | SS | TF | TZ | TI | VA |
|--------------------------|------|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Chemical                 | PPCO |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Aqua Regia               | U    | U  | U   | O  | U  | O  | O  | O  | U  | U  | U  | U  | O  | O  | S  | S  | S  | M  |
| Barium Chloride          | U    | O  | O   | O  | O  | O  | O  | O  | S  | O  | S  | S  | O  | O  | O  | O  | O  | O  |
| Barium Hydroxide         | U    | O  | O   | O  | O  | O  | O  | O  | S  | O  | S  | S  | 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  |
| Benzaldehyde             | S    | O  | O   | O  | O  | O  | O  | O  | Sd | Mt | S  | Sd | M  | O  | O  | O  | O  | O  |
| Benzene                  | S    | U  | P   | O  | M  | O  | O  | S  | U  | U  | U  | U  | U  | S  | S  | S  | S  | S  |
| Benzoic Acid, Sat        | St   | O  | O   | O  | O  | O  | O  | O  | Sd | Sd | S  | Sd | M  | 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  |
| Benzyl Alcohol           | S    | U  | U   | O  | M  | O  | O  | U  | U  | U  | U  | U  | O  | O  | S  | S  | S  | S  |
| Boric Acid               | U    | O  | O   | O  | O  | O  | O  | O  | S  | U  | Sd | S  | U  | O  | O  | O  | O  | O  |
| Bromine                  | U    | O  | O   | O  | O  | O  | O  | O  | U  | Mt | U  | U  | U  | O  | O  | O  | O  | O  |
| Bromobenzene             | U    | O  | O   | O  | O  | O  | O  | O  | U  | U  | U  | U  | U  | O  | O  | O  | O  | O  |
| Bromoform                | U    | O  | O   | O  | O  | O  | O  | O  | U  | U  | U  | U  | U  | O  | O  | O  | O  | O  |
| Butadiene                | S    | O  | O   | O  | O  | O  | O  | O  | U  | U  | U  | U  | U  | O  | O  | O  | O  | O  |
| Butane                   | S    | 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  |
| n-Butyl Acetate          | S    | O  | O   | O  | O  | O  | O  | O  | S  | U  | S  | S  | U  | O  | O  | O  | O  | O  |
| Butylene                 | S    | O  | O   | O  | O  | O  | O  | O  | O  | O  | S  | 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  |
| Butyric Acid             | S    | O  | O   | O  | O  | O  | O  | O  | U  | Mt | U  | U  | S  | 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  |
| Caesium Bromide          | M    | O  | O   | O  | O  | O  | O  | O  | S  | S  | S  | S  | S  | O  | S  | S  | O  | O  |
| Caesium Chloride         | M    | O  | S   | S  | O  | O  | O  | O  | S  | S  | S  | S  | S  | S  | S  | S  | S  | O  |
| Caesium Formiate         | M    | O  | O   | O  | O  | O  | O  | O  | S  | S  | S  | S  | S  | O  | S  | S  | O  | O  |
| Caesium Iodide           | M    | O  | O   | O  | O  | O  | O  | O  | S  | S  | S  | S  | S  | O  | S  | S  | O  | O  |
| Caesium Sulphate         | M    | O  | O   | O  | O  | O  | O  | O  | S  | S  | S  | S  | S  | O  | S  | S  | O  | O  |
| Caesium Trifluoroacetate | M    | O  | M   | U  | O  | O  | O  | O  | S  | S  | S  | S  | S  | M  | S  | O  | O  | O  |
| Calcium Carbonate        | U    | O  | O   | O  | O  | O  | O  | O  | S  | O  | St | S  | 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  |
| Calcium Hypochlorite     | M    | U  | O   | O  | M  | S  | O  | S  | S  | M  | S  | S  | S  | U  | S  | O  | S  | S  |
| Calcium Sulphate         | M    | O  | O   | O  | O  | O  | O  | O  | S  | O  | St | S  | 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  |
| Carbon Sulphide          | S    | O  | O   | O  | O  | O  | O  | O  | U  | U  | U  | U  | U  | 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  |
| Cedarwood Essence        | O    | O  | O   | O  | O  | O  | O  | O  | U  | St | U  | U  | M  | 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  |
| Chlorine, moist          | U    | O  | O   | O  | O  | O  | O  | O  | Mt | Sd | St | Mt | 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  |
| p-Chloroacetophenone     | O    | O  | O   | O  | O  | O  | O  | O  | S  | U  | S  | S  | U  | O  | O  | O  | O  | O  |
| Chlorobenzene            | O    | O  | U   | U  | O  | S  | O  | O  | U  | U  | U  | U  | O  | O  | S  | O  | S  | O  |
| Chloroform               | X    | U  | M   | S  | M  | S  | O  | U  | U  | U  | U  | U  | U  | S  | S  | M  | S  | S  |
| Chlorosulphonic          | M    | O  | O   | O  | O  | O  | O  | O  | M  | O  | M  | M  | O  | O  | O  | O  | O  | O  |
| Chromic Acid (5 %)       | U    | O  | O   | O  | O  | O  | O  | O  | S  | M  | S  | S  | U  | 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  |
| Chromic Acid (50%)       | U    | U  | U   | S  | U  | S  | O  | O  | D  | U  | S  | S  | U  | U  | S  | S  | M  | S  |
| Cinnamon Essence         | O    | O  | O   | O  | O  | O  | O  | O  | U  | St | U  | U  | M  | 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  |
| Copper Nitrate           | U    | O  | O   | O  | O  | O  | O  | O  | S  | O  | S  | S  | O  | O  | O  | O  | O  | O  |

| Material                      | AL   | BN | CAB | CN | DL | KY | NO | NY | PA | PC | PE | PP | PS | SS | TF | TZ | TI | VA |
|-------------------------------|------|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Chemical                      | PPCO |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Copper Sulphate               | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | St | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Croesol                       | S    | 0  | 0   | 0  | 0  | S  | 0  | U  | S  | U  | S  | S  | 0  | 0  | S  | M  | S  | 0  |
| Cyclohexane                   | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | Sd | Mt | Mt | U  | 0  | 0  | 0  | 0  | 0  |
| Cyclohexanol                  | S    | 0  | U   | 0  | 0  | 0  | 0  | S  | S  | M  | S  | S  | 0  | 0  | S  | 0  | S  | 0  |
| Cyclohexanone                 | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  |
| Cyclopentane                  | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  |
| Decane                        | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | Mt | Mt | Mt | Sd | 0  | 0  | 0  | 0  | 0  |
| Dextran Sulphate              | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | S  | S  | 0  | 0  |
| Diacetone                     | S    | 0  | U   | 0  | 0  | 0  | 0  | 0  | S  | 0  | S  | S  | 0  | 0  | S  | 0  | S  | 0  |
| Diacetone Alcohol             | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | S  | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| o-Dichlorobenzene             | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | U  | Mt | Mt | U  | 0  | 0  | 0  | 0  | 0  |
| p-Dichlorobenzene             | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | U  | Mt | Mt | U  | 0  | 0  | 0  | 0  | 0  |
| Dichloroethane                | 0    | U  | U   | U  | S  | 0  | S  | S  | U  | U  | U  | U  | 0  | 0  | S  | S  | S  | S  |
| Dichlorophenol                | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Diethylamine                  | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | St | U  | U  | St | Sd | 0  | 0  | 0  | 0  | 0  |
| Diethyl Benzene               | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | Mt | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Diethylene Glycol             | S    | S  | S   | S  | S  | S  | 0  | U  | S  | S  | S  | S  | S  | 0  | S  | S  | S  | S  |
| Diethylene Glycol Ethyl Ether | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Mt | S  | S  | M  | 0  | 0  | 0  | 0  | 0  |
| Diethyl Ether                 | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | 0  | U  | 0  | 0  | 0  | 0  | 0  | 0  |
| Diethyl Ketone                | S    | 0  | U   | U  | M  | 0  | 0  | U  | U  | U  | M  | M  | 0  | 0  | S  | M  | S  | 0  |
| Dimethylacetamide             | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | U  | St | S  | U  | 0  | 0  | 0  | 0  | 0  |
| Dimethylformamide             | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | U  | S  | S  | 0  | 0  | S  | M  | S  | 0  |
| Dimethylsulphoxide            | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | U  | 0  | S  | 0  | S  | S  | M  | S  | 0  |
| Dioxane                       | S    | U  | U   | 0  | M  | S  | 0  | 0  | M  | U  | M  | M  | 0  | 0  | S  | S  | S  | U  |
| Diphenyloxide                 | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | 0  | 0  | U  | 0  | 0  | 0  | 0  | 0  | 0  |
| Dipropylene Glycol            | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Distilled Water               | S    | S  | S   | S  | S  | 0  | 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  |
| Ethanol (95%)                 | S    | S  | U   | U  | M  | S  | S  | U  | S  | U  | S  | S  | S  | S  | S  | S  | S  | S  |
| Ethyl Acetate                 | M    | U  | U   | U  | M  | S  | 0  | U  | M  | U  | S  | U  | U  | 0  | S  | S  | S  | U  |
| Ethyl Benzene                 | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | U  | St | Mt | U  | 0  | 0  | 0  | 0  | 0  |
| Ethyl Benzoate                | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | M  | S  | Sd | U  | 0  | 0  | 0  | 0  | 0  |
| Ethyl Butyrate                | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | St | U  | St | St | U  | 0  | 0  | 0  | 0  | 0  |
| Ethyl Chloride                | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | St | U  | St | St | U  | 0  | 0  | 0  | 0  | 0  |
| Ethylene Chloride             | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | St | U  | St | St | U  | 0  | 0  | 0  | 0  | 0  |
| Ethylene Glycol               | S    | S  | S   | S  | S  | S  | 0  | U  | S  | S  | S  | S  | S  | 0  | S  | S  | S  | S  |
| Ethylene Oxide                | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | M  | Mt | M  | M  | S  | 0  | 0  | 0  | 0  | 0  |
| Ethyl Ether                   | S    | 0  | U   | U  | 0  | 0  | 0  | 0  | M  | U  | M  | M  | 0  | 0  | S  | M  | S  | 0  |
| Ethyl Lactate                 | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | 0  | S  | St | S  | S  | M  | 0  | 0  | 0  | 0  |
| Ethyl Malonate                | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | 0  | S  | Mt | S  | S  | M  | 0  | 0  | 0  | 0  |
| Fatty Acids                   | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | Sd | Sd | Sd | S  | 0  | 0  | 0  | 0  | 0  |
| Ferric Chloride               | U    | S  | 0   | 0  | M  | S  | S  | S  | S  | 0  | S  | S  | 0  | U  | S  | S  | S  | S  |
| Ferric Nitrate                | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | St | S  | M  | 0  | 0  | 0  | 0  | 0  |
| Ferric Sulphate               | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | S  | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Ficoll Paque                  | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | S  | S  | 0  | 0  |
| Fluorine                      | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | Sd | St | Mt | U  | 0  | 0  | 0  | 0  | 0  |
| Fluorhydric Acid (10%)        | U    | U  | M   | M  | U  | S  | 0  | S  | S  | M  | S  | S  | S  | U  | S  | S  | U  | 0  |
| Fluorhydric Acid (50%)        | U    | U  | U   | U  | U  | S  | 0  | 0  | S  | U  | S  | S  | M  | U  | S  | S  | U  | M  |

| Material                  | AL   | BN | CAB | CN | DL | KY | NO | NY | PA | PC | PE | PP | PS | SS | TF | TZ | TI | VA |
|---------------------------|------|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Chemical                  | PPCO |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Formaldehyde (20%)        | S    | O  | O   | O  | O  | O  | O  | O  | S  | Sd | S  | S  | Sd | 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  |
| Formaldehyde (50%)        | S    | O  | O   | O  | O  | O  | O  | O  | S  | Sd | S  | S  | Sd | 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  |
| Freon TF                  | U    | O  | O   | O  | O  | O  | O  | O  | Sd | Sd | Sd | Sd | Sd | 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  |
| Glucose                   | S    | O  | O   | O  | O  | O  | O  | O  | S  | O  | S  | S  | O  | O  | O  | O  | O  | O  |
| Glutaraldehyde            | O    | O  | O   | O  | O  | O  | O  | O  | Sd | Sd | S  | Sd | Sd | O  | O  | O  | O  | O  |
| Glycerine                 | S    | O  | O   | O  | O  | O  | O  | O  | S  | S  | S  | S  | S  | O  | O  | O  | O  | O  |
| Glycerol                  | S    | O  | O   | S  | O  | S  | S  | O  | S  | S  | S  | S  | S  | S  | S  | S  | S  | O  |
| Heptane                   | S    | O  | O   | O  | O  | O  | O  | O  | M  | O  | S  | M  | 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  |
| Hydrazine                 | O    | O  | O   | O  | O  | O  | O  | O  | U  | U  | U  | U  | U  | 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  |
| Hydrochloric Acid (37 %)  | U    | O  | O   | O  | O  | O  | O  | O  | Sd | U  | S  | Sd | S  | 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  |
| Hydrochloric Acid (conc). | U    | U  | U   | O  | U  | O  | O  | O  | S  | U  | O  | S  | O  | U  | S  | S  | S  | O  |
| Hydrofluoric Acid (10%)   | U    | U  | M   | M  | U  | S  | O  | S  | S  | M  | S  | S  | S  | U  | S  | S  | U  | O  |
| Hydrofluoric Acid (50%)   | U    | U  | U   | U  | U  | S  | O  | O  | S  | U  | S  | S  | M  | U  | S  | S  | U  | M  |
| Hydrogen Peroxide (3%)    | S    | M  | S   | S  | S  | O  | S  | S  | S  | S  | S  | D  | 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  |
| Iodine, Crystals          | S    | O  | O   | O  | O  | O  | O  | O  | Mt | U  | U  | Mt | U  | 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  |
| Isopropyl Alcohol         | U    | M  | U   | U  | S  | O  | S  | U  | S  | M  | S  | S  | M  | O  | S  | S  | S  | S  |
| Isopropylbenzene          | O    | O  | O   | O  | O  | O  | O  | O  | Mt | U  | Mt | Mt | U  | O  | O  | O  | O  | O  |
| Kerosene                  | S    | O  | O   | O  | O  | O  | O  | O  | Sd | S  | Mt | Sd | St | 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  |
| Lactic Acid (100%)        | O    | S  | O   | O  | O  | O  | O  | O  | S  | S  | S  | S  | O  | 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  |
| Lemon Essence             | U    | 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  |
| Magnesium Chloride        | M    | O  | O   | O  | O  | O  | O  | O  | S  | S  | S  | S  | S  | O  | S  | S  | O  | O  |
| Magnesium Hydroxide       | U    | O  | U   | O  | O  | S  | S  | O  | S  | U  | S  | S  | O  | O  | S  | O  | S  | O  |
| Magnesium Nitrate         | M    | O  | O   | O  | O  | O  | O  | O  | S  | O  | Sd | S  | 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  |
| Manganese Salts           | M    | O  | S   | O  | O  | O  | O  | O  | S  | O  | S  | S  | O  | O  | S  | O  | S  | O  |
| Mercury                   | O    | O  | O   | O  | O  | O  | O  | O  | S  | U  | S  | S  | S  | 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  |
| Methyl Acetate            | S    | O  | O   | O  | O  | O  | O  | O  | M  | U  | M  | M  | U  | 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  |
| Methyl Butyl Ketone       | 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  |
| Methyl Isobutyl Ketone    | St   | O  | O   | O  | O  | O  | O  | O  | S  | U  | S  | S  | U  | 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  |
| Methylene Chloride        | X    | U  | U   | U  | S  | S  | O  | U  | U  | U  | M  | U  | U  | S  | S  | S  | S  | M  |
| Mineral Oil               | O    | O  | O   | O  | O  | O  | O  | O  | Mt | U  | Mt | Mt | Mt | 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  |
| Nickel Salts              | M    | S  | S   | O  | O  | O  | O  | S  | S  | S  | S  | S  | O  | S  | S  | S  | S  | S  |

| Material                    | AL   | BN | CAB | CN | DL | KY | NO | NY | PA | PC | PE | PP | PS | SS | TF | TZ | TI | VA |
|-----------------------------|------|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Chemical                    | PPCO |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Nickel Sulphate             | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | St | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Nitric Acid (10%)           | M    | U  | S   | S  | U  | S  | S  | M  | D  | S  | S  | S  | S  | D  | S  | S  | S  | S  |
| Nitric Acid (20%)           | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | St | 0  | 0  | 0  | 0  | 0  |
| Nitric Acid (50%)           | M    | U  | M   | M  | U  | S  | S  | M  | D  | M  | M  | M  | 0  | D  | S  | S  | S  | S  |
| Nitric Acid (95%)           | M    | U  | U   | 0  | U  | 0  | 0  | U  | M  | U  | U  | M  | U  | S  | S  | S  | S  | S  |
| Nitric Acid (conc.)         | St   | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | Mt | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Nitrobenzene                | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Octane                      | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | Sd | 0  | 0  | 0  | 0  | 0  |
| Octyl Alcohol               | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  | S  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Oleic Acid                  | S    | U  | S   | S  | S  | S  | 0  | S  | S  | S  | S  | S  | S  | S  | S  | S  | S  | M  |
| Orange Essence              | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | M  | Mt | Mt | M  | 0  | 0  | 0  | 0  | 0  |
| Oxalic Acid                 | M    | M  | S   | S  | 0  | S  | 0  | S  | S  | S  | S  | S  | S  | S  | S  | S  | M  | S  |
| Oxygenated Water (20%)      | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Oxygenated Water (50%)      | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Oxygenated Water (90%)      | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Ozone                       | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | Sd | S  | Sd | S  | 0  | 0  | 0  | 0  | 0  |
| Paraffin                    | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | S  | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Pentane                     | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | 0  | U  | U  | 0  | 0  | 0  | 0  | 0  | 0  |
| Perchlorethylene            | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Perchloric Acid             | X    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | St | U  | St | St | U  | 0  | 0  | 0  | 0  | 0  |
| Perchloric Acid (10%)       | U    | 0  | 0   | 0  | U  | S  | 0  | 0  | S  | U  | M  | M  | 0  | U  | S  | S  | S  | S  |
| Perchloric Acid (70%)       | X    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | M  | U  | M  | M  | U  | 0  | S  | S  | 0  | 0  |
| Petrol                      | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | St | M  | St | St | M  | 0  | 0  | 0  | 0  | 0  |
| Phenol (5%)                 | S    | U  | 0   | 0  | U  | S  | 0  | U  | M  | U  | S  | M  | U  | S  | S  | S  | U  | S  |
| Phenol (50%)                | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | S  | M  | 0  | 0  |
| Phenol, crystals            | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | St | U  | St | St | U  | 0  | 0  | 0  | 0  | 0  |
| Phenol, liquid              | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Phenyl Ethyl Alcohol        | 0    | 0  | U   | 0  | 0  | 0  | 0  | S  | S  | 0  | S  | S  | 0  | 0  | S  | 0  | S  | 0  |
| Phosphoric Acid (10%)       | 0    | M  | S   | S  | U  | S  | S  | 0  | S  | S  | S  | S  | S  | S  | S  | S  | 0  | S  |
| Phosphoric Acid (conc.)     | 0    | U  | M   | M  | U  | S  | 0  | 0  | S  | U  | S  | S  | S  | M  | S  | S  | M  | S  |
| Picric Acid                 | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Pine Oil                    | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | St | St | Sd | M  | 0  | 0  | 0  | 0  | 0  |
| Potash, conc.               | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | U  | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Potassium Bromide           | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Potassium Carbonate         | M    | 0  | S   | S  | 0  | S  | S  | S  | S  | U  | S  | S  | 0  | S  | S  | S  | S  | 0  |
| Potassium Chlorate          | M    | 0  | S   | S  | 0  | S  | S  | S  | S  | S  | S  | S  | 0  | S  | S  | 0  | S  | 0  |
| Potassium Chloride          | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | S  | S  | 0  | 0  |
| Potassium Hydroxide (5%)    | U    | M  | S   | M  | U  | 0  | 0  | S  | S  | U  | S  | S  | S  | S  | S  | S  | M  | S  |
| Potassium Hydroxide (conc.) | U    | M  | U   | U  | U  | 0  | 0  | 0  | S  | U  | S  | S  | 0  | S  | S  | S  | U  | M  |
| Potassium Nitrate           | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | S  | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Potassium Permanganate      | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | D  | 0  | S  | S  | 0  | 0  |
| Propane Gas                 | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | St | U  | U  | M  | 0  | 0  | 0  | 0  | 0  |
| Propionic Acid              | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | U  | M  | Sd | S  | 0  | 0  | 0  | 0  | 0  |
| Propyl Alcohol              | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | St | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Propylene Glycol            | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Propylene Oxide             | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | St | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Pyridine                    | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | M  | U  | S  | M  | 0  | 0  | 0  | 0  | 0  | 0  |
| Resorcinol, Sat'd., Sol     | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | U  | 0  | 0  | 0  | 0  | 0  |

| Material                          | AL   | BN | CAB | CN | DL | KY | NO | NY | PA | PC | PE | PP | PS | SS | TF | TZ | TI | VA |
|-----------------------------------|------|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Chemical                          | PPCO |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Rubidium Bromide                  | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | 0  | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Saccharose                        | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Salicylic Acid, Sat               | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Serum                             | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | S  | S  | 0  | 0  |
| Silver Acetate                    | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Silver Nitrate                    | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | S  | S  | 0  | 0  |
| Sodium Acetate                    | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Sodium Bisulphate                 | M    | 0  | S   | S  | 0  | S  | S  | S  | S  | S  | S  | S  | 0  | S  | S  | 0  | S  | 0  |
| Sodium Borate                     | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | Sd | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Sodium Bromide                    | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | 0  | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Sodium Carbonate (2%)             | M    | S  | S   | S  | S  | S  | S  | S  | S  | S  | S  | D  | 0  | S  | S  | S  | S  | S  |
| Sodium Chloride (10%)             | S    | S  | S   | S  | S  | 0  | 0  | S  | S  | S  | S  | S  | S  | S  | S  | S  | M  | S  |
| Sodium Chloride (Sat'd.)          | S    | S  | 0   | 0  | S  | 0  | 0  | S  | S  | 0  | S  | S  | 0  | S  | S  | S  | S  | S  |
| Sodium Hydroxide (>1%)            | U    | M  | S   | S  | U  | S  | 0  | S  | S  | U  | S  | S  | S  | S  | S  | S  | S  | S  |
| Sodium Hydroxide (10%)            | U    | M  | U   | U  | U  | S  | 0  | S  | S  | U  | S  | S  | S  | S  | S  | S  | S  | S  |
| Sodium Hydroxide (conc.)          | U    | M  | U   | U  | U  | 0  | 0  | 0  | M  | U  | S  | M  | 0  | S  | S  | S  | M  | U  |
| Sodium Hypochlorite (5%)          | M    | M  | S   | S  | U  | S  | S  | S  | D  | S  | S  | S  | S  | M  | S  | S  | S  | S  |
| Sodium Iodide                     | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | 0  | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Sodium Nitrate                    | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | Sd | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Sodium Sulfate                    | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | 0  | Sd | Sd | 0  | 0  | 0  | 0  | 0  | 0  |
| Sodium Sulphide                   | S    | S  | S   | 0  | 0  | S  | 0  | S  | S  | U  | S  | S  | 0  | S  | S  | S  | M  | S  |
| Stearic Acid                      | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Sulphuric Acid (10%)              | M    | U  | S   | S  | U  | S  | S  | S  | S  | M  | S  | S  | S  | U  | S  | S  | S  | S  |
| Sulphuric Acid (20%)              | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | Sd | S  | Sd | S  | 0  | 0  | 0  | 0  | 0  |
| Sulphuric Acid (50%)              | U    | U  | U   | U  | U  | S  | S  | U  | S  | S  | S  | S  | S  | U  | S  | S  | M  | S  |
| Sulphuric Acid (conc.)            | U    | U  | U   | U  | U  | S  | 0  | U  | D  | U  | M  | D  | U  | M  | S  | S  | U  | S  |
| Sulphuric Anhydride, dry or moist | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Tetrachloroethane                 | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | M  | 0  | 0  | M  | 0  | 0  | 0  | 0  | 0  | 0  |
| Tetrachlorethylene                | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | 0  | S  | U  | 0  | 0  | 0  | 0  | 0  | 0  |
| Tannic Acid                       | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | 0  | Sd | S  | 0  | 0  | 0  | 0  | 0  | 0  |
| Tartaric Acid                     | M    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Tetrahydrofuran                   | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | S  | S  | 0  | 0  |
| Thionyl Chloride                  | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Toluene                           | S    | U  | P   | S  | M  | S  | 0  | U  | U  | U  | U  | U  | U  | S  | S  | S  | M  | M  |
| Trichlorethylene                  | S    | U  | 0   | 0  | 0  | S  | 0  | U  | U  | U  | U  | U  | U  | U  | S  | S  | M  | S  |
| Trichloroacetic Acid              | U    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Mt | Mt | Mt | Mt | S  | 0  | 0  | 0  | 0  | 0  |
| 1,2,4 - Trichlorobenzen           | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |
| Trichloroethane                   | S    | U  | S   | 0  | M  | S  | 0  | S  | U  | U  | U  | U  | M  | 0  | S  | S  | S  | S  |
| Triethylamine                     | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | 0  | 0  | U  | 0  | 0  | 0  | 0  | 0  | 0  |
| Triethylene Glycol                | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | Sd | S  | S  | S  | 0  | 0  | 0  | 0  | 0  |
| Tris Buffer (neutral)             | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | S  | S  | 0  | 0  |
| Trisodium Phosphate               | 0    | 0  | S   | 0  | M  | 0  | 0  | S  | S  | 0  | S  | S  | 0  | 0  | S  | S  | S  | S  |
| Triton X-100                      | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | S  | S  | S  | S  | S  | 0  | S  | M  | 0  | 0  |
| Turpentine                        | S    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | Mt | St | Sd | U  | 0  | 0  | 0  | 0  | 0  |
| Undecyl Alcohol                   | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | Sd | Sd | St | Sd | M  | 0  | 0  | 0  | 0  | 0  |
| Urea                              | M    | 0  | S   | S  | S  | 0  | 0  | S  | S  | S  | S  | S  | S  | S  | S  | S  | S  | 0  |
| Urine                             | 0    | 0  | S   | 0  | S  | 0  | 0  | S  | S  | S  | S  | S  | 0  | 0  | S  | S  | S  | 0  |
| Vinylidene chloride               | 0    | 0  | 0   | 0  | 0  | 0  | 0  | 0  | U  | U  | U  | U  | U  | 0  | 0  | 0  | 0  | 0  |

| Chemical           | Material | AL | BN | CAB | CN | DL | KY | NO | NY | PA | PC | PE | PP | PS | SS | TF | TZ | TI | VA |
|--------------------|----------|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| PPCO               |          |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Xylene             |          | S  | U  | P   | O  | M  | S  | O  | U  | U  | U  | U  | U  | U  | S  | S  | S  | S  | S  |
| Zinc Chloride      |          | M  | S  | S   | O  | O  | O  | O  | S  | S  | S  | S  | S  | S  | M  | S  | S  | S  | S  |
| Zinc Hydrosulphite |          | U  | 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  |

\* 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.

## Certificate of Decontamination and Cleaning



Read carefully the instructions below before sending an instrument, or parts of it, to Thermo Service Dept. or to any Authorized Technical Assistance Service. ▲

Mr / Mrs (name) ..... Establishment .....

Department .....

Address ..... Post / Zip code .....

City ..... State / Country .....

### Declares the cleaning and decontamination of the following:

Product type ..... Serial N° .....

Rotor ..... Serial N° .....

Rotor ..... Serial N° .....

Accessory - Description ..... Serial N° .....

Accessory - Description ..... Serial N° .....

### Nature of contamination

.....  
.....

### Decontamination Procedure used

.....  
.....

### Decontamination certified by:

Mr / Mrs ..... Institution .....

Date ..... Signature .....

When an instrument, or parts of it, requires servicing by Thermo personnel, the following procedure must be accomplished to ensure personnel safety:

- Clean the instrument and proceed to its decontamination from any kind of dangerous products.
- Compile this Decontamination Certificate with all the information required.

- Attach this Certificate to the instrument (or part) before sending it to Thermo Service or other authorized technical service.

Thermo personnel will not accept to work on instruments deprived of this Decontamination Certificate.

If an instrument is received at our Service facilities and, in our opinion, is a radioactive or biological hazard, the item will be refused and resent to the Customer. Disposition costs will be borne by the sender.

Instructions for decontamination and cleaning are explained in the User Manual. Additional certificates are available from your local technical or Customer Service representative. In the event these certificates are not available, a written statement certifying that the instrument or part has been properly decontaminated and outlining the procedures used will be acceptable.

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