

Z320 SERVICE MANUAL

(COMMERCIAL MAINTENANCE MANUAL)

4640-01-315-5382



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II-1-6



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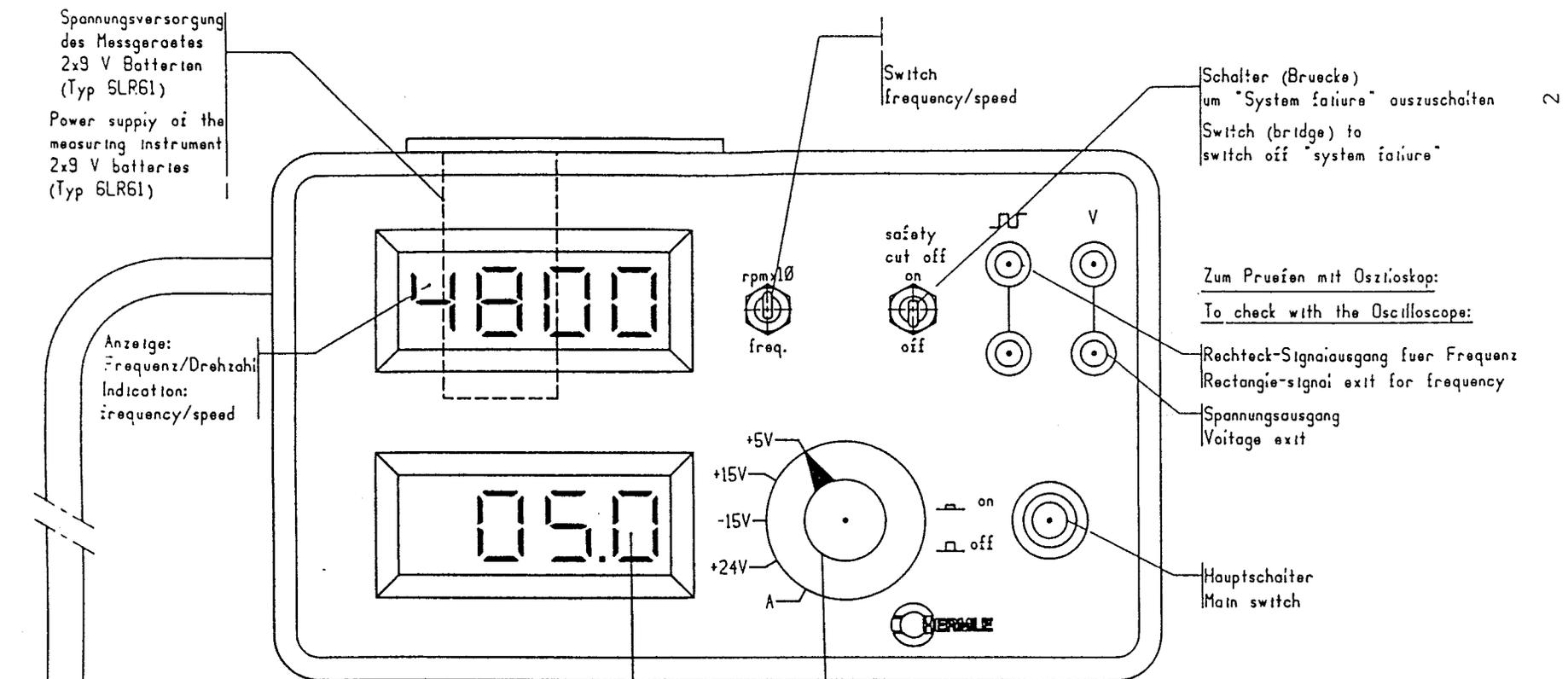
INSTRUCTIONS FOR ADJUSTMENT

Under normal operating conditions, there should be no need for the operator to perform any internal adjustments. However, the following aspects of performance may be checked:

| | |
|---|-------------------------|
| Maximum speed..... | 2900 RPM |
| Time required to reach maximum speed..... | less than 90 seconds |
| Deceleration time (full braking)..... | less than 90 seconds |
| *Tachometer accuracy..... | 100 RPM |

If any of the above performance characteristics are found to be lacking, they may be readjusted via potentiometers on the main circuit board as described in sections A and B of this chapter.

* Requires use of additional external equipment, as set forth in section B4 of this chapter. This test should be performed every year or 3.



Spannungsversorgung
des Messgeraetes
2x9 V Batterien
(Typ SLR61)
Power supply of the
measuring instrument
2x9 V batteries
(Typ 6LR61)

Anzeige:
Frequenz/Drehzahl
Indication:
frequency/speed

Anzeige: Spannung/Strom
Indication: Voltage/current

Switch
frequency/speed

Schalter (Bruecke)
um "System failure" auszuschalten
Switch (bridge) to
switch off "system failure"

Zum Pruefen mit Oszilloskop:
To check with the Oscilloscope:

Rechteck-Signalausgang fuer Frequenz
Rectangle-signal exit for frequency

Spannungsausgang
Voltage exit

Hauptschalter
Main switch

Illustration #1

HERMLE DIAGNOSIS MEASURING INSTRUMENT

- Wahlschalter fuer interne Betriebsspannungen/-strom der Regeikarte:
 * +5V,+15V,-15V (stabilisierte Spannungen, Toleranz ±5%)
 * +24V (nicht stabilisiert)
 * A - Strom (Ampere)
 Turning switch for internal working voltage of the PC board:
 * +5V,+15V,-15V (stabilized power tolerance ±5%)
 * +24V (not stabilized)
 * A - Circuit (Ampere)

Service-Stecker
(zur Servicebuchse vom Gerat)
Service plug
(for the service socket of the centrifuge)



Service manual Z 320

**Remarks to the following instructions of
adjustment**

Version A

If a Hermle diagnosis - measuring instrument with
corresponding adapter is available with you

Version B

With a recommended measuring instrument like

Fluke 75 Multimeter

Soar : Digital Multimeter

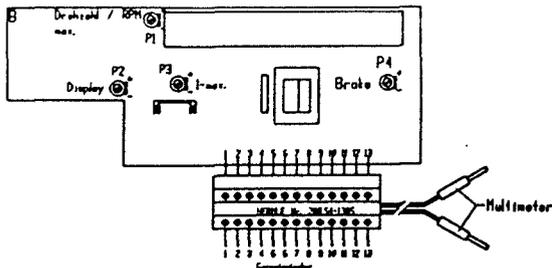
D2M2 series model 4050

with Hermle adapter No. 200.S4-1385

and external speed measuring instrument

PC Board HE 85.00.03 (Z320)

Illustration #2



see next page

1. Connect the centrifuge to the measuring instrument by means of the adapter.

Set all potentiometers "P1-P4" to the left limit position

A. With Hermle diagnosis measuring instrument and adapter

Set the following on the measuring instrument:

- Set switch "rpm x 10 - freq" to position "rpm x 10"
- Safety cut off: as you like (No function)
- Set switch +5V , +15V etc. to position A
- Switch on the measuring instrument

A2. Adjustment of the motor current: Potentiometer P3 = 1 max:

- Lock the motor by means of the Hermle clamping device
- for centrifuges upto serial no..... "motor shaft without driving pin" see supplementary page in the appendix.
- Close the Lid
- Set the knob "speed" to position 10
- Start the Centrifuge by means of the timer
- Wait for abt. 5 sec.
- Set the current to 1.2 Ampere
- Switch off the centrifuge and remove the clamping device

Attention:

If the motor is locked too long, there is danger of overheating

Recommended measuring instruments:

Hermle diagnosis- measuring instrument with adapter or alternatively
Fluke 75 Multimeter

Soar : Digital Multimeter
D2M2 series model 4050
with Hermle adapter no. 200.S4-1385

Note:

Compare to layout diagram no. S 230

ATTENTION !

To avoid any short circuit, as well as any damage on the PCB, use a suitable insulated screwdriver.

DIN 7457 2.5 x 75 mm
or a insulated electronic adjustment screwdriver (for example of (Messrs. "Spectrol")

Inner Chamber - Z320

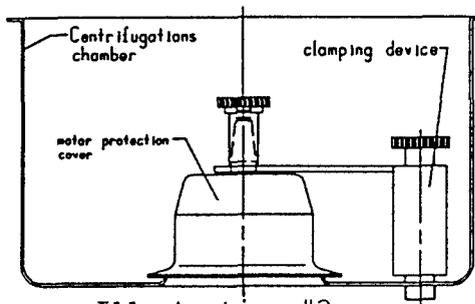


Illustration #3

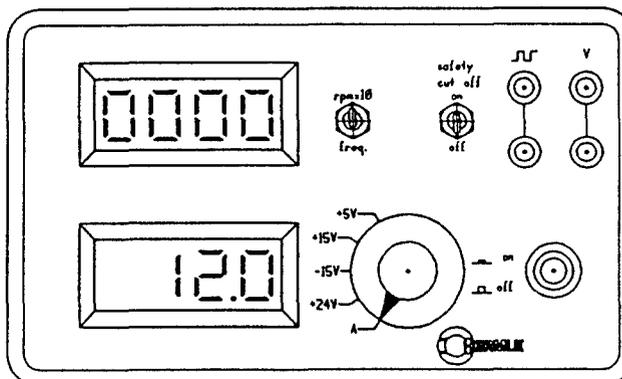


Illustration #4 Hermle Diagnosis Instrument

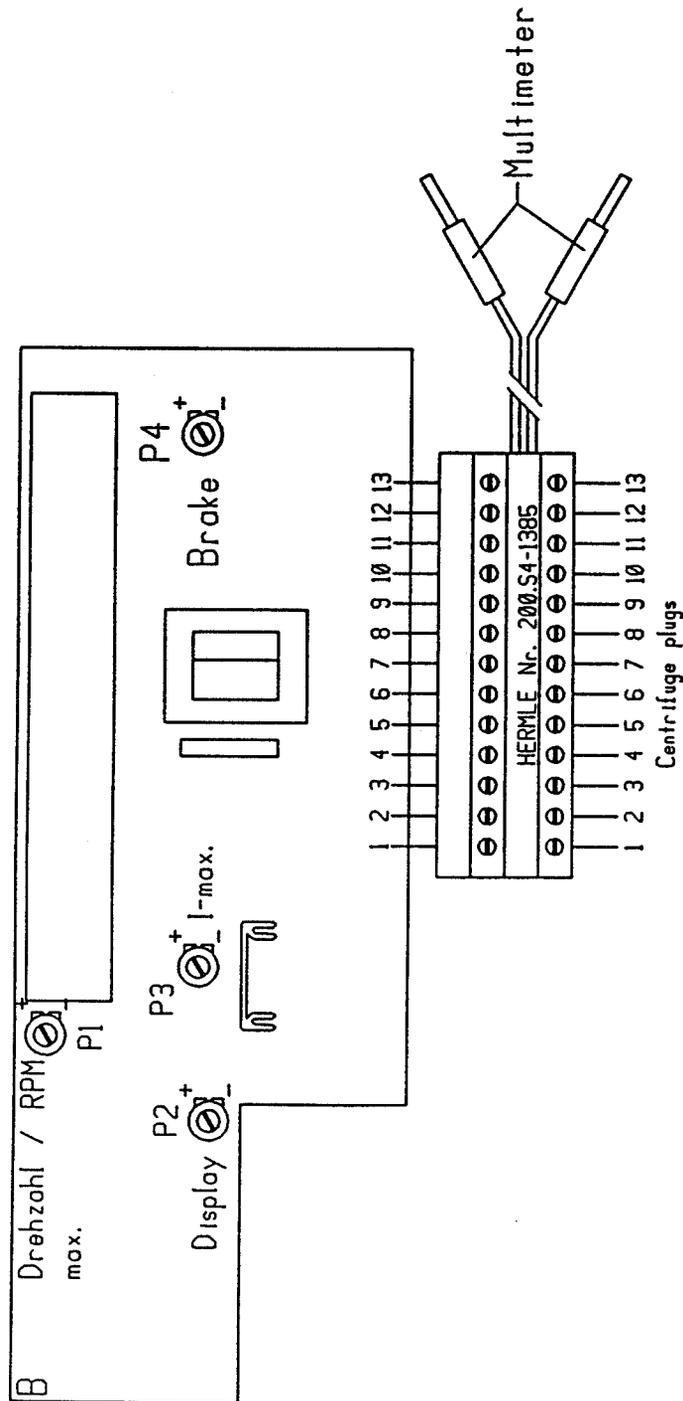
The Hermle measuring instrument shows now 10 times the value of the current. Adjust the centrifuge until the measuring instrument indicates 12.0 .

Upon adjustment of the current value, please take care that the run-up barrier is overcome.

Pay attention to exact adjustment 1.2 Ampere.

Schematic Diagram of the PC Board
- PC Board HE 85.00.03 (Z320) -

Illustration #5



A3. Adjustment of the speed limit Potentiometer P1 = n max.

- Speed limit has to be adjusted to 10 000 rpm by means of potentiometer P1
 - Place rotor 220.45 V01 in the centrifuge.
 - Close the lid
 - Set the speed to position 10 on the scale (front panel)
 - Start the centrifuge
 - Adjust the centrifuge with potentiometer P1 in such a way that the measuring instrument shows you 1000 - 1002 .
- This corresponds to an actual maximum speed of 10 000 - 10 020 rpm.

A4. Adjustment of the digital indication Potentiometer P2 - Range - Adjust.

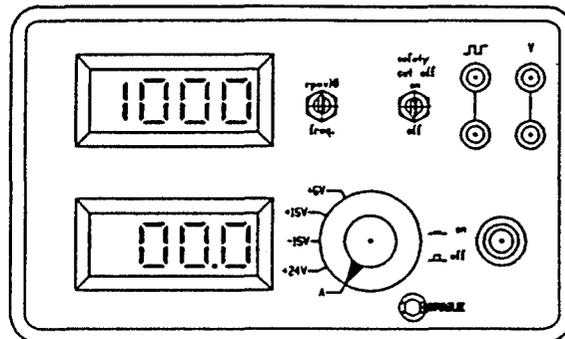
- After adjustment of the speed limit to 10 000 rpm, (described in A3) adjust the digital indication by means of potentiometer P2 in such a way that the measured actual speed is equal to the speed indicated by the digital indication.

A5. Adjustment of the braking current Potentiometer P4 Brake

- Place the heaviest rotor in the centrifuge.
- Close the lid
- Set the speed and the braking intensity to position 10 on the scale (front panel).
- Start the centrifuge with the timer .
- When the rotor has reached its maximum speed, set the timer back to "0" and adjust the braking current to 300 mA with the potentiometer P4.
- Switch off the centrifuge, unplug the power cord.

- If the respective rotor is not available, proceed as described, but without rotor.

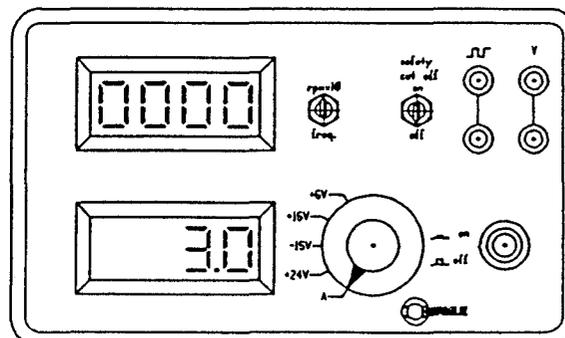
Illustration #6
Hermle Diagnosis Instrument



Attention :

Take care that the turning switch is in the correct position: rpm x 10.

Illustration #7
Hermle Diagnosis Instrument



The Hermle measuring instrument indicates you now 10 times the value of the current. Adjust the centrifuge until the measuring instrument indicates 3.0 .

A5. Adjustment of the braking current Potentiometer P4 Brake

- Place the heaviest rotor in the centrifuge.
- Close the lid
- Set the speed and the braking intensity to position 10 on the scale (front panel).
- Start the centrifuge with the timer .
- When the rotor has reached its maximum speed, set the timer back to "0" and adjust the braking current to 300 mA with the potentiometer P4.
- Switch off the centrifuge, unplug the power cord.

Final adjustments as described under A6 and A7.

A6. Seal all potentiometers with sealing lacquer.

- Remove the measuring adapters.
- Test run.

A7. Adjustment of the imbalance switch off:

- Turning the adjustment screw clockwise, makes the imbalance switch off more sensible.
- Turning the adjustment screw counter-clockwise, makes the imbalance switch off less sensible.

Table #1

Adjustment of imbalance with a liquid

| rotor no. | switch off at | does still not switch off at |
|------------|---------------|------------------------------|
| 220.72 V01 | 20 gr. | 15 gr. |
| 220.36 V01 | 16 gr. | 13 gr. |
| 220.37 V01 | 2 x 8 gr. | 2 x 6 gr. |
| 220.42 V01 | 9 gr. | 7 gr. |

Note:

How to settle the imbalance indication

If the centrifuge switches off due to imbalance, this is indicated by a blinking of the digital indication.

When the rotor is stationary, open the lid and close it again. this settles the imbalance indication.

Note :

At the values indicated in the column " does still not switch off at " the centrifuge should maintain normal operation

At the values indicated in the column "switch off at" the centrifuge should - if correctly adjusted - switch off upon reaching a speed of 200-400 rpm.

Illustration #8
View of Z320 Motor

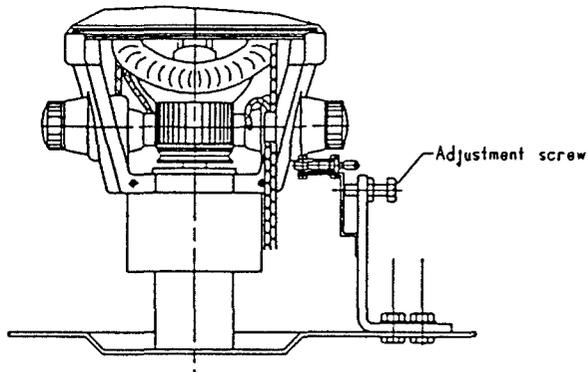
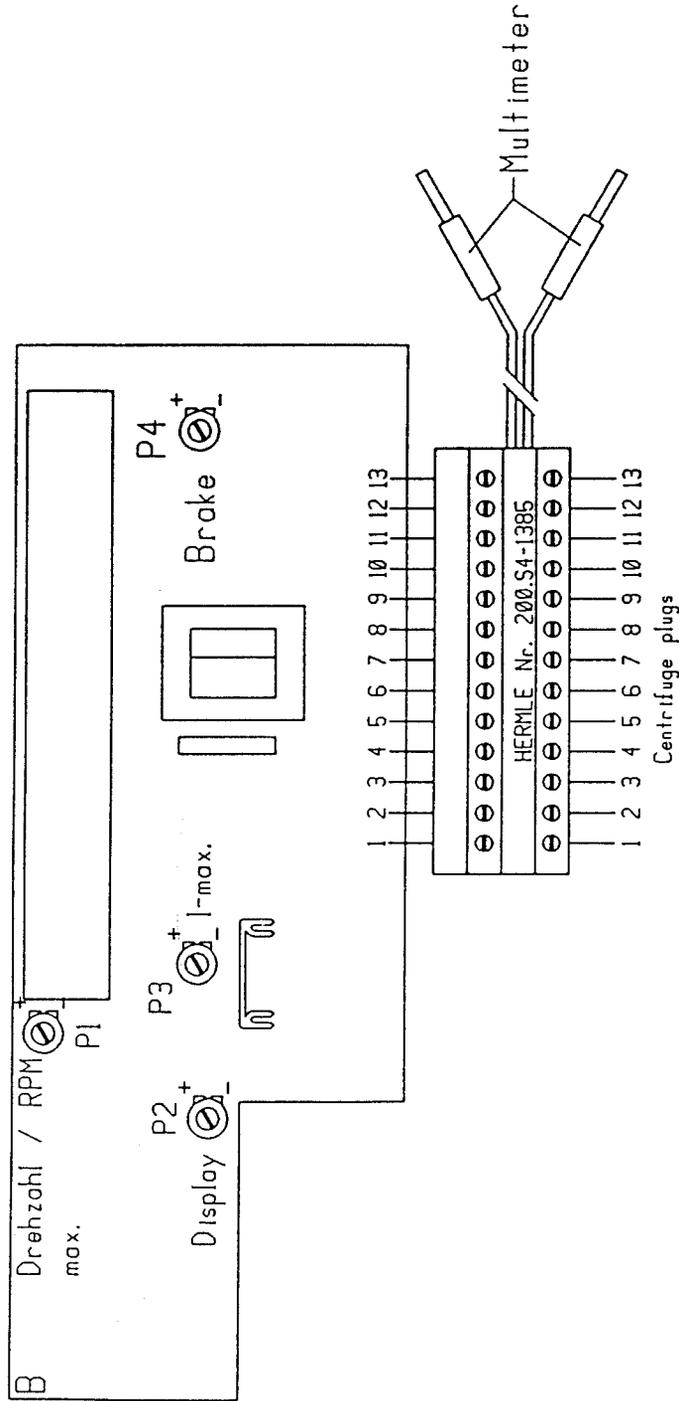
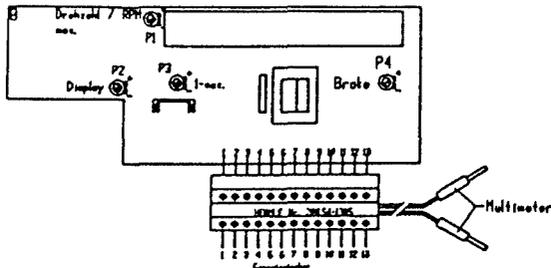


Illustration #9
Schematic Diagram of the PC Board
- PC Board HE 85.00.03 (Z320) -



PC Board HE 85.00.03 (Z320) Illustration #10



see next page

1. Connect the centrifuge to the measuring instrument by means of the adapter.

Set all potentiometers "P1-P4" to the left limit position

- B. Alternative without Hermle diagnosis measuring instrument, but with Hermle adapter No. 200.S4-1385 and with an external speed measuring instrument.

B2. Adjustment of the motor current: Potentiometer P3 = I max:

- Lock the motor by means of the Hermle clamping device
- for centrifuges upto the serial no..... "motor shaft without driving pin" see supplementary page in the appendix.
- Close the lid
- Set the knob "speed" to position 10
- Start the centrifuge by means of the timer
- Wait for abt. 5 sec.
- Set the current to 1.2 Ampere
- Switch off the centrifuge and remove the clamping device

Attention:

If the motor is locked too long, there is danger of overheating

Recommended measuring instruments:

Alternatively
Fluke 75 Multimeter

Soar : Digital Multimeter
D2M2 series model 4050
with Hermle adapter no. 200.S4-1385

Note:

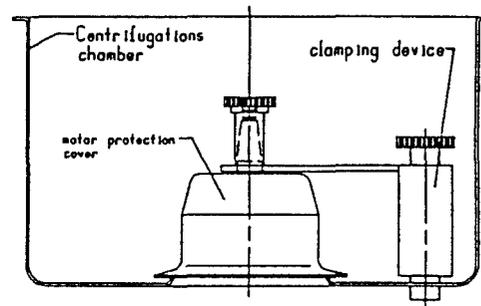
Compare to layout diagram no. S 230

ATTENTION !

To avoid any short circuit, as well as any damage on the PCB, use a suitable insulated screwdriver.

DIN 7457 2.5 x 75 mm
or a insulated electronic adjustment screwdriver
(for example of (Messrs. "Spectrol")

Illustration #11
Inner Chamber - Z320



Upon adjustment of the current value, please take care that the run-up barrier is overcome.
Pay attention to exact adjustment 1.2 Ampere.

B3. Adjustment of the speed limit Potentiometer P1=n max.

- Speed limit has to be adjusted to 10 000 rpm by means of potentiometer P1
- For that aim, use an external speed measuring instrument.
- Place rotor no. 220.45 V01 in the centrifuge
- Close the lid
- Set the speed to position 10 on the scale (front panel)
- Start the centrifuge.
- When using a stroboscope you should set the adjustment potentiometer P1 to the limit stop clockwise. by turning it

Set the stroboscope to the final speed of 10 000 rpm By turning the 10000 rpm. potentiometer P1 counter - clockwise, the centrifuge is adjusted to the maximum speed allowed for the unit.

B4. Adjustment of the digital indication Potentiometer P2 - Range - Adjust.

- After adjustment of the speed limit to 10 000 rpm, (described in A3) adjust the digital indication by means of potentiometer P2 in such a way that the measured actual speed is equal to the speed indication by the digital indicated.

- If the respective rotor is not available, proceed as described, but without rotor.

Note :

Recommended external speed measuring instrument:

Stroboscope - e.g "TURO - STROB PICOSTROB 331"

Flash - light - stroboscope, frequency range:
3.3 - 300 cyc.
200 - 18 000 rpm

Attention:

Upon adjustment with a stroboscope, ensure to have set the correct frequency range.

There is a possibility of very exact adjustment when measuring the speed at the collector of the motor .

To avoid any faulty adjustment, we recommend to mark the collector with a black pen

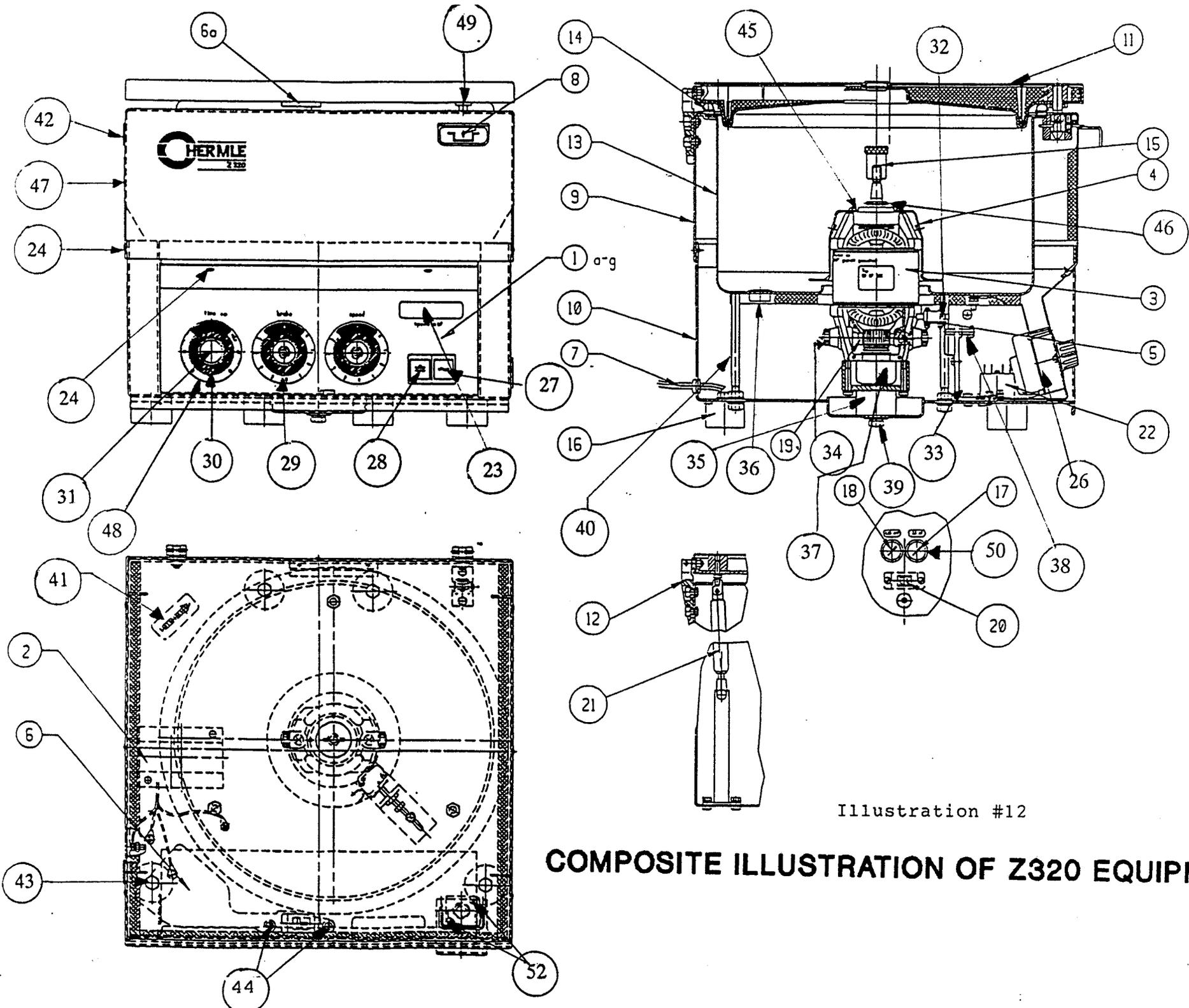


Illustration #12

COMPOSITE ILLUSTRATION OF Z320 EQUIPMENT

CORRESPONDING PART LIST TO ILLUSTRATION #12

| Drawing Reference No. | Description | Part Number | Qty. Required |
|-----------------------|--|---------------|---------------|
| 1 | Front panel, complete with board & timer | 200 S2-569 | |
| 2 | Transformer | 39.0021 | |
| 3 | Motor | 243..00.40.02 | |
| 4 | Cover for motor | 242.00.10.04 | |
| 5 | Imbalance switch, complete | 243.00.80.04 | |
| 6 | Lid latch, electrical mechanism | 23.5056 | |
| 6a | Lid locking hook | 70.0038 | |
| 7 | Power cord | 42.0108 | |
| 8 | Lid latch mechanical, complete | 250.04.00.03 | |
| 9 | Housing top part | 243.00.13.00 | |
| 10 | Housing bottom part | 200.S0-209 | |
| 11 | Lid, complete | 200.S1-393 | |
| 11a | Lid, inside covering | 200.S1-395 | |
| 12 | Hinges | 70.0205 | (2) |
| 13 | Bowl, stainless steel | 243.00.03.01 | |
| 14 | Rubber gasket | 70.0184 | |
| 15 | Rotor nut, left thread | 229.00.37.14 | |
| 16 | Rubber feet for housing | 26.5034 | (4) |
| 17 | Fuse for 115 Volts 2.5 AT | 25.0023 | |
| 18 | Fuse for 220 Volts 1.25 AT | 25.0021 | |
| 19 | Carbon brush | 32.0050 | (2) |
| 20 | Switch for voltage (115V/220V) | 38.0186 | |
| 21 | Gas pressure spring compl. | 70.0206 | |
| 22 | Shifter | 40.0095 | |
| 23 | LED Tachometer, per digit | TFK843 | |
| 24 | Screw, Phillips head, B3.5 x 9.5 (DIN 7981) | 07.5210 | (6) |
| 25 | Control unit, circuit board only, not pictured | HE 85.00.03 | |
| 26 | Timer, 60 minute | 35.0004-M | |
| 27 | Power switch with light | 38.0083 | |
| 28 | Lid switch with light | 38.0123 | |
| 29 | Brake/Speed scale | 243.00.48.14 | (2) |
| 30 | Time scale | 200.S4-1614 | |
| 31 | Knob for timer, brake or speed | 30.5069 | (3) |
| 32 | Microswitch (for imbalance detection), momentary | 38.0110 | |
| 33 | Mounting post for imbalance detector | 38.2140 | |
| 34 | Screw cap for motor brush | 32.0040 | (2) |
| 35 | Mounting cushion for motor, rubber | 26.5110 | |
| 36 | Drain plug, plastic, 21mm | 40.1238 | (2) |
| 37 | Tachgenerator | 80.1836 | |
| 38 | Adjusting screw for imbalance detection, M6 x 25 | 03.8666 | |
| 38a | Locking nut for above, BM6 (DIN 439) | 01.2809 | |
| 39 | Fixing bolt for motor assembly, M8 x 10 (DIN 933) | 03.8648 | |
| 40 | Steel mounting post for chamber bowl | 40.4186 | (3) |
| 41 | Label, directional arrow | 20.1011 | |
| 42 | Plug, emergency lid lock release | 40.1256 | |
| 43 | Pullstring, emergency lid lock release | 40.1281 | |
| 44 | Screw for mounting electrical lid lock, B3.5 x 9.5 | 07.5210A | (2) |
| 45 | Screw for mounting motor cover, M4 x 8, DIN85 | 00.6507 | (4) |
| 46 | Drive (cross) pin for motor shaft | 20.2145 | |
| 47 | Label, safety, multi-lingual | 20.1016 | |
| 48 | Faceplate, control panel | 37.1408 | |
| 49 | Locking post for mechanical lid lock | 23.4001 | |
| 50 | Fuse cap, interchangeable | 20.1501 | (2) |
| 51 | Combination tachgenerator shield/mounting bracket | 80.1857 | |
| 52 | Screws for mechanical lid lock, M4 x 10, DIN965 | 04.2507 | (2) |

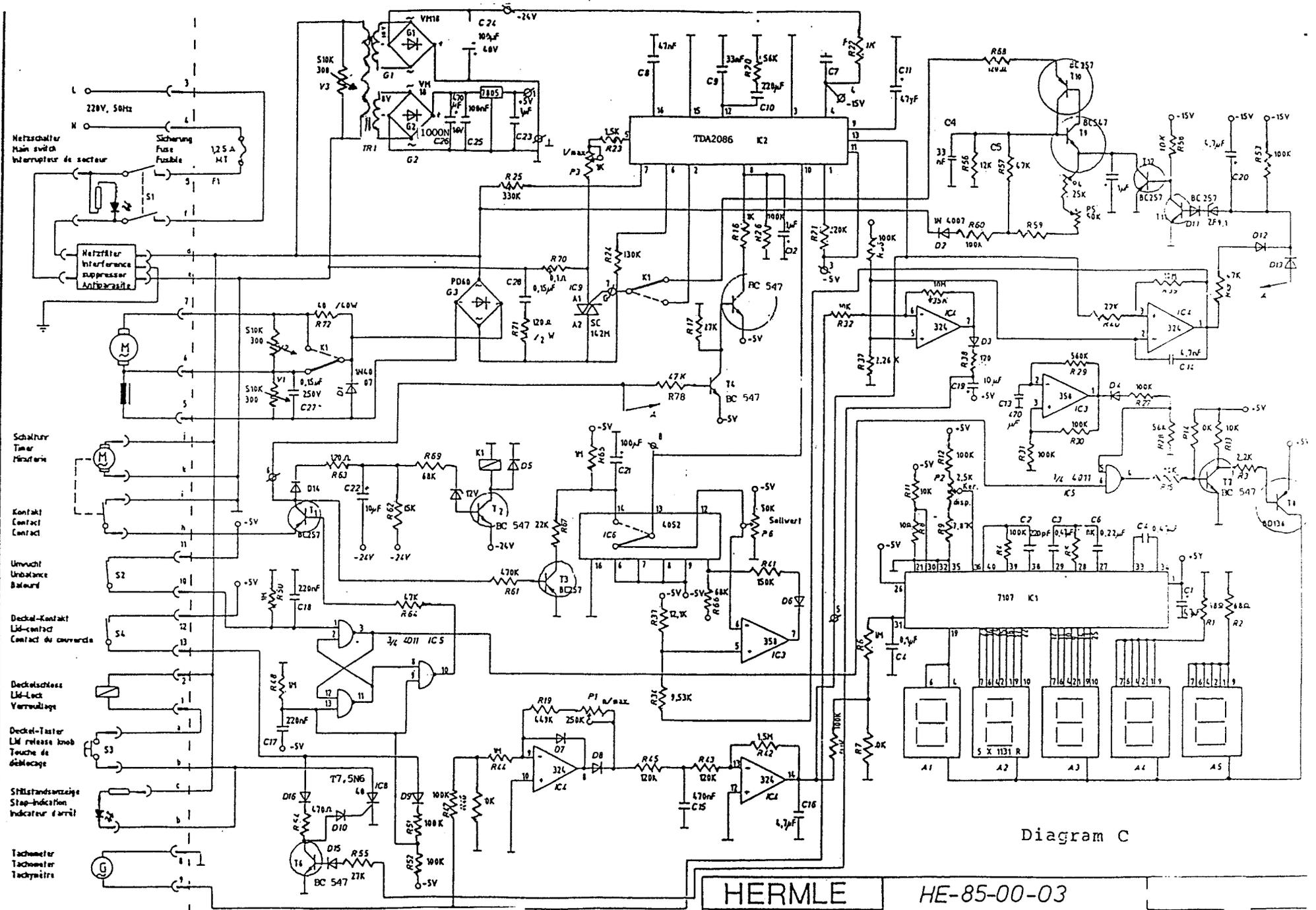


Diagram C

| | | | |
|---------------|--|--------------------|-------|
| HERMLE | | HE-85-00-03 | |
| And. Nr. | | Power Unit | Z320 |
| Name | | | S 236 |

For corresponding list of all semiconductors noted please see Instruction Manual (Section B) pages 24A thru 24F.

Deceleration and acceleration curves

Chart #1

Model : Z 320

Rotor : 220.59 V02

Bucket 8 x 45.5060

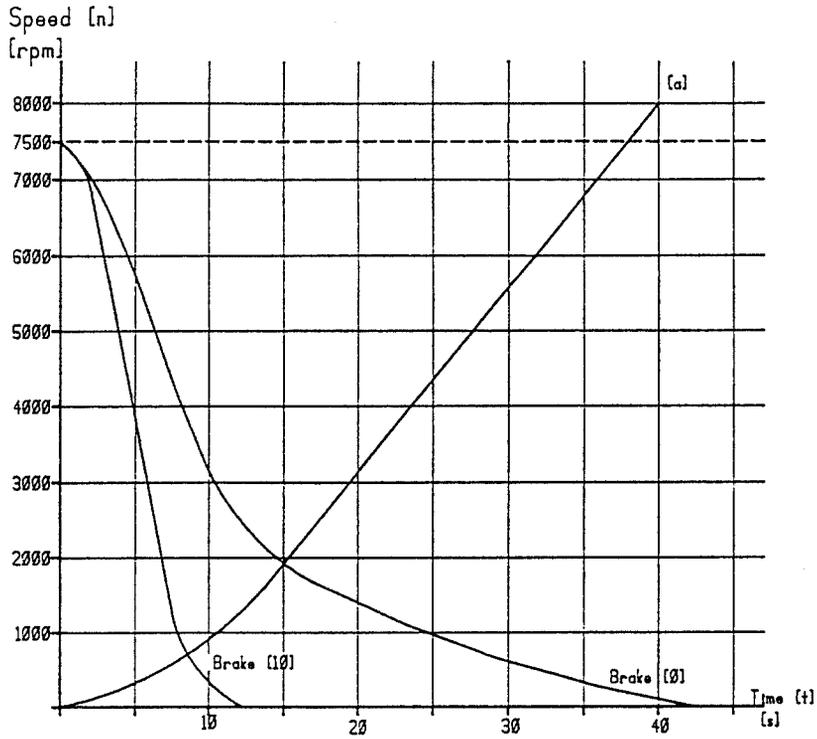
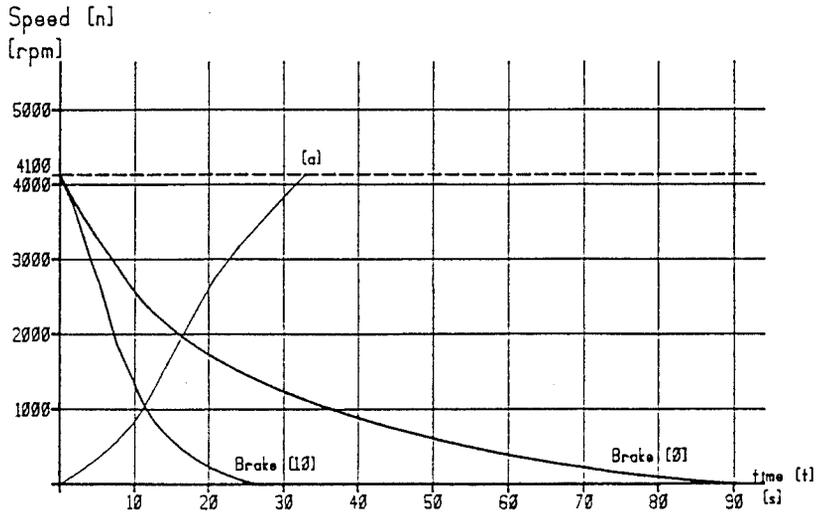


Chart #2

Model : Z 320

Rotor : 220.72 V01

Bucket 4 x 220.72.03.03



Deceleration and acceleration curves

Chart #3

Model : Z 320

Rotor : 220.42 V01

Bucket 8 x 220.42 V04

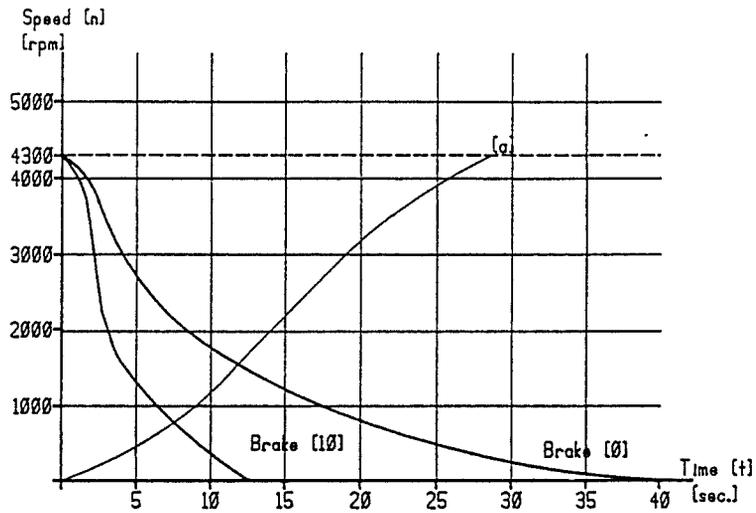
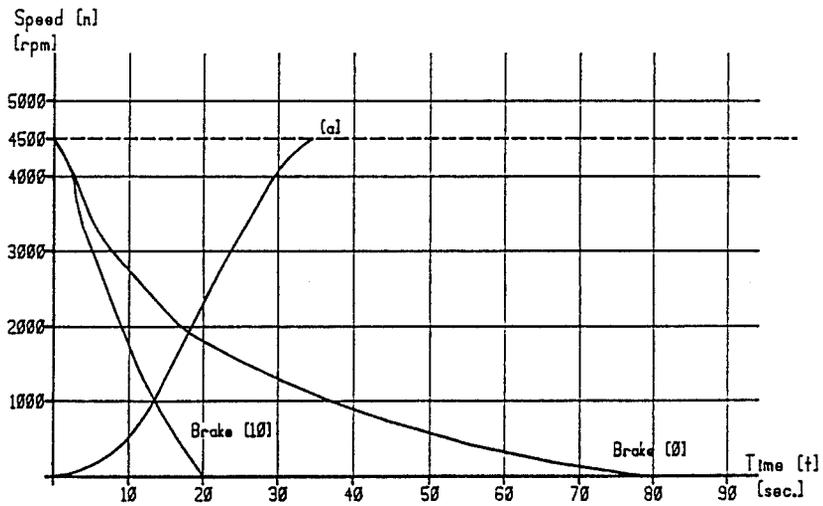


Chart #4

Model : Z 320

Rotor : 220.37 V01

Bucket 12 x 220.42 V04



Deceleration and acceleration curves

Chart #5

Model : Z 320

Rotor : 220.43 V01

Bucket 12 x 37.5039

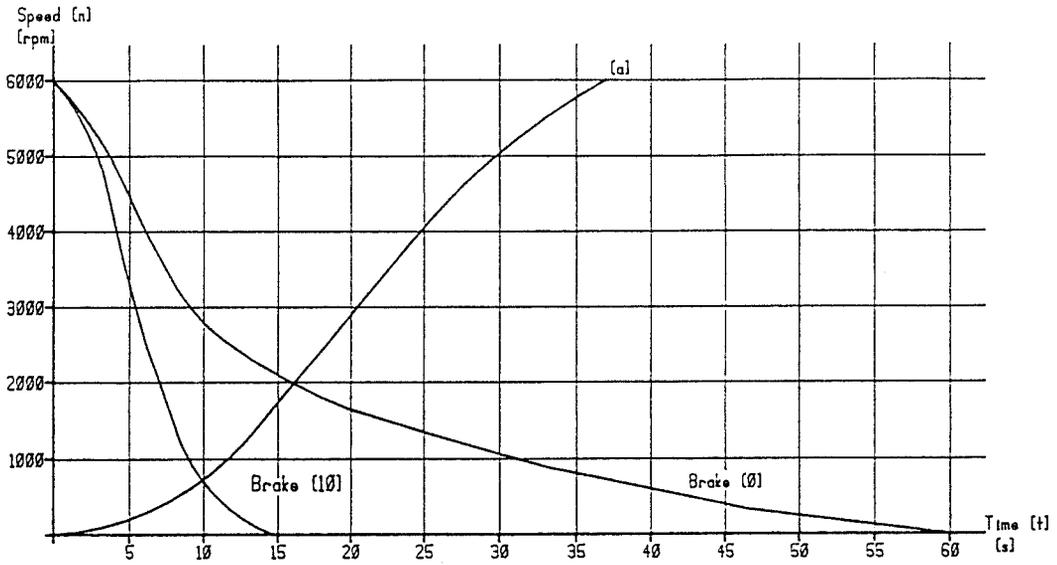
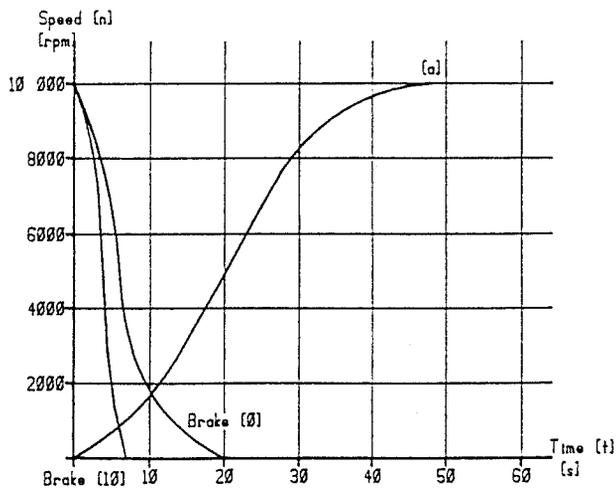


Chart #6

Model : Z 320

Rotor : 220.45 V01

Bucket 6 x 45.5060



Deceleration and acceleration curves

Chart #7

Model : Z 320

Rotor : 220.50 V01

Bucket : 220.50.03.03

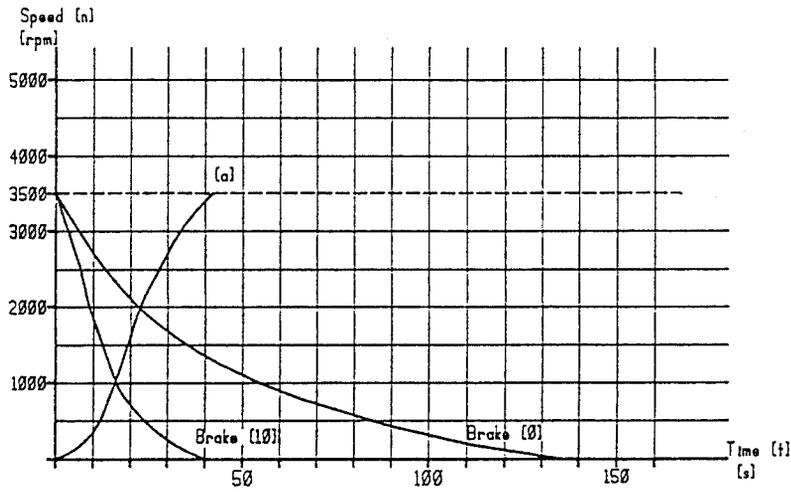


Chart #8

Model : Z 320

Rotor : 220.58 V02

Bucket : -

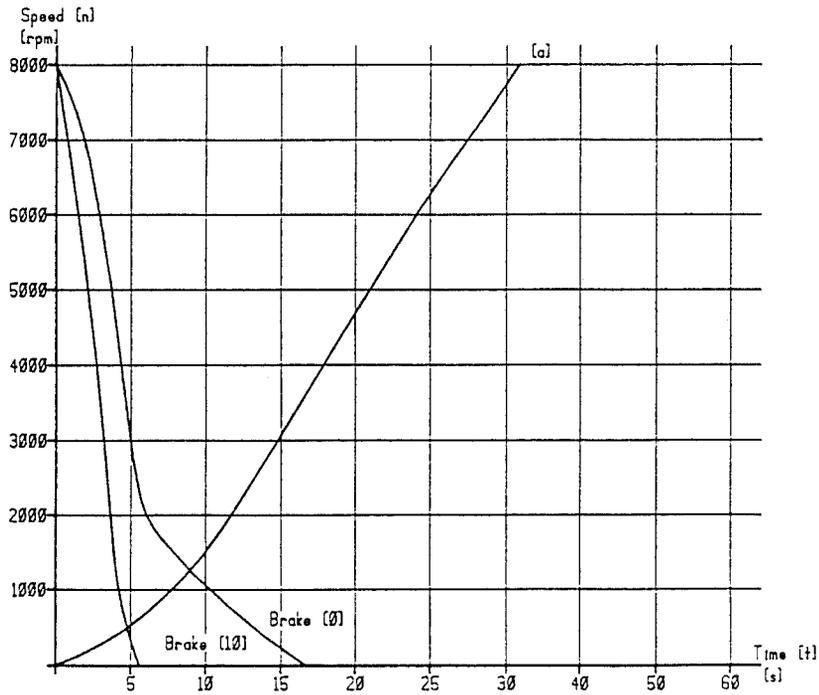


Chart #9

Model Z 320

Rotor 220.42 V01 Bucket 220.42 V04

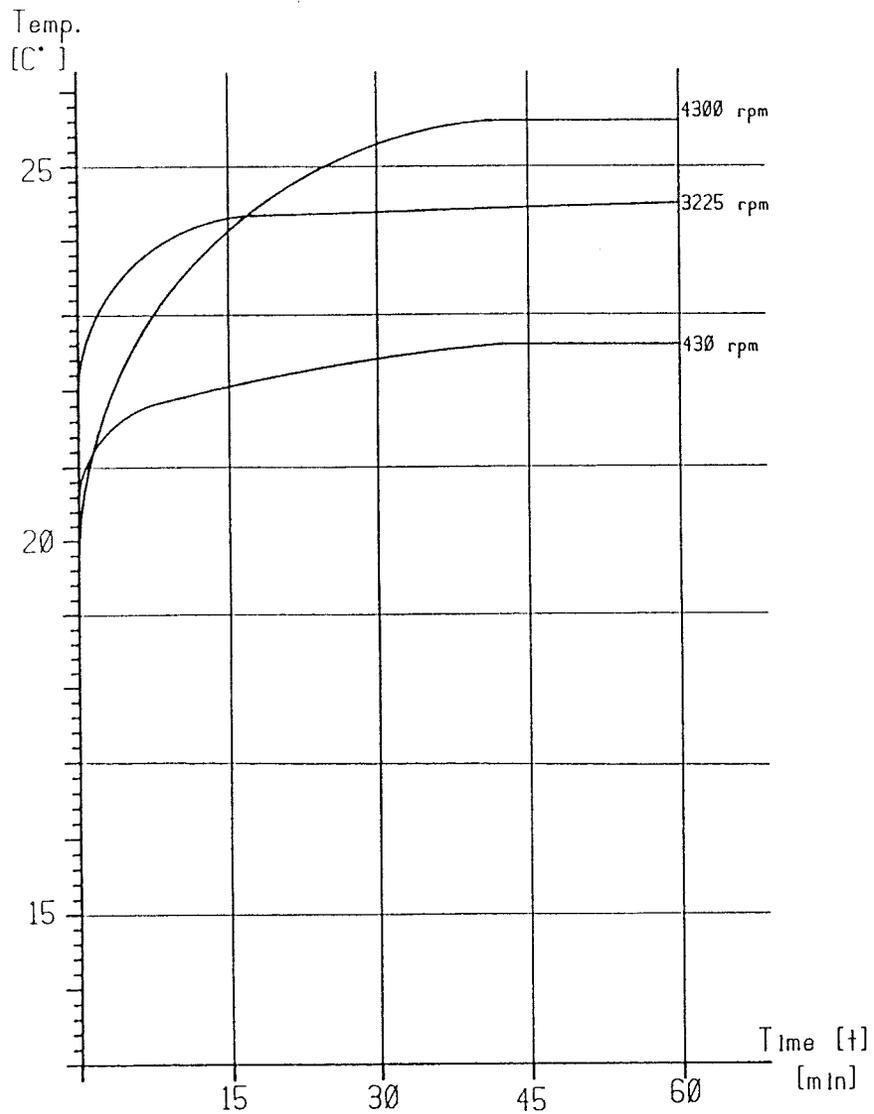


Chart #10

Model Z 320

Rotor 220.72 V01 Bucket 220.72.03.03

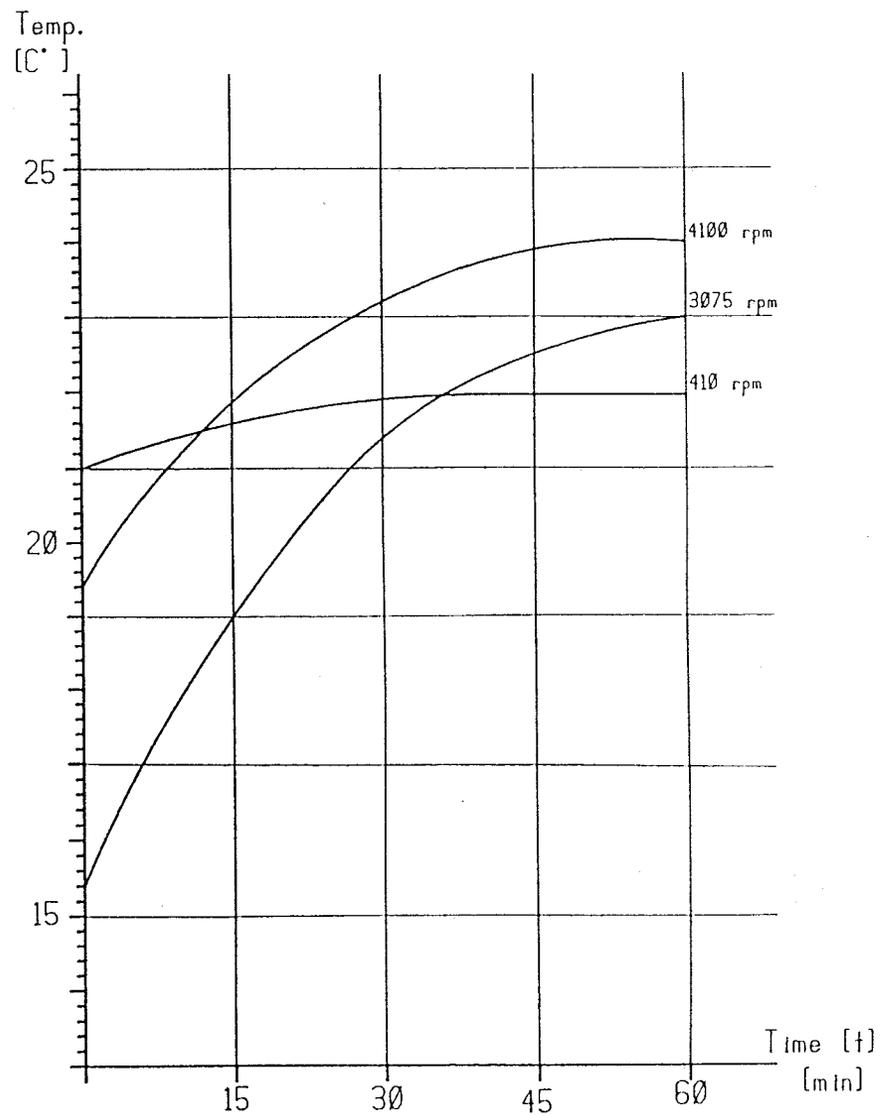


Chart #11

Model 'Z 320

Rotor 220.59 V02 Bucket 45.5060

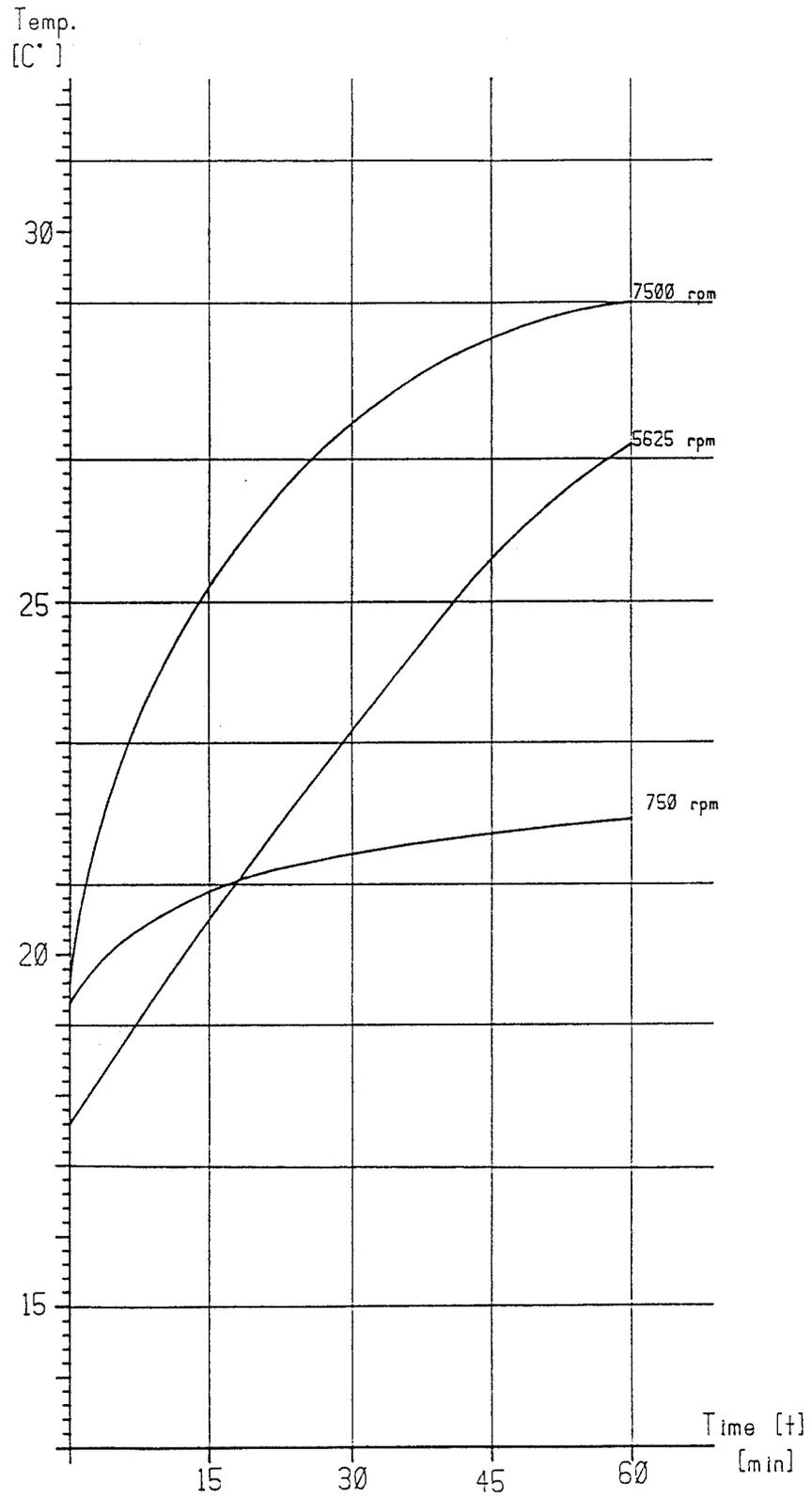


Chart #12

Temperature diagram

Model Z 320

Rotor 220.37 V01

Bucket 220.42 V04

Temperature
[degrees celsius]

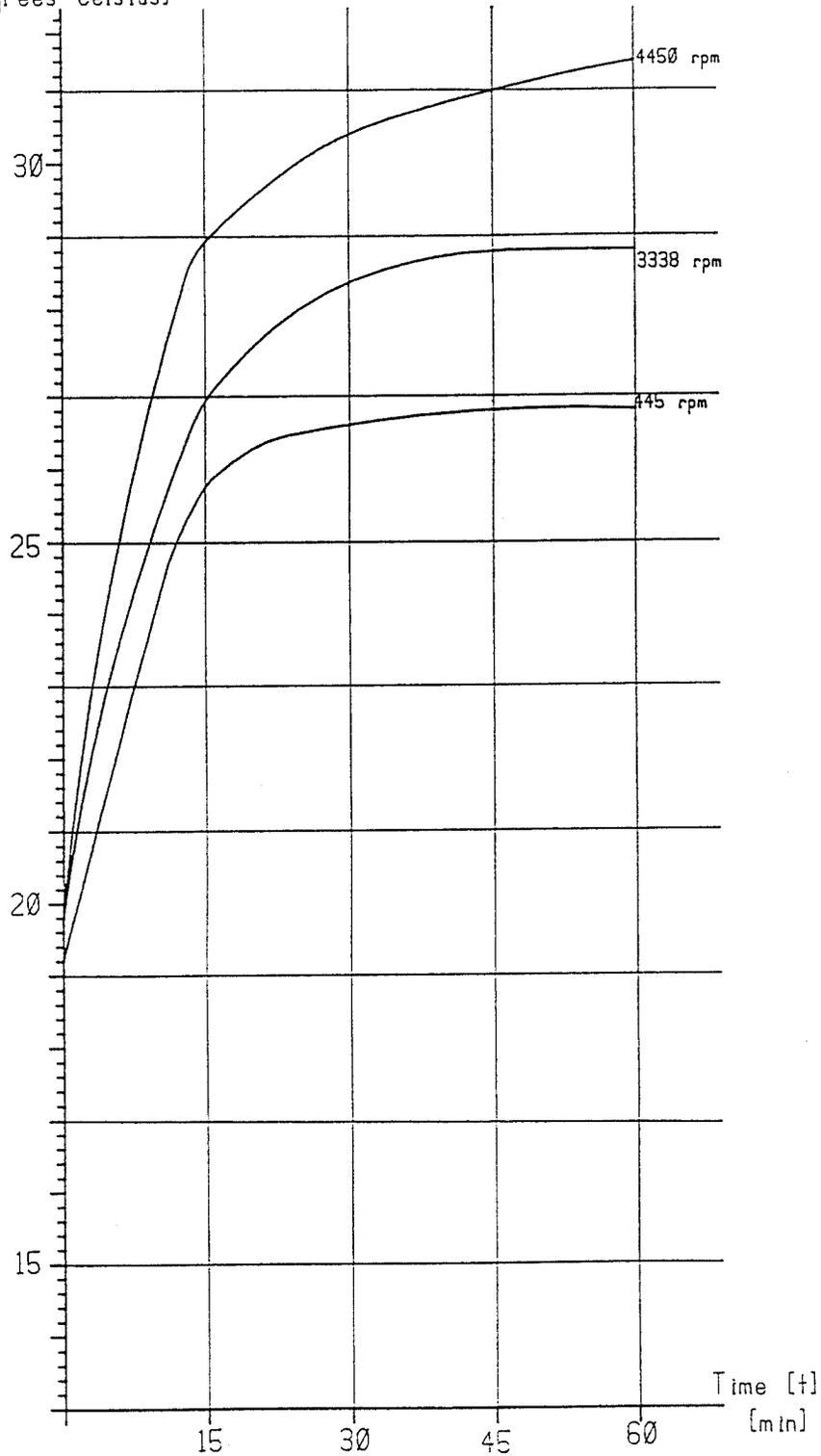


Chart #13

Model Z 320

Rotor 220.43 V01 Bucket 37.5039

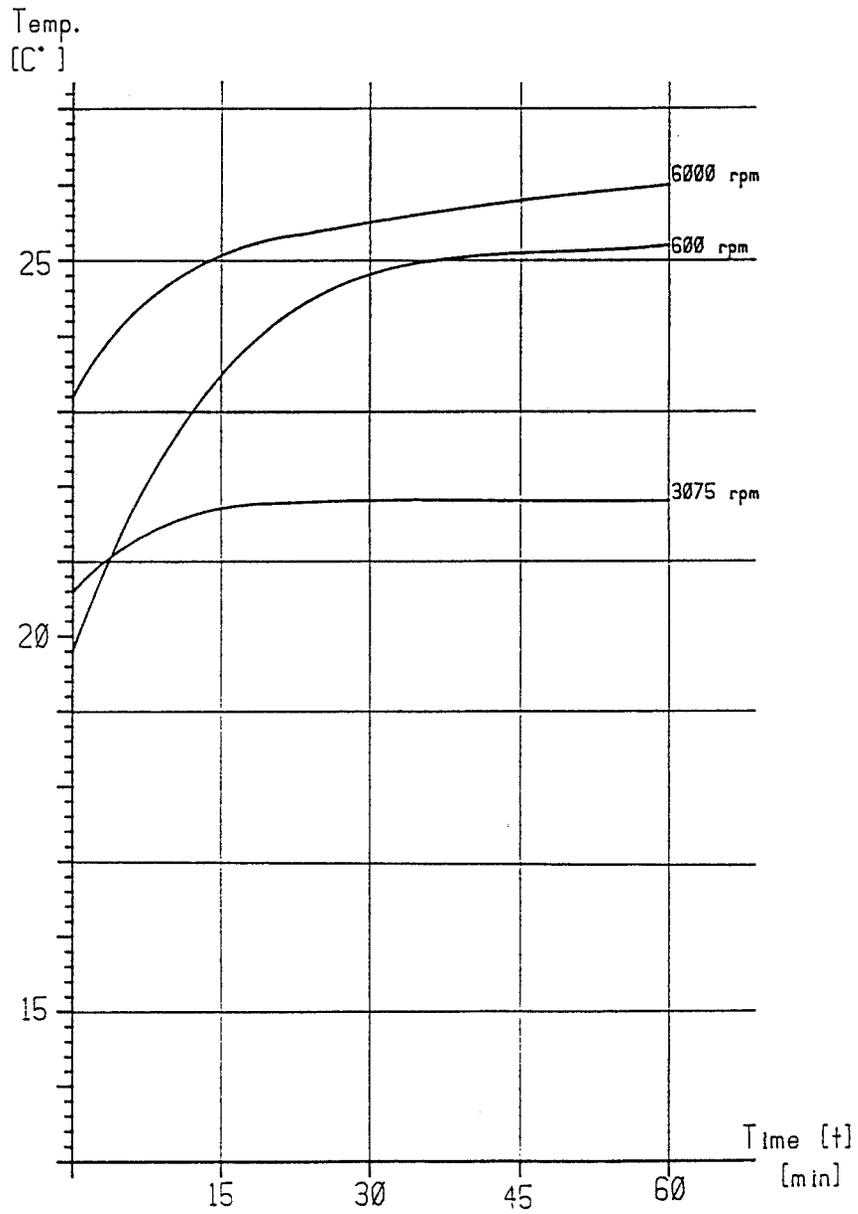
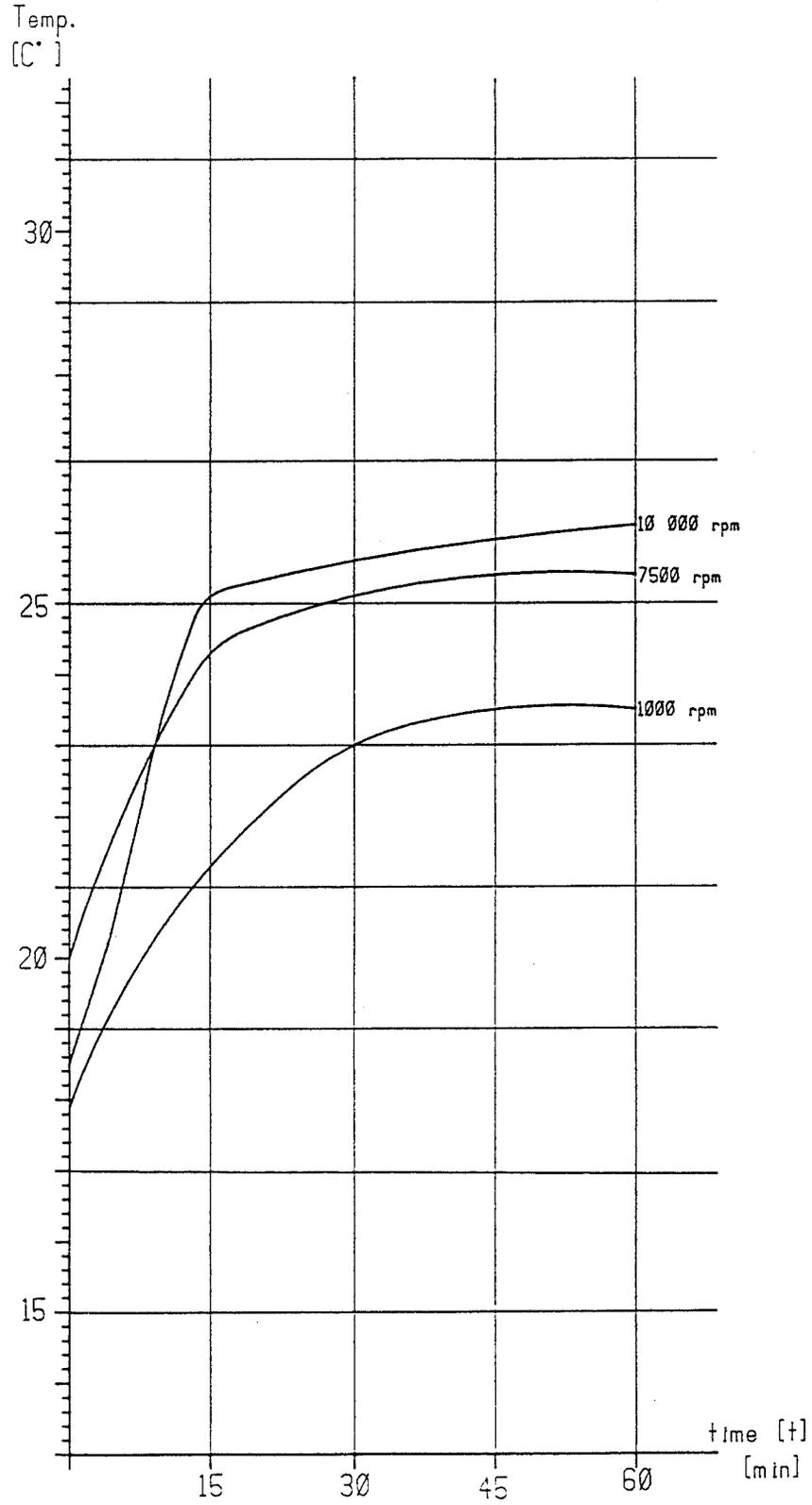


Chart #14

Model Z 320

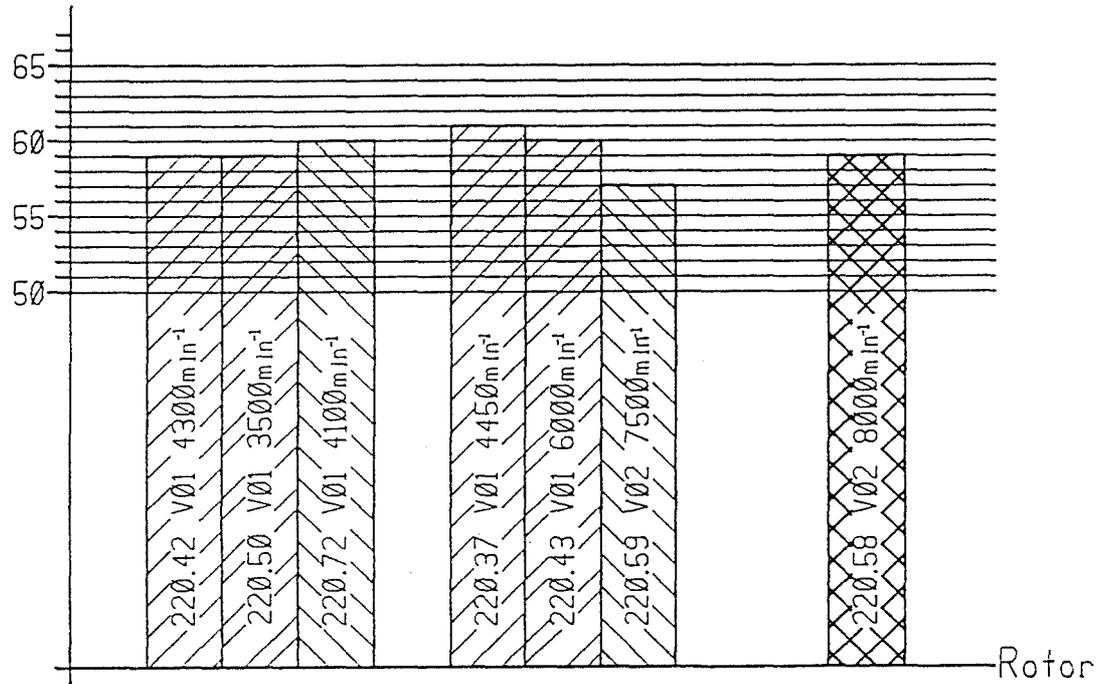
Rotor 220.45 V01 Bucket 45.5060



noise level measurement Z320

Chart #15

noise level
[dB B]



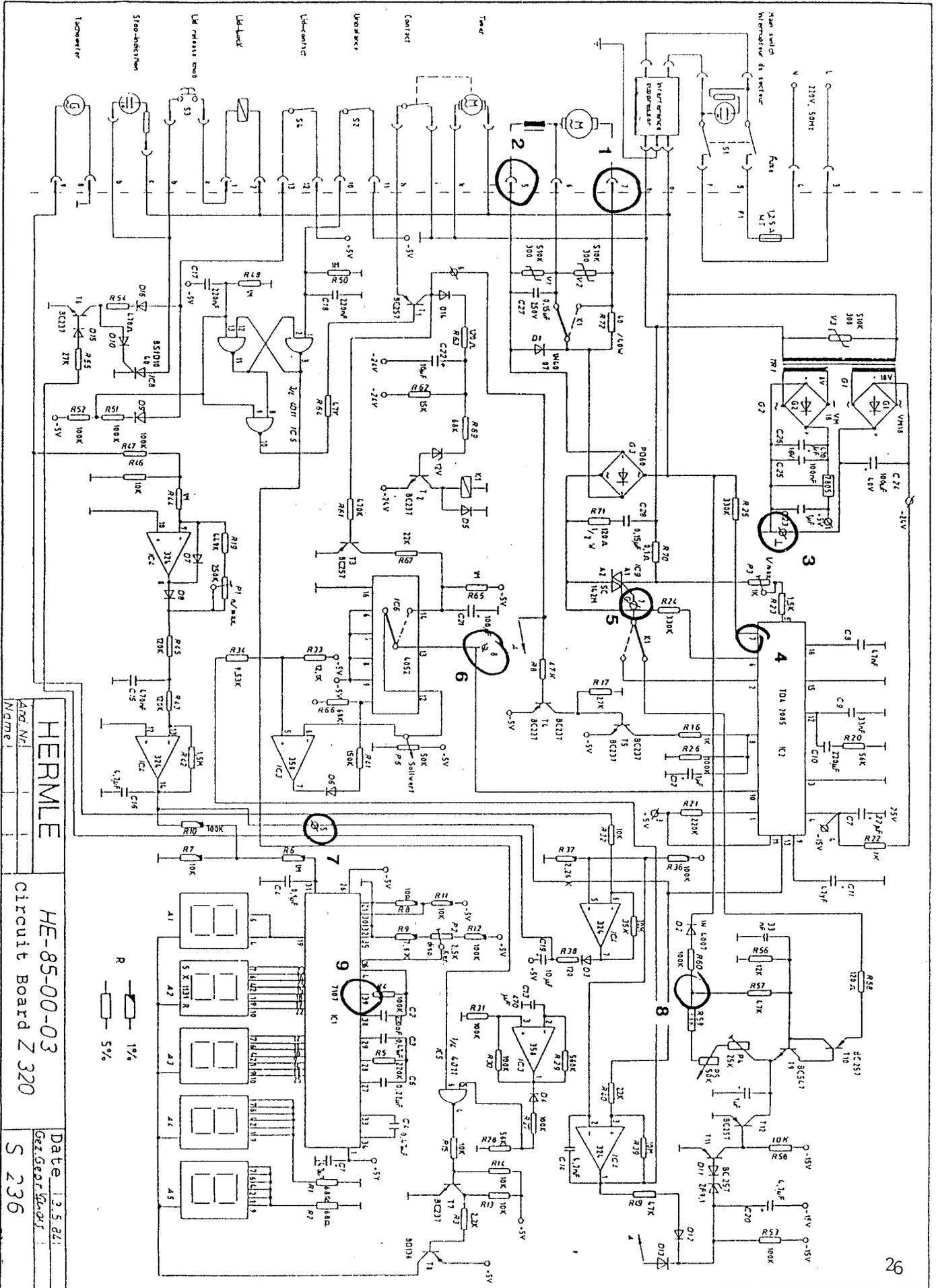


Check list / Trouble shooting

| FAULT | POSSIBLE REASON | SOLUTION |
|---|---|---|
| Centrifuge will not start - no indication on front panel. | No power supply. Defective fuse. | Check mains (power) and centrifuge fuses. Replace if necessary. |
| ***** | | |
| Lid cannot be released. | Defective lid lock. | Open manually (see 7.1) |
| | Lid lock is jammed. | Re-adjust lid lock. |
| | No power from PC board. | Call service. |
| ***** | | |
| Centrifuge cannot be started, although power is on. | Lid not closed correctly (white indicator lamp does not light). | Close lid correctly. |
| | No speed or time preselected. | Check and set the time. |
| | Fuse on front panel is defective. | Check fuses and replace if necessary. |

"OSCILLOSCOPE WAVEFORM REFERENCE POINTS"

The numbers next to each circled point refer to the oscilloscope waveforms on pages 27 thru 31.



HERMLE

HE-85-00-03

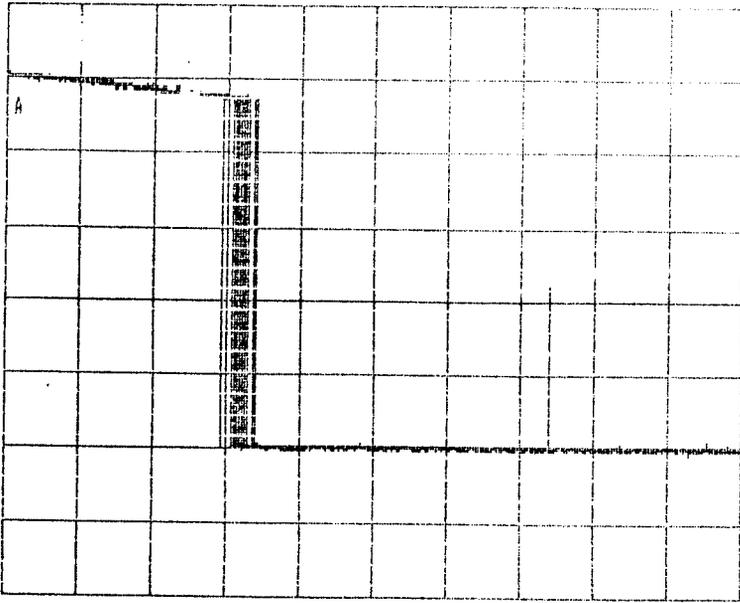
Circuit Board Z 320

Date 1.3.5.81

Gen. Design

S 236

A= 1 V TB= 2 s Figure A

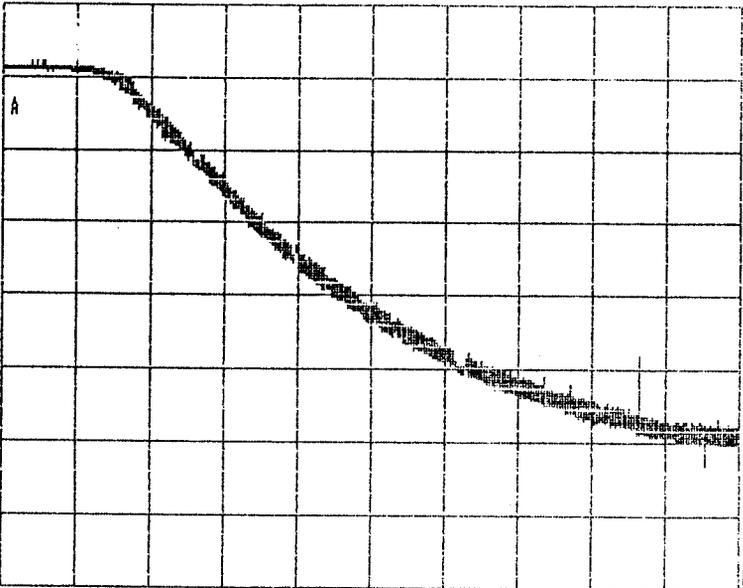


Test Pin 8: Rated value, break point between soft acceleration and fast acceleration.

This figure refers to point no. 6 of "Oscilloscope Waveform Reference Points" on page 26.

Return

A= 1 V TB= 5 s Figure B

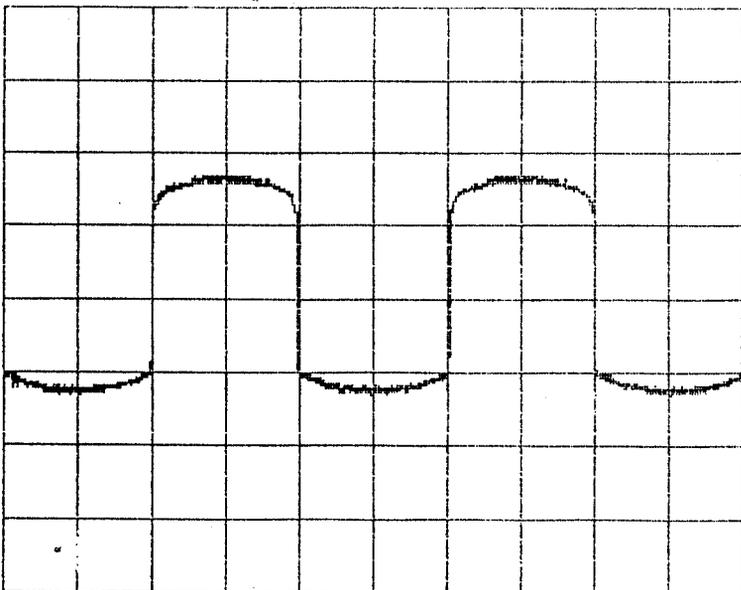


Test Pin 5: Rectified voltage from tachogenerator during acceleration 0 to 2900 RPM.

This figure refers to point no. 7 of "Oscilloscope Waveform Reference Points" on page 26.

Return

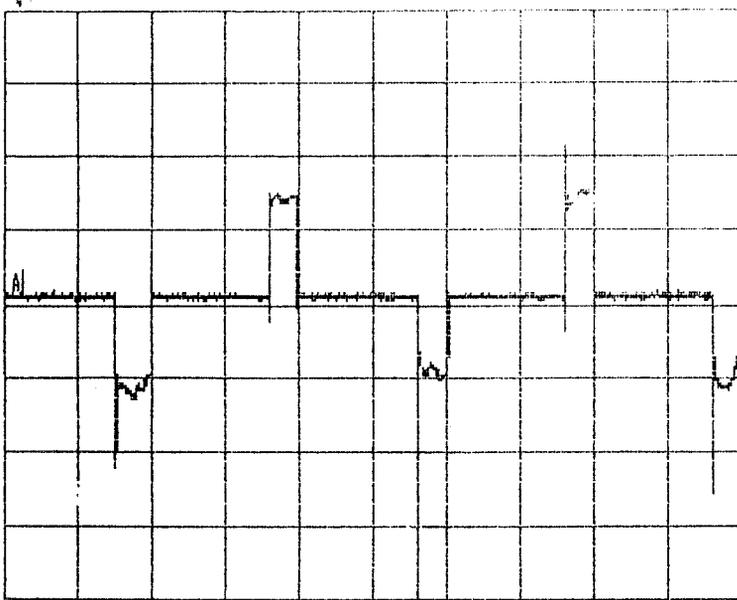
A= 0.5V TB= 50s Figure C



IC2 (TDA 2086) Pin 7: Line-synchronization (50 Hz)

This figure refers to point no. 4 of "Oscilloscope Waveform Reference Points" on page 26.

Return



A= 0.5 V TB= 5os Figure D

Test Pin 7: (gate of TRIAC) Drive mode:
preselected speed 1000 RPM.
Corresponding to Figure C.

This figure refers to point no. 5 of
"Oscilloscope Waveform Reference Points" on
page 26.

Return



A= 0.1kV TB= 5os Figure E

Motor voltage at Pins 5 and 7: Drive mode,
preselected speed 1000 RPM.
(corresponding to Figure C
and D).

This figure refers to point no. 2 & 1 of
"Oscilloscope Waveform Reference Points" on
page 26.

Return

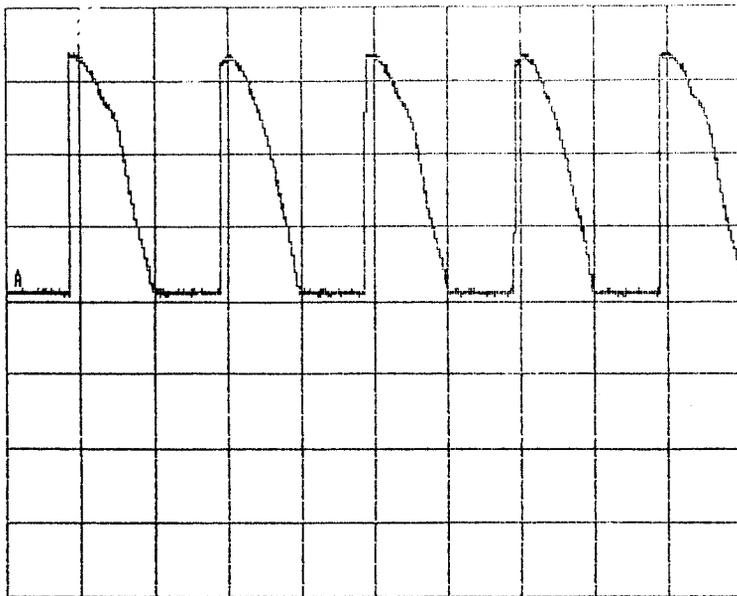


A= 0.5V TB= 5os Figure F

Test Pin 7: (gate of TRIAC) Drive mode,
preselected speed 2900 RPM.
(corresponding to Figure C).

This figure refers to point no. 5 of
"Oscilloscope Waveform Reference Points" on
page 26.

Return

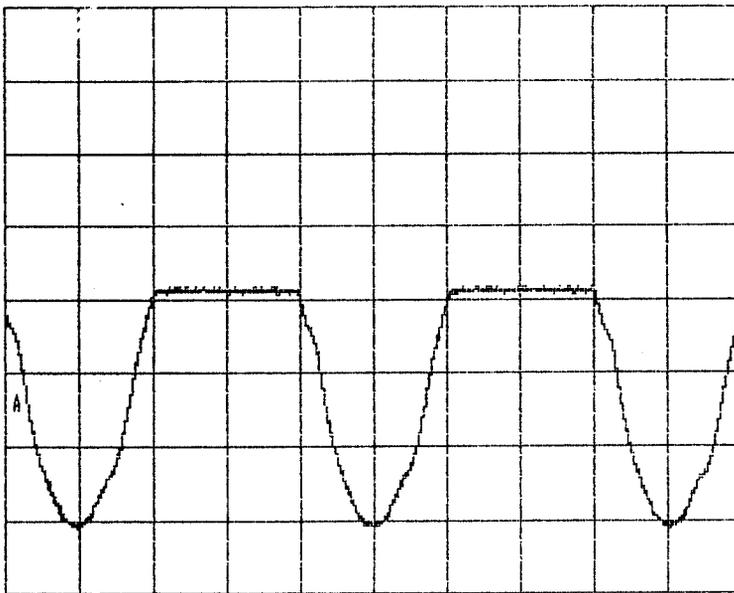


A= 0.1kV TB= 5os Figure G

Motor voltage at Pins 5 & 7: Drive mode, preselected speed 2900 RPM. (corresponding to Figure C and Figure F).

This figure refers to point no. 2 & 1 of "Oscilloscope Waveform Reference Points" on page 26.

Return

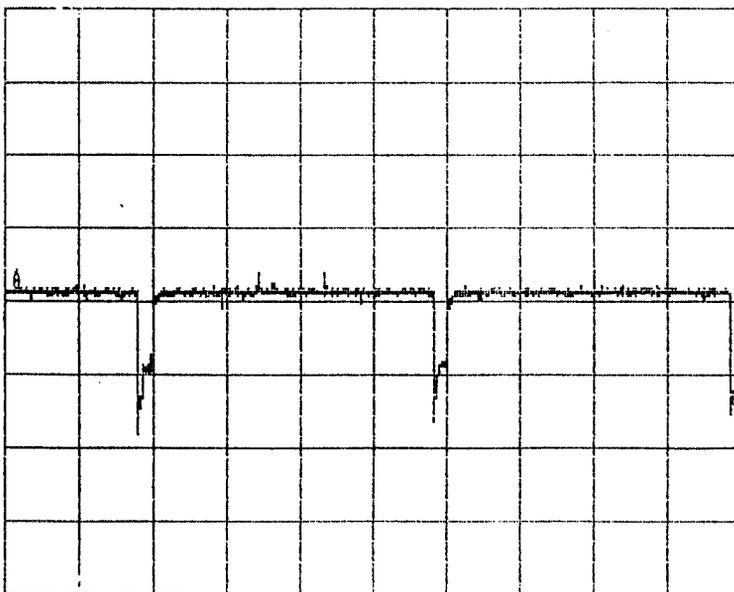


A= 20V TB= 5os Figure H

Point between R60 and R57 and R59: Line-synchronization for brake mode.

This figure refers to point no. 8 of "Oscilloscope Waveform Reference Points" on page 26.

Return



A= 0.5V TB= 5os Figure I

Test Pin 7: (gate of TRIAC) Brake rate min.

This figure refers to point no. 5 of "Oscilloscope Waveform Reference Points" on page 26.

Return

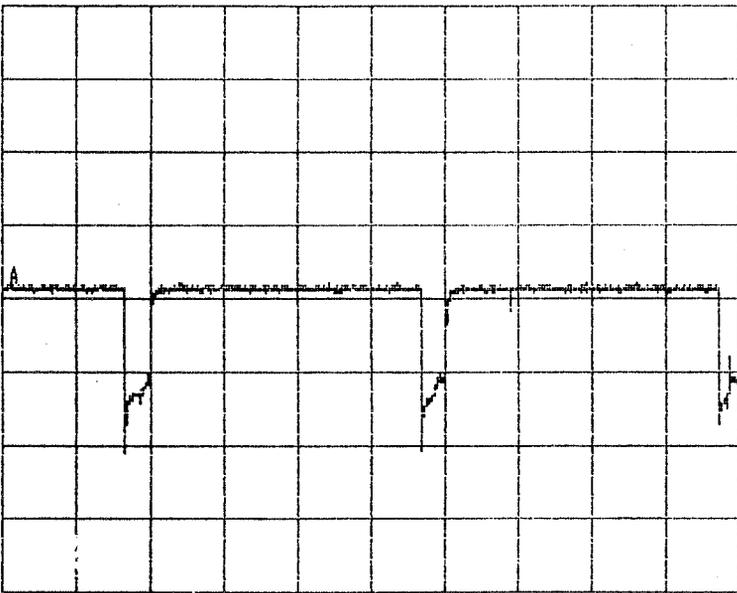


A= 0.1kV TB= 5os Figure J

Motor voltage at Pins 5 & 7: Brake mode,
brake rate at min.
(corresponding to Figure I)

This figure refers to point no. 2 & 1 of
"Oscilloscope Waveform Reference Points" on
page 26.

Return

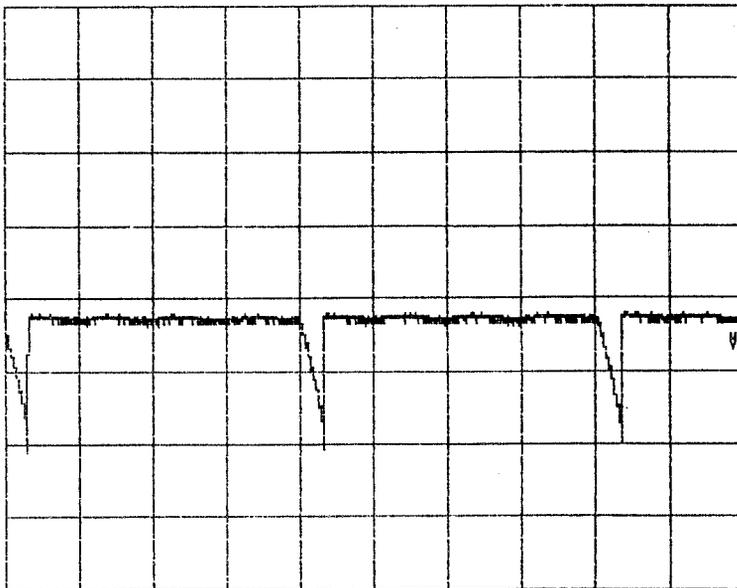


A= 0.5V TB= 5os Figure K

Test pin 7: (gate of TRIAC) Brake rate at
max.

This figure refers to point no. 5 of
"Oscilloscope Waveform Reference Points" on
page 26.

Return



A= 0.1kV TB= 5os Figure L

Motor voltage at pins 5 & 7: Brake mode,
brake rate at max.
(corresponding to Figure K).

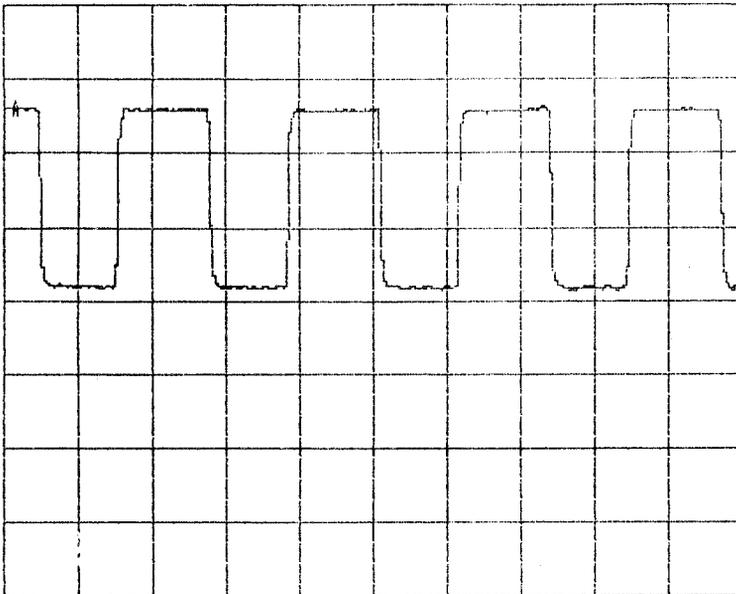
This figure refers to point no. 2 & 1 of
"Oscilloscope Waveform Reference Points" on
page 26.

Return



A= 2V TB= 20us

Figure M



Clock for the AID-converter IC1 Pin 39

This figure refers to point no. 9 of "Oscilloscope Waveform Reference Points" on page 26.

Return

Point no. 3 of "Oscilloscope Waveform Reference Points" on page 26 is the "Ground".

INSTRUCTION MANUAL
FOR
LABORATORY CENTRIFUGE
Z 320

NATIONAL LABNET COMPANY

P.O. BOX 841

WOODBIDGE NJ, 07095

(201) 283-4555

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INTRODUCTION

Getting To Know Your New Z320 Centrifuge
(see illustration on page 1B)

The Hermle model Z320 is a laboratory benchtop centrifuge designed for medium throughput in research, clinical and industrial laboratories. Up to 24 15ml tubes can be simultaneously centrifuged at speeds ranging up to 3300 RPM. With optional rotors and accessories, the Z320 can accommodate a maximum capacity of 400ml or a maximum speed of 9000 RPM.

The Z320 may be used to achieve separations in a variety of different test tube sizes and a variety of biological samples including blood and urine.

The main operating control is the timer which basically serves as an ON/OFF switch. Each Z320 incorporates a number of safety features including an electronic and mechanical lid lock, heavy gauge stainless steel rotor chamber, and an all steel lid and housing. **NO ATTEMPT SHOULD BE MADE TO OVERRIDE ANY SAFETY FEATURE.**



FEATURES OF THE Z320 CENTRIFUGE



Figure 18

1

2

3

4

5

6

1B

1. General Information

1.1 Description

Model" Z 320" is a universal bench top centrifuge which covers many fields of application by offering a wide range of accessories. It accomodates swing out rotors up to a max. capacity of 4 x 100 ml, as well as angle rotors up to 10.000 rpm (microtiter rotor and hematocrit rotor see brochure).

1.2 Safety precautions to be observed before operating the centrifuge

Do not operate if:

- the centrifuge has not been installed correctly
- the centrifuge is partly dismantled
- service has been attempted by non-authorized or non-qualified personnel
- the rotor has not been installed securely on the motor shaft

Do not operate the centrifuge with rotors and accessories not belonging to the standard range of accessories of this centrifuge without obtaining the prior permission of the manufacturer. Exception: tubes and bottles made of glass or plastic normally available in the laboratory.

Do not operate the centrifuge in explosive atmospheres.

1.3 Safety standards

The centrifuge corresponds to the general requirements set by German law for medical apparatus, "Med GV" group 3.

The following standards have been considered for the production of our centrifuges:

- Accident prevention rules for centrifuges UVV-VBG 7z
- Accident prevention rules for electrical equipment & installations UVV-VBG 4
- DIN 58970, part 1,2 and 4 for centrifuges and centrifuge tubes
- Electrical interference suppression according to interference degree N as per VDE 0875

1.4 Technical Data

| | |
|--------------|---|
| Manufacturer | BHG HERMLE GmbH & Co. Industriestrasse 8 - 12 7209 Gosheim/Fed. Rep. of Germany Tlx: 760613 bhgd, Fax: (07426)67 170 |
|--------------|---|

| | |
|----------|-------|
| Type No. | Z 320 |
|----------|-------|

| | |
|-------------|--------|
| Dimensions: | |
| Width | 390 mm |
| Depth | 390 mm |
| Height | 340 mm |

| | |
|--------|-------|
| Weight | 29 kg |
|--------|-------|

| | |
|-------------|----------|
| Noise level | 64 dB(A) |
|-------------|----------|

| | |
|------------------------|------------------------|
| max. speed | 10.000 rpm +/- 5% |
| max. volume | 400,0 ml |
| max.RCF | 6.580 x g |
| Admiss. density | 1,2 kg/dm ³ |
| Admiss. kinetic energy | 2.400 Nm |

| | | |
|-------------------------|-------------------|-----------|
| Electrical requirements | 115/220V, 50/60Hz | |
| Current | 0,71 A | 1,7 A |
| Connected load | 0,155 KVA | 0,195 KVA |
| Fuse | 2.5 Amp, 5 x 20mm | |

| | |
|--------------------------|---------------------------------------|
| Interference suppression | interference degree N as per VDE 0875 |
|--------------------------|---------------------------------------|

| | |
|--------------------------|-----------------|
| Service Dept. at HERMLE: | 074 26 / 67-438 |
|--------------------------|-----------------|

For service or parts within the U.S.A., contact:

NATIONAL LABNET CO.

P.O. Box 841

Woodbridge, NJ 07095 USA

Phone: 201 283-4555

Fax: 201 561-5634

1.5 Accessories supplied with each centrifuge unit

- 2 spare fuses
- 2 plastic plugs
- 1 instruction manual
- 1 warranty certificate
- 1 spanner wrench for mounting and removing the rotor

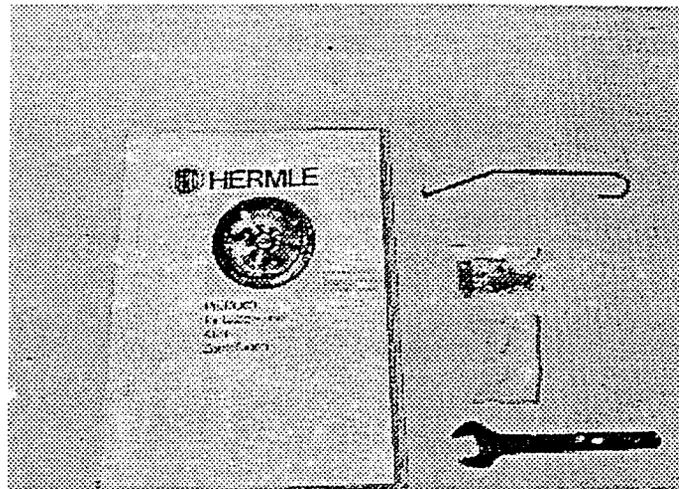


Figure 1

1.6 Warranty

The centrifuge has been subjected to thorough testing and quality control.

In the unlikely event of any manufacturing faults occurring, the centrifuge and rotors are covered by warranty for a period of 1 year from date of delivery.

This warranty becomes invalid in case of wrong operation, use of non-appropriate spare parts or accessories and non-authorized modification of rotor or centrifuge.

The manufacturer reserves the right for any technical modifications of the product in respect to technical improvement.



2. Installation

2.1 Unpacking the centrifuge

The centrifuge Z 320 is supplied in a carton protected by PU foam. Open the carton and take off the upper foam part (including the accessories) and remove the centrifuge.

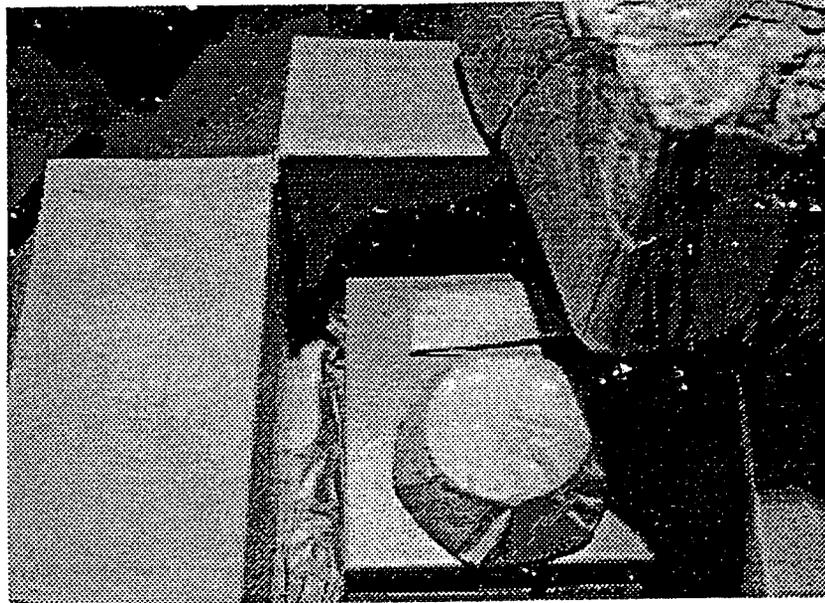


Figure 2

The instruction manual and the

accessories mentioned under 1.5 should be kept with the centrifuge.

This unit is not designed for outdoor storage or outdoor use.

It must be stored in a cool dry place (between 5°C and 25°C).

2.2 Required space

The centrifuge should be installed on a rigid, even surface. The Z 320 should only be operated on a stable laboratory table/cabinet etc..

To guarantee sufficient ventilation, please ensure that the centrifuge has at least 15 cm free space around the unit.

It is recommended that the centrifuge is not sited in positions subject to excessive heat, e.g. strong sunlight, radiators etc. as heat-build-up can occur within the centrifuge bowl.

2.3 Installation

1. Before operating the centrifuge check that the power supply corresponds to that on the manufacturer's rating label which is mounted on the rear panel.
2. Switch on the power switch (1), the green control lamp of the power supply (1), as well as the white control lamp of the lid release (2) will light. The lid can then be opened by pressing firstly the lid release switch (2), as well as secondly the mechanical lid lock (3), (see figure 3).

FRONT VIEW OF CENTRIFUGE

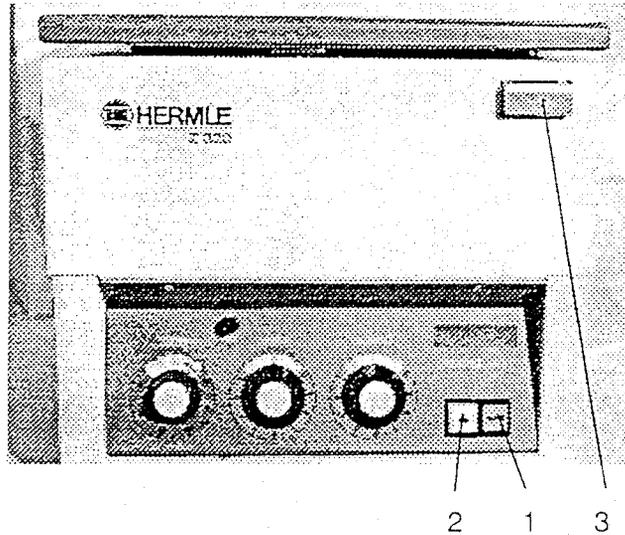


Figure 3

3. Remove the locking nut (1) on the motor shaft by turning clockwise and the transport protection out of the centrifuge bowl (2), (see figure 4).

TOP VIEW OF CHAMBER WITH TRANSPORT PROTECTION

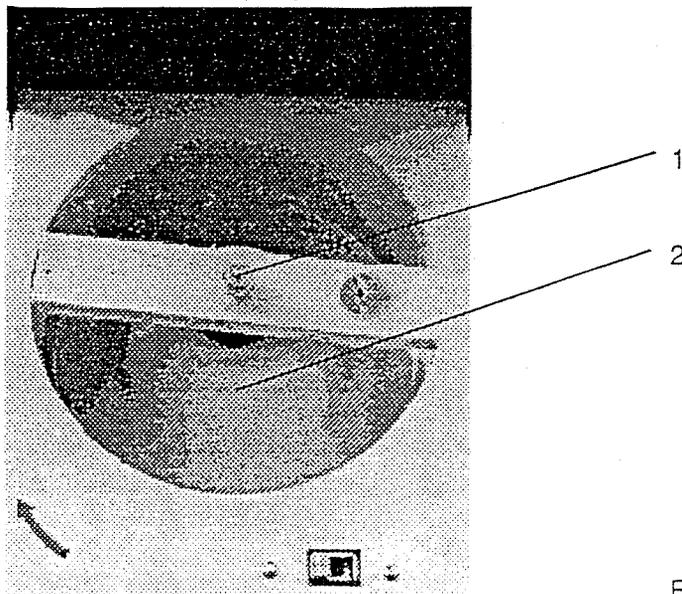


Figure 4

3. How to install and load a rotor

3.1 Mounting and securing a swing out rotor

Clean the motor shaft (3), as well as the rotor mounting hole (2) with a piece of cloth and place the rotor on the motor shaft ensuring that the pins (4) align correctly with the rotor slots (1). Secure the rotor to the shaft by turning the rotor nut counter-clockwise (see figure 5 + 6).

BOTTOM OF TYPICAL ROTOR

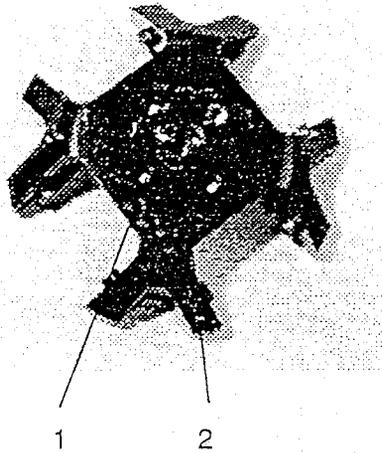


Figure 5

MOTOR SHAFT

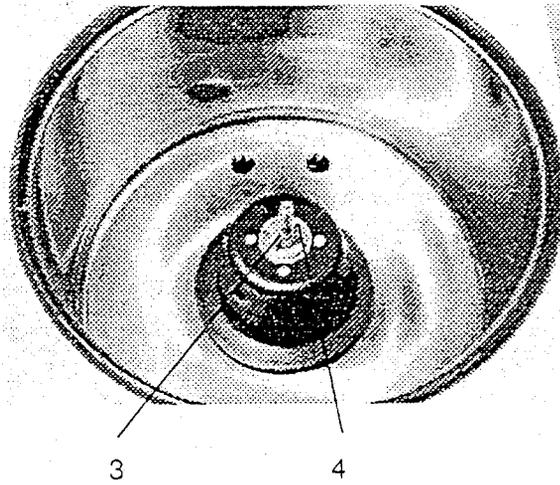
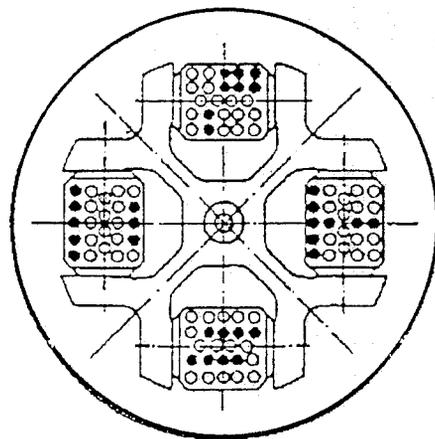


Figure 6

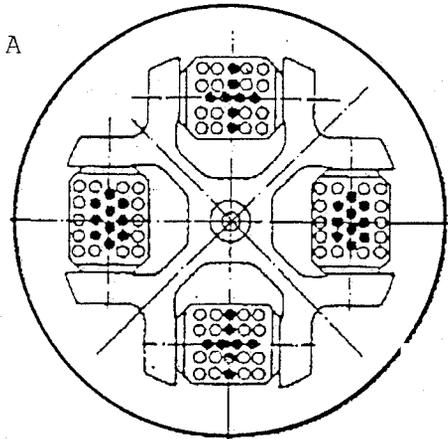
When loading the buckets, and tube racks, you should proceed according to the below sketch A.

ROTOR LOADING DIAGRAMS



incorrect

SKETCH A



correct

It is very important to load the rotor with the complete set of buckets / tube racks. Fill the tubes equally by eye-measuring and insert them into the tube-holes, respectively tube racks. The difference in weight between the loaded buckets / tube racks should not exceed 10 grams.

It is also allowed to operate. (for example) a 4-place swing out rotor with 2 loaded and 2 unloaded buckets, but it is important that the loaded buckets are then opposite each other (see sketch A, page 7).

To remove the rotor from the shaft turn the rotor nut clockwise repeatedly until the rotor nut has lifted the rotor from its former position on the motor shaft.

3.2 Mounting and securing a micro titre plate rotor

Is same as for swing out rotors.

3.3 Mounting and securing an angle rotor

Clean the motor shaft (1) and the rotor mounting hole (2) with a piece of cloth and place the rotor on the motor shaft ensuring that the pins (3) align correctly with the rotor slots (4), (see figure 7).

BOTTOM ANGLE ROTOR AND TOP VIEW OF
MOTOR SHAFT

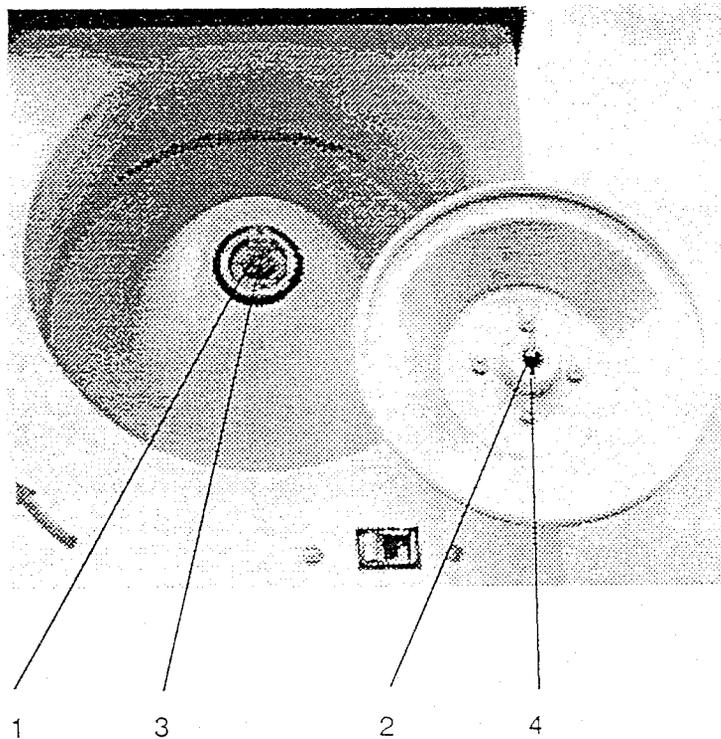


Figure 7

Secure the rotor to the shaft by turning the rotor nut (1) counter-clockwise. When doing this, hold the rotor with the other hand (see figure 8).

VIEW OF SECURING ANGLE ROTOR

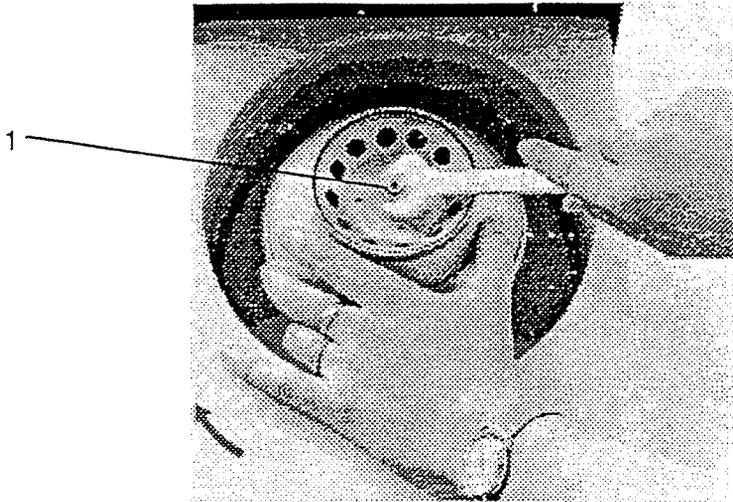


Figure 8

ATTENTION:

Before operation, secure the rotor lid to the rotor by pressing the snap connector onto the rotor nut (see figure 9).

SECURING AN ANGLE ROTOR COVER

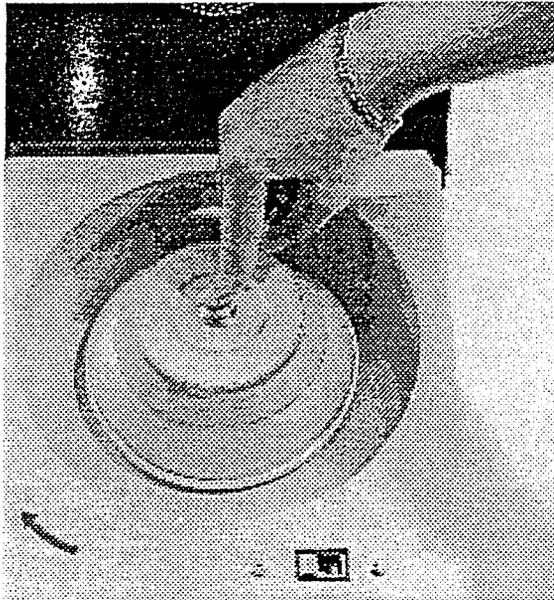


Figure 9

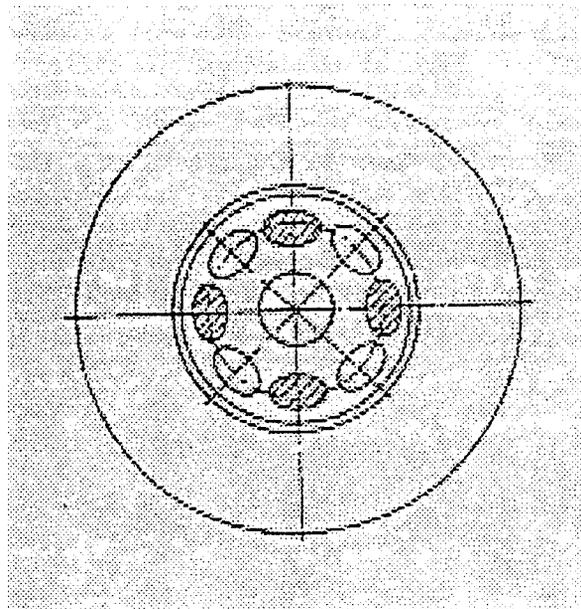
To remove the rotor from the motor shaft, turn the rotor nut clockwise, screw it off and take the rotor vertically off the shaft.



ANGLE ROTOR LOADING DIAGRAM

When loading the rotor you should proceed according to sketch B. Fill the tubes equally by eye-measuring and insert them into the tube-holes of the rotor (see sketch B).

The difference in weight between the tubes should not exceed 2 - 3 grams.



- empty tube-holes
- loaded tube-holes

Sketch B

It is also allowed to operate, (for example) a 6-place rotor with 2 or 4 loaded tubes only, but it is important that the 2 occupied tube-holes are opposite each other (see sketch B).

To remove the rotor from the motor shaft, turn the rotor nut clockwise, screw it off and take the rotor vertically off the shaft.

3.4 Mounting and securing a hematocrit rotor

Clean the motor shaft (1) and the rotor mounting hole (2) with a piece of cloth and place the rotor on the motor shaft ensuring that the pins (3) align correctly with the rotor slots (4), (see figure 10).

BOTTOM VIEW OF HEMATOCRIT ROTOR AND MOTOR SHAFT

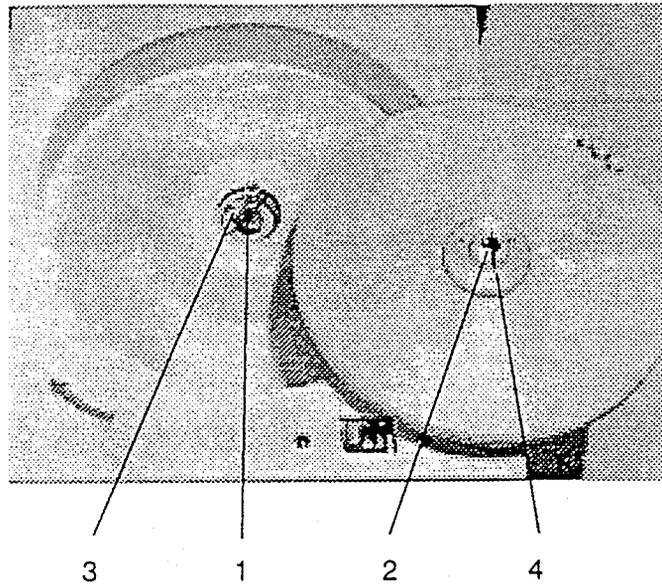


Figure 10

Secure the rotor to the shaft by turning the rotor nut (1) counter-clockwise. When doing this, hold the rotor with the other hand (see figure 11).

VIEW OF SECURING HEMATOCRIT ROTOR

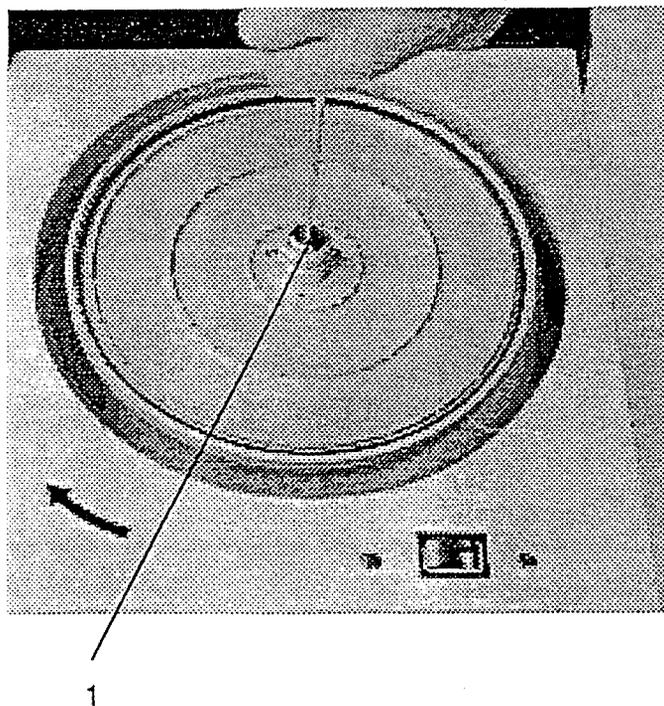


Figure 11

ATTENTION:

Before operation, secure the rotor lid to the rotor by pressing the snap connector onto the rotor nut (see figure 12).

INSTALLING HEMATOCRIT ROTOR COVER

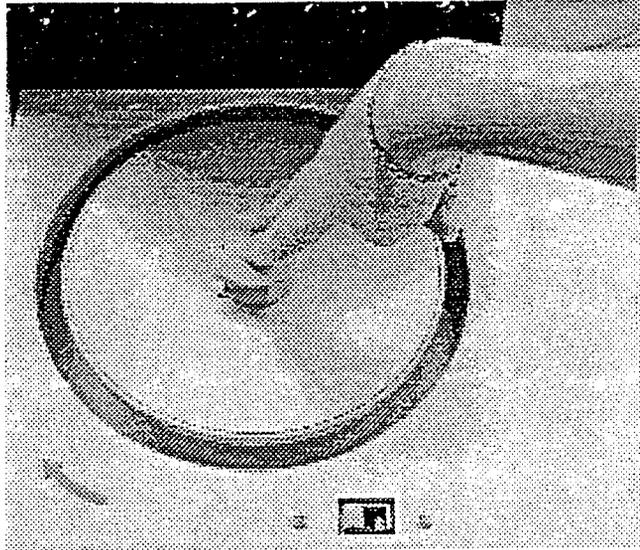


Figure 12

To install or remove the lid, press both locking bolts together (see figure 13).

To remove the rotor from the motor shaft, turn the rotor nut clockwise, screw it off and take the rotor vertically off the shaft.

REMOVING HEMATOCRIT ROTOR COVER

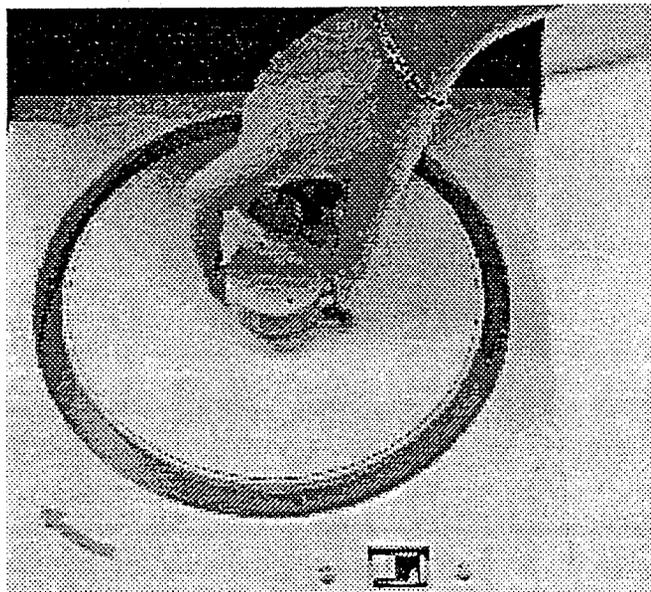


Figure 13

3.5 Overloading of rotors

The max. load permitted for a rotor, which is determined by the manufacturer, as well as the max. speed allowed with the rotor (see indications on the rotor itself) must not be exceeded.

The liquids with which the rotors are loaded should have an average homogeneous density of 1,2 g per ml or less, when the rotor is run at maximum speed.

To spin liquids of a higher density, the speed should be reduced according to the following formula:

$$\text{Reduced speed (n red.)} = \frac{1,2}{\text{higher density value}} \times \text{max. speed (n max.)}$$

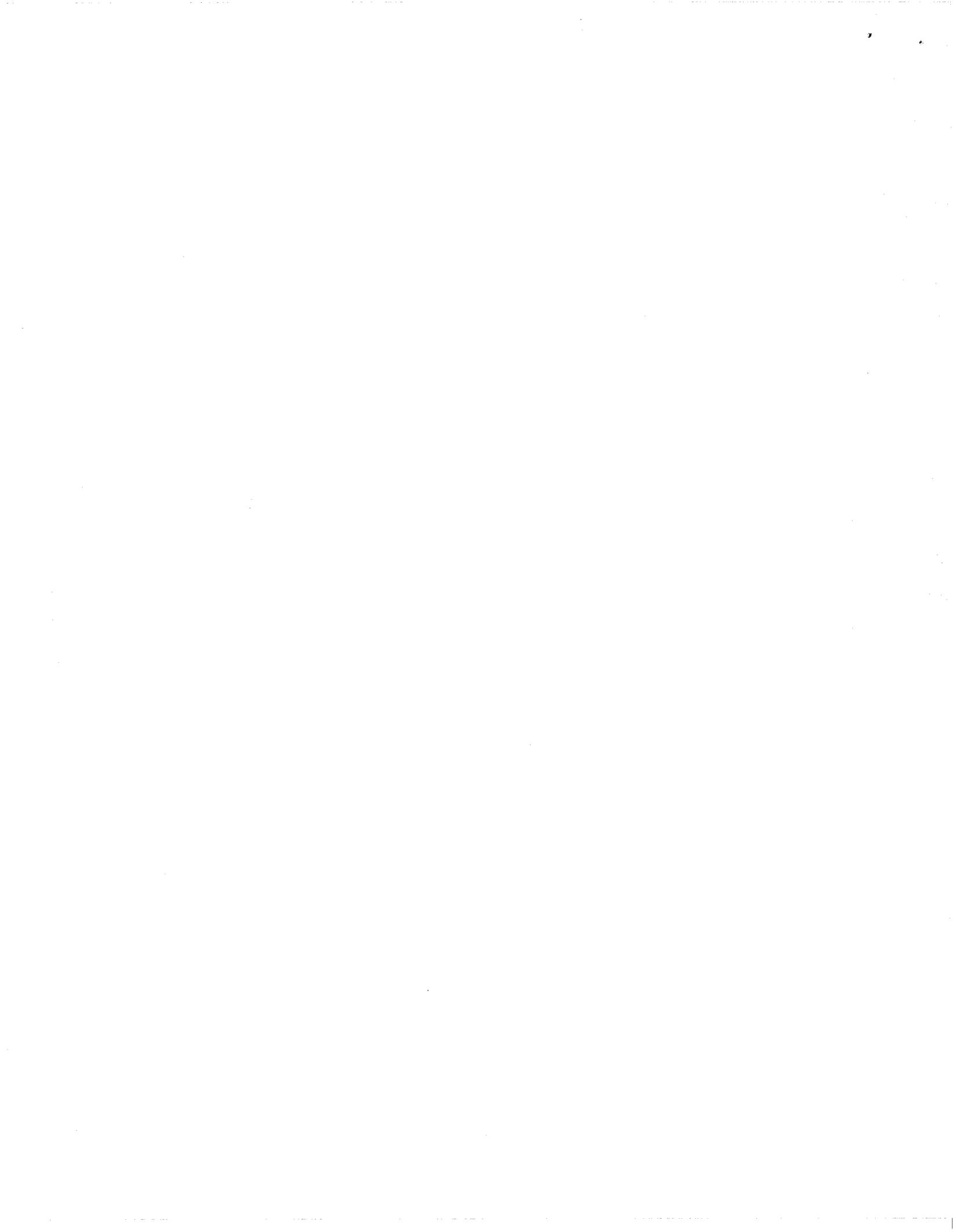
$$\text{Example: } n \text{ red} = \frac{1,2}{1,7} \times 4000 = 2.823 \text{ rpm}$$

In case of any questions please contact the manufacturer!

ATTENTION:

Never operate the centrifuge with rotors or buckets which show any signs of corrosion or mechanical damage.

Never operate with strongly corrosive materials which could damage rotor and buckets.



4. Operation

4.1 Power switch

The power supply switch (1) (green light), switches the centrifuge on and the control lamp of the lid release (2), as well as the digital indication of the speed (3) will light. The power switch (1) should always be the first to be switched on and the last to be switched off, (see figure 14).

4.2 Lid release

When the lid release lamp (2) is on and the rotor is stationary, the lid can be opened. To open the lid, press the lid release switch (2) of the electrical lid lock, the indicator lamp (2) will go out, and then press the lid release button (4) of the mechanical lid lock.

The lid can only be opened when the rotor is stationary and the white control lamp (2) lights up (lid lock according to UVV-VBG 7z).

FRONT VIEW OF CENTRIFUGE

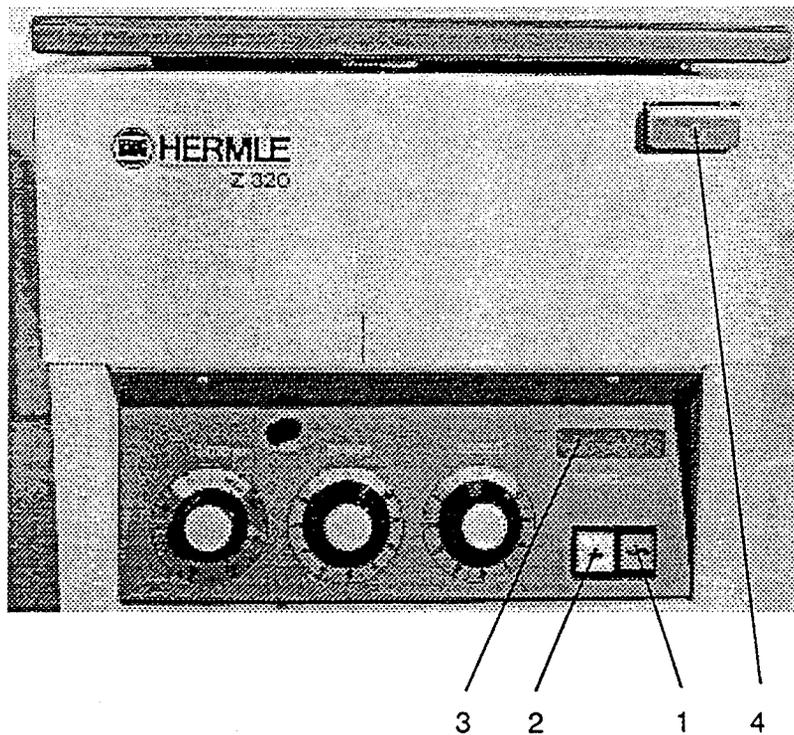


Figure 14

4.3 Rotor installation

see part 3. of the manual.

4.4 Lid lock

After correct fitting and loading of the rotor, close the lid. The white control lamp of the lid release (1) will light, indicating that the rotor is stationary and the lid closed correctly.

The centrifuge can only be started with the lid closed (lid lock according to UVV-VBG 7z).

When the rotor starts accelerating, the lid release indication (1) switches off and the lid cannot be opened, (see figure 15).

4.5 Speed preselection

The speed (rpm) can be steplessly preselected between 100 and 10.000 rpm (depending on the rotor type) with the knob SPEED (2).

Once set, the speed can be reproduced to within $\pm 2\%$. The actual speed is indicated in steps of 100 rpm on the digital indication SPEED (3).

CONTROL PANEL - SPEED SELECTION

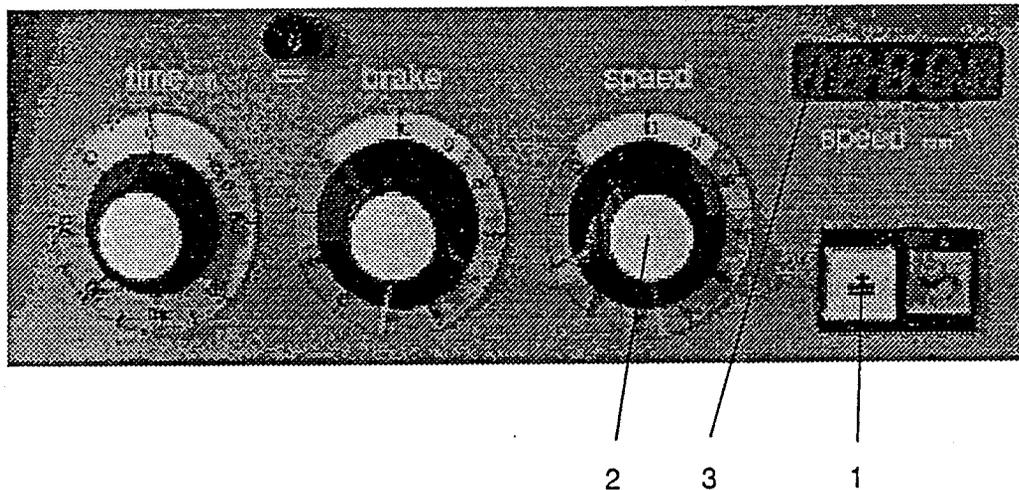


Figure 15

4.6 Preselection of operating time

Turning the timer switch (1) clockwise, sets the operating time (max. 60 mins.) and starts the centrifuge. If the required operation time is 5 minutes or less, the timer should be switched over the 30 minute position and then back to the desired value. When the set time expires, the centrifuge switches off automatically. For continuous operation, switch the knob TIME (1) to the position HOLD, (see figure 16).

4.7 Preselection of brake intensity

To reduce the risk of resuspending samples, during deceleration, it is possible to steplessly pre-select the brake intensity with the knob BRAKE (2), (see figure 16). In addition, please have a look at the acceleration and deceleration curves under point 8.1!

CONTROL PANEL

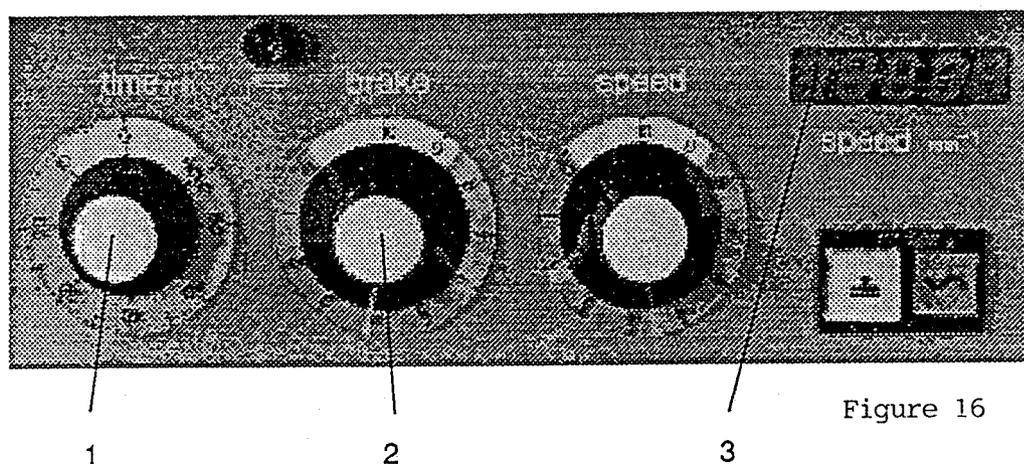


Figure 16

4.8 Stopping the centrifuge

When the preselected time has elapsed and the timer reaches the "0" position, the centrifuge will automatically start to decelerate and will soon come to a complete stop, at which time the lid release light will be illuminated, allowing the lid to be opened. The timer may be turned back to "0" at any time should there be a reason to discontinue operation.

5. Safety facilities

5.1 Imbalance

In case of unequal loading of opposite buckets / tube racks or tube-holes, the operation is interrupted during the acceleration phase, and the centrifuge switches off. To indicate, when the digital LED speed display blinks on and off, an imbalance cut off has occurred.

The centrifuge cannot be re-started until the imbalance has been corrected and the lid has been opened and re-closed.

6. Service and Maintenance

6.1 Service of centrifuge

Centrifuge service and maintenance should be done regularly and only by authorized and qualified personnel.

6.2 Cleaning the centrifuge

Always keep the centrifuge housing, rotor chamber, rotors and rotor accessories clean. The bucket insert bolts of a swing out rotor should be regularly greased. Cleaning is not merely for hygienic or aesthetic purposes, but also is necessary to prevent corrosion and damage to the centrifuge.

Anodized parts such as rotors, reduction plates etc., should only be cleaned with neutral cleaning agents (pH value 6 - 8). Never use an alkaline cleaning agent (pH > 8). After cleaning ensure that all parts are dried thoroughly by hand or in a warm-air-cabinet (max. temp. + 50°C).

It is recommended that all anodized aluminium parts are regularly treated with anti-corrosion oil, so that their durability will be increased and the corrosion risk reduced.

6.3 Cleaning of centrifuge after breakage of glass tubes/glass bottles

With high g-values, there is a possibility that tube breakage will occur.

Should this happen, the centrifuge rotor and rotor chamber must be thoroughly cleaned and all broken particles must be removed immediately. If this is not done, they could scratch the protecting coat of the rotor or stick to the bucket insert bolts and hinder the buckets to swing out properly.

If the rotor chamber has not been properly cleaned, this will produce a fine black dust which can cause significant damage to the centrifuge.

6.4 Disinfection

If, due to tube breakage, infectious material contaminates the centrifuge, rotor, rotor chamber, buckets etc. should be disinfected !!!

Rotor and swing-out buckets must not be autoclaved.

Rotor and rotor chamber should then be treated with a neutral disinfection agent. This would be the best way to achieve a good result upon all surfaces.



7. Breakdown

7.1 Emergency lid release

In case of power failure or any malfunction, the lid can be opened manually by the following procedure:

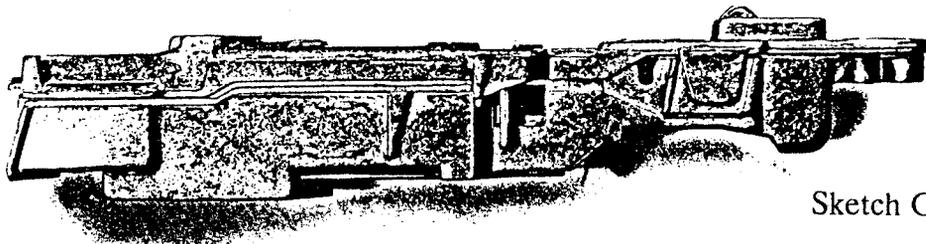
1. Switch off the centrifuge and unplug the power cord.
2. Remove the plastic plug (1) on the side of the housing.
3. Pull the white nylon tab, which is located behind the plastic plug

(1)



Figure 17

VIEW OF INNER LID LOCK MECHANISM



Sketch C

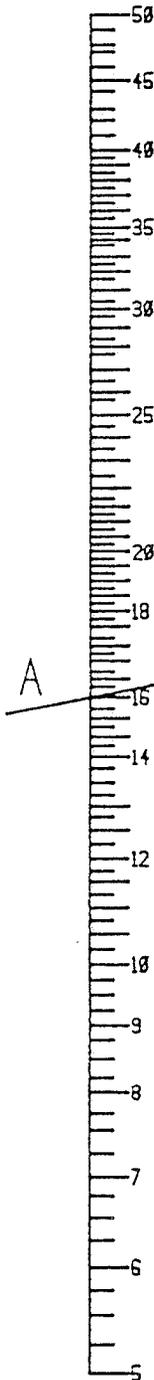
7.2 Check list / Trouble shooting

| FAULT | POSSIBLE REASON | SOLUTION |
|---|---|--|
| Centrifuge will not start - no indication on front panel. | No power supply. Defective fuse. | Check mains (power) and centrifuge fuses. Replace if necessary. |
| ***** | | |
| Lid cannot be released. | Defective lid lock. Lid lock is jammed. No power from PC board. | Open manually (see 7.1) Re-adjust lid lock. Call service. |
| ***** | | |
| Centrifuge cannot be started, although power is on. | Lid not closed correctly (white indicator lamp does not light). No speed or time preselected. Fuse on front panel is defective. | Close lid correctly. Check and set the time. Check fuses and replace if necessary. |

CHART

For the Determination of the g - Value

Spinning radius in cm

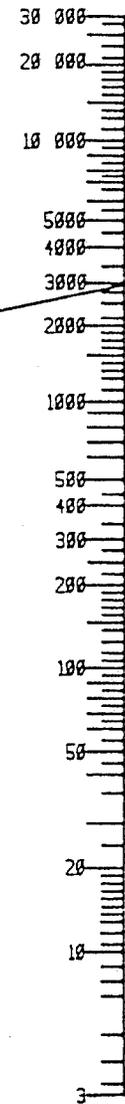


Example :

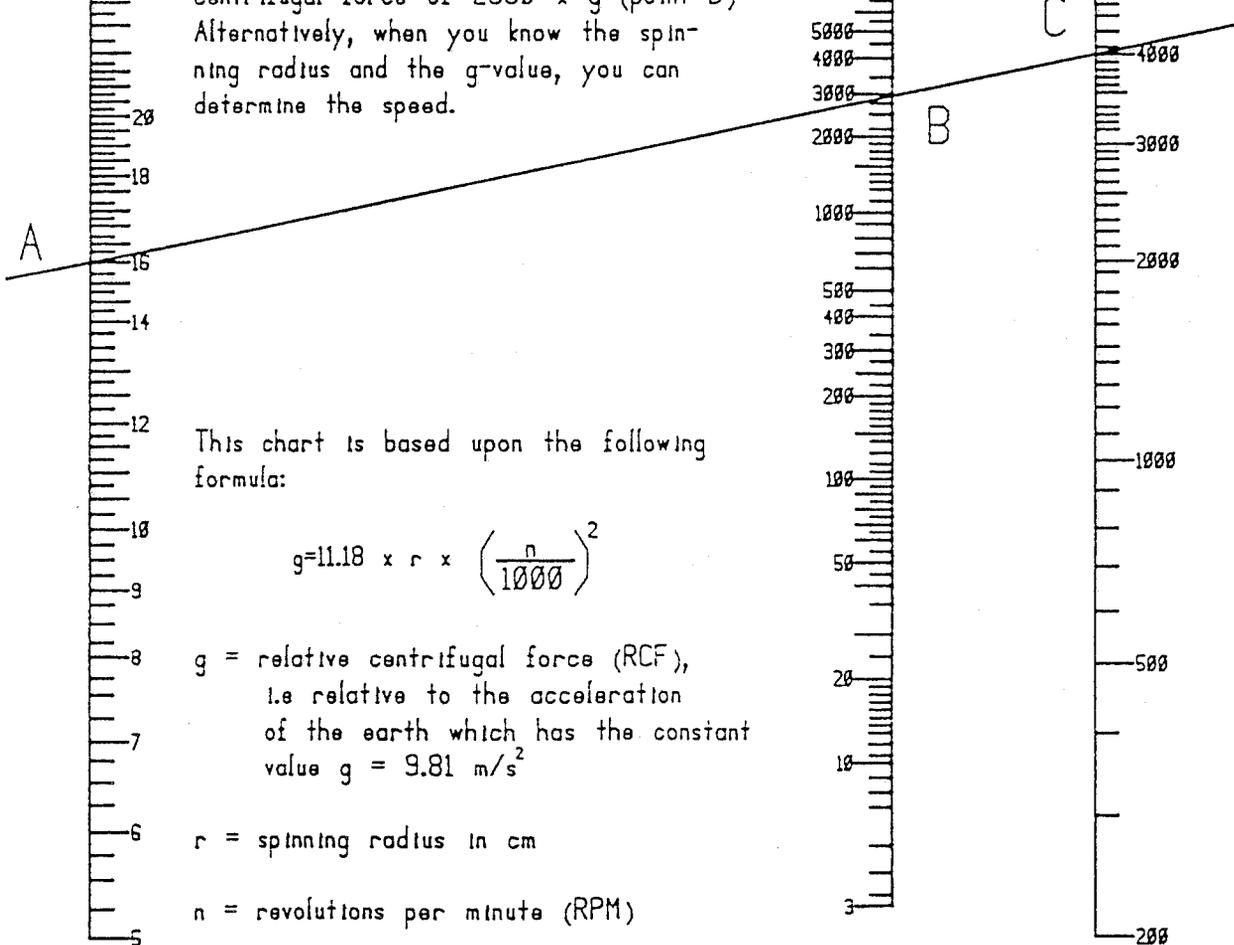
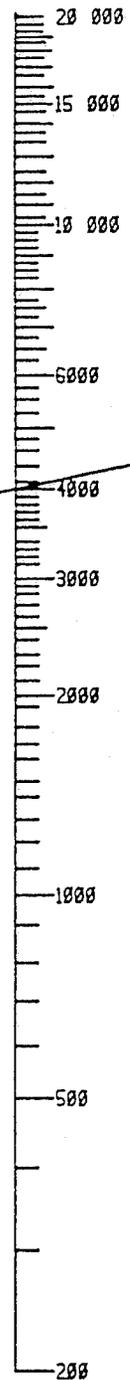
To determine the spinning radius you measure the distance from the center of the drive shaft up to the most outer part of your sample tube when it is in spinning position.

Thus, you will get with a radius $r=16$ cm (point A) and with a speed $n = 4000$ rpm/min (point C) a relative centrifugal force of $2860 \times g$ (point B). Alternatively, when you know the spinning radius and the g-value, you can determine the speed.

Relative centrifugal force in "g"



Speed (RPM) per minute



This chart is based upon the following formula:

$$g = 11.18 \times r \times \left(\frac{n}{1000} \right)^2$$

g = relative centrifugal force (RCF),
i.e. relative to the acceleration of the earth which has the constant value $g = 9.81 \text{ m/s}^2$

r = spinning radius in cm

n = revolutions per minute (RPM)

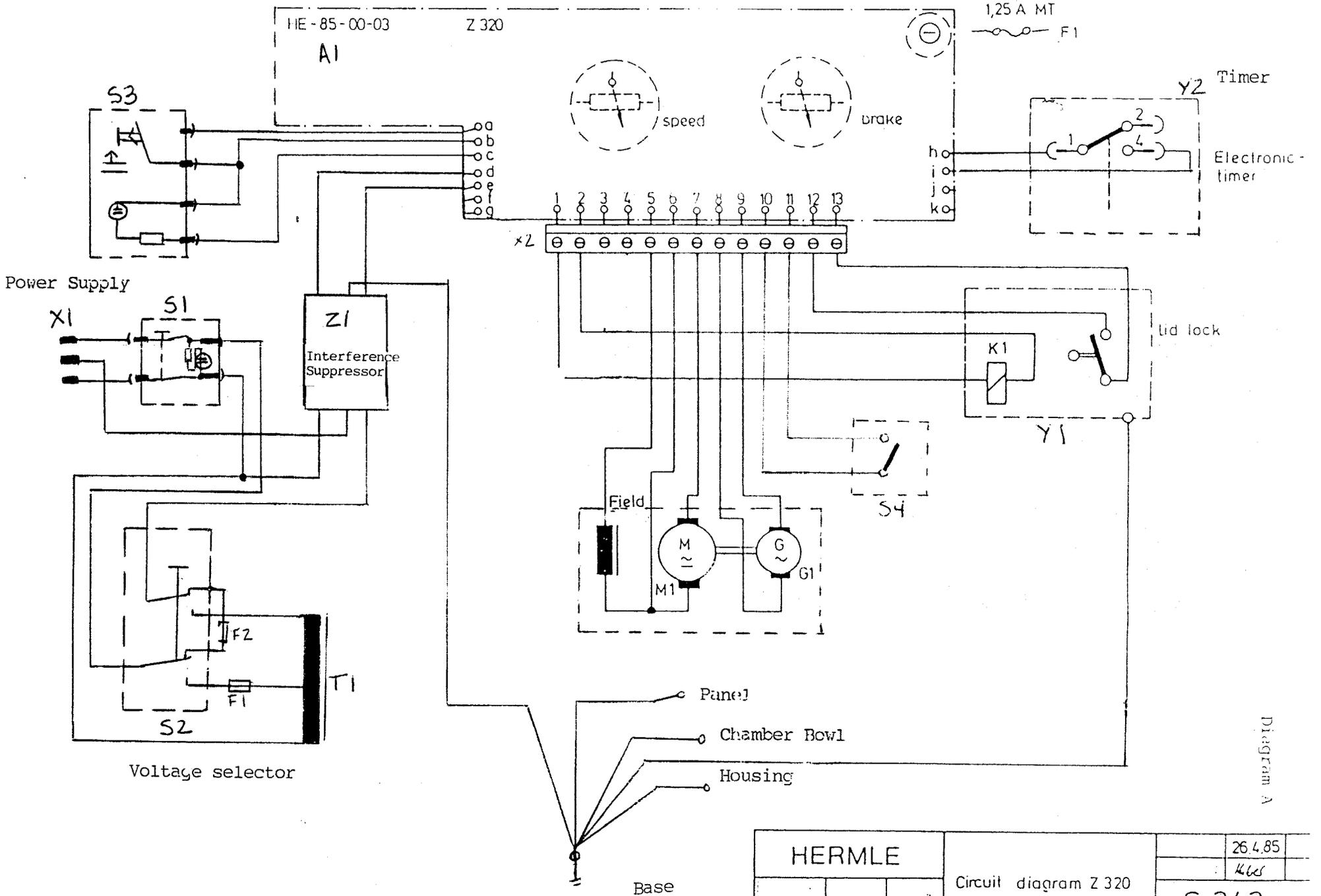


Diagram A

| | | | |
|-----------------------|--|---------|--|
| HERMLE | | 26.4.85 | |
| | | 466 | |
| Circuit diagram Z 320 | | S 242 | |
| Name | | | |

DESCRIPTION OF CIRCUIT OPERATION

The following paragraphs refer to the wiring diagram A on page 22. The wiring diagram should be referred to while reading the circuit descriptions of the centrifuge.

1. Power Supply

When the main power switch (S1) is activated, the line current that is supplied through the main power cord (X1), illuminates the green pilot lamp in the power switch. When the voltage selector on the back panel of the centrifuge (S2) is in the 115V position, the line current flows through the fuse (F1) to the interference suppressor (Z1) via the primary winding of the main power transformer (T1).

If the voltage selector is in the 220V/230V position, line current flows through fuse (F2) to the interference suppressor (Z1) and bypasses the power transformer.

From the interference suppressor (Z1), current flows directly to the control unit circuit board (A1) contacts "D" and "E".

2. Lid Interlock

When the centrifuge is in operation and the rotor is in motion, the centrifuge lid remains locked by an electromagnetic latch (Y1). The lid cannot be opened until the pilot lamp of lid switch (S3) is illuminated, indicating that the rotor has come to a complete stop. When the lid is opened (or not completely closed) the pilot lamp goes out. When the rotor has ceased rotating, the pilot lamp receives voltage from the contacts "B" and "C" of control unit A1 and therefore becomes illuminated. After pressing the lid switch (S3), voltage passes to the control unit A1 via contact "A", thereby activating the unlocking magnet in Y1 via X2.1 and X2.2. Then the lid is opened. Simultaneously, the switch contact in Y1 informs the control unit (A1) that the lid is open and the pilot lamp goes out.

3. Timer

The timer is a mechanical timer and is therefore independent of voltage and frequency (Hz). When the timer knob is turned, the duration of operation is preselected via the knob's integral dial. Turning the timer knob also closes switch contacts H and I thereby initiating rotation.

4. Imbalance Detector

The centrifuge is equipped with an imbalance detector which prevents operation with an unbalanced or improperly loaded rotor. This is controlled by switch S4 which opens upon detection of unacceptable radial movement of the motor M1 during acceleration. The control unit monitors this function via X2.10 and X2.11.

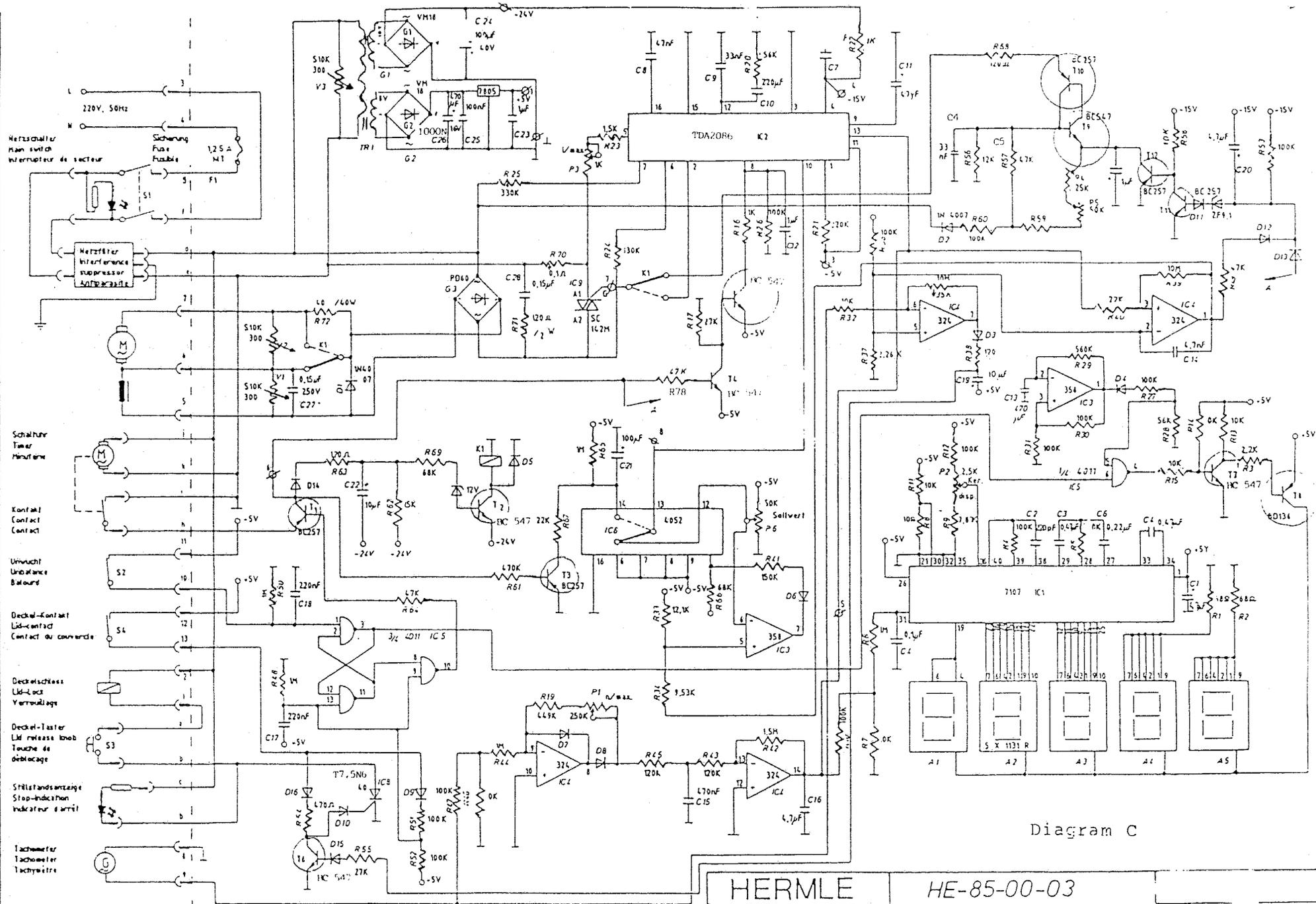
5. Drive System

The rotor is driven by a DC motor (M1) that is supplied with variable voltage DC by control unit A1. A tach-generator G1 is mechanically connected to motor M1 and indicates rotor speed on the LED display.

Braking is effected by application of a variable voltage to the field windings of motor M1. This variable voltage is controlled by the brake potentiometer on control unit A1. All armature regeneration is dissipated by a braking resistor on control unit A1.

6. Control Unit (Circuit Board) - see diagram D on page 25

The centrifuge's functions are controlled by the control unit (A1). It is a closed loop system which analyzes the difference between the set point and actual values. This creates an error voltage which controls a phase controller with triac and a downstream bridge rectifier. The changeover from drive mode to braking mode is facilitated by relay contacts (K1) controlled by the timer. The speed indicator uses a digitalized signal derived from the rectified tachgenerator voltage.



Netzschalter
Main switch
Wentruer de secteur

Netzfilter
Interference suppressor
Antiparasite

Schaltuhr
Timer
Minuterie

Kontakt
Contact
Contact

Umwucht
Unbalance
Balourd

Deckel-Kontakt
Lid-contact
Contact du couvercle

Deckelschloss
Lid-lock
Verrouillage

Deckel-Tester
Lid release knob
Touche de debloage

Stillstandsanzeige
Stop-indication
Indicateur d'arrêt

Tachometer
Tachometer
Tachymètre

Diagram C

| | | | |
|--------|--|-------------|------|
| HERMLE | | HE-85-00-03 | |
| And Nr | | Power Unit | Z320 |
| Name | | S 236 | |

**CORRESPONDING PART LIST
TO DIAGRAM C
(LISTING OF SEMICONDUCTORS)**

| Item | Part No. | Description | | | | |
|------|----------|-------------|----------|------|------|---------|
| R 1 | 60.0010 | Resistor | (carbon) | 68 | Ohm | tol. 5% |
| R 2 | 60.0010 | Resistor | (carbon) | 68 | Ohm | tol. 5% |
| R 3 | 60.0028 | Resistor | (carbon) | 2.2 | kOhm | tol. 5% |
| R 4 | 60.0048 | Resistor | (carbon) | 100 | kOhm | tol. 5% |
| R 5 | 60.0048 | Resistor | (carbon) | 100 | kOhm | tol. 5% |
| R 6 | 60.00107 | Resistor | (metal) | 1 | MOhm | tol. 1% |
| R 7 | 60.0091 | Resistor | (metal) | 10 | kOhm | tol. 1% |
| R 8 | 60.0091 | Resistor | (metal) | 10 | kOhm | tol. 1% |
| R 9 | 60.0089 | Resistor | (metal) | 7.8 | kOhm | tol. 1% |
| R 10 | 60.0097 | Resistor | (metal) | 100 | kOhm | tol. 1% |
| R 11 | 60.0091 | Resistor | (metal) | 10 | kOhm | tol. 1% |
| R 12 | 60.0097 | Resistor | (metal) | 100 | kOhm | tol. 1% |
| R 13 | 60.0036 | Resistor | (carbon) | 10 | kOhm | tol. 5% |
| R 14 | 60.0036 | Resistor | (carbon) | 10 | kOhm | tol. 5% |
| R 15 | 60.0036 | Resistor | (carbon) | 10 | kOhm | tol. 5% |
| R 16 | 60.0024 | Resistor | (carbon) | 1 | kOhm | tol. 5% |
| R 17 | 60.0041 | Resistor | (carbon) | 27 | kOhm | tol. 5% |
| R 18 | 60.0044 | Resistor | (carbon) | 47 | kOhm | tol. 5% |
| R 19 | ----- | | | | | |
| R 20 | 60.0045 | Resistor | (carbon) | 56 | kOhm | tol. 5% |
| R 21 | 60.0052 | Resistor | (carbon) | 220 | kOhm | tol. 5% |
| R 22 | 60.0024 | Resistor | (carbon) | 1 | kOhm | tol. 5% |
| R 23 | 60.0026 | Resistor | (carbon) | 1.5 | kOhm | tol. 5% |
| R 24 | 60.0054 | Resistor | (carbon) | 330 | kOhm | tol. 5% |
| R 25 | 60.0054 | Resistor | (carbon) | 330 | kOhm | tol. 5% |
| R 26 | 60.0048 | Resistor | (carbon) | 100 | kOhm | tol. 5% |
| R 27 | 60.0048 | Resistor | (carbon) | 100 | kOhm | tol. 5% |
| R 28 | 60.0045 | Resistor | (carbon) | 56 | kOhm | tol. 5% |
| R 29 | 60.0057 | Resistor | (carbon) | 560 | kOhm | tol. 5% |
| R 30 | 60.0048 | Resistor | (carbon) | 100 | kOhm | tol. 5% |
| R 31 | 60.0048 | Resistor | (carbon) | 100 | kOhm | tol. 5% |
| R 32 | 60.0036 | Resistor | (carbon) | 10 | kOhm | tol. 5% |
| R 33 | 60.0092 | Resistor | (metal) | 12.1 | kOhm | tol. 1% |



| Item | Part No. | Description | | | | |
|------|----------|-------------|----------|-----------|---------|--|
| R 34 | 60.0090 | Resistor | (metal) | 9.53 kOhm | tol. 1% | |
| R 35 | 60.0072 | Resistor | (carbon) | 10 MOhm | tol. 5% | |
| R 36 | 60.0097 | Resistor | (metal) | 100 kOhm | tol. 1% | |
| R 37 | 60.0084 | Resistor | (metal) | 2.26 kOhm | tol. 1% | |
| R 38 | 60.0013 | Resistor | (carbon) | 120 Ohm | tol. 5% | |
| R 39 | 60.0072 | Resistor | (carbon) | 10 MOhm | tol. 5% | |
| R 40 | 60.0040 | Resistor | (carbon) | 22 kOhm | tol. 5% | |
| R 41 | 60.0050 | Resistor | (carbon) | 150 kOhm | tol. 5% | |
| R 42 | 60.0062 | Resistor | (carbon) | 1.5 MOhm | tol. 5% | |
| R 43 | 60.0049 | Resistor | (carbon) | 120 kOhm | tol. 5% | |
| R 44 | 60.0060 | Resistor | (carbon) | 1 MOhm | tol. 5% | |
| R 45 | 60.0049 | Resistor | (carbon) | 120 kOhm | tol. 5% | |
| R 46 | 60.0036 | Resistor | (carbon) | 10 kOhm | tol. 5% | |
| R 47 | 60.0048 | Resistor | (carbon) | 100 kOhm | tol. 5% | |
| R 48 | 60.0060 | Resistor | (carbon) | 1 MOhm | tol. 5% | |
| R 49 | 60.0044 | Resistor | (carbon) | 47 kOhm | tol. 5% | |
| R 50 | 60.0060 | Resistor | (carbon) | 1 MOhm | tol. 5% | |
| R 51 | 60.0048 | Resistor | (carbon) | 100 kOhm | tol. 5% | |
| R 52 | 60.0048 | Resistor | (carbon) | 100 kOhm | tol. 5% | |
| R 53 | 60.0048 | Resistor | (carbon) | 100 kOhm | tol. 5% | |
| R 54 | 60.0056 | Resistor | (carbon) | 470 kOhm | tol. 5% | |
| R 55 | 60.0041 | Resistor | (carbon) | 27 kOhm | tol. 5% | |
| R 56 | 60.0037 | Resistor | (carbon) | 12 kOhm | tol. 5% | |
| R 57 | 60.0044 | Resistor | (carbon) | 47 kOhm | tol. 5% | |
| R 58 | 60.0036 | Resistor | (carbon) | 10 kOhm | tol. 5% | |
| R 59 | 60.0042 | Resistor | (carbon) | 33 kOhm | tol. 5% | |
| R 60 | 60.0048 | Resistor | (carbon) | 100 kOhm | tol. 5% | |
| R 61 | 60.0056 | Resistor | (carbon) | 470 kOhm | tol. 5% | |
| R 62 | 60.0048 | Resistor | (carbon) | 15 kOhm | tol. 5% | |
| R 63 | 60.0013 | Resistor | (carbon) | 120 kOhm | tol. 5% | |
| R 64 | 60.0044 | Resistor | (carbon) | 47 kOhm | tol. 5% | |
| R 65 | 60.0060 | Resistor | (carbon) | 1 MOhm | tol. 5% | |
| R 66 | 60.0046 | Resistor | (carbon) | 68 kOhm | tol. 5% | |

| Item | Part No. | Description | | | | | |
|------|----------|--------------|---------------|------------|----------|---------|----------|
| R 67 | 60.0040 | Resistor | (carbon) | 22 | kOhm | tol. 5% | |
| R 60 | 60.0048 | Resistor | (carbon) | 100 | kOhm | tol. 5% | |
| R 68 | 60.0013 | Resistor | (carbon) | 120 | kOhm | tol. 5% | |
| R 69 | 60.0046 | Resistor | (carbon) | 68 | kOhm | tol. 5% | |
| R 70 | 60.0456 | Resistor | (wire) | 0.1 | Ohm | tol. 5% | Bgr. 720 |
| R 71 | 60.0073 | Resistor | (carbon) | 120 | Ohm | tol. 5% | 0.5 W |
| R 72 | 37.0031 | Resistor | (wire) | 40 | Ohm | tol. 5% | 40 W |
| | | | | | | | |
| P 1 | 60.0124 | Poti | 250 | kOhm | tol. 20% | 0.15 W | |
| P 2 | 60.0130 | Poti | 2.5 | kOhm | tol. 20% | 0.15 W | |
| P 3 | 60.0120 | Poti | 1 | kOhm | tol. 20% | 0.15 W | |
| P 4 | 60.0121 | Poti | 25 | kOhm | tol. 20% | 0.15 W | |
| P 5 | 60.0134 | Poti | 50 | kOhm | tol. 20% | 0.25 W | |
| P 6 | 60.0134 | Poti | 50 | kOhm | tol. 20% | 0.25 W | |
| | | | | | | | |
| V 1 | 60.0230 | Varistor | S 10 K | 300 V | | | |
| V 2 | 60.0230 | Varistor | S 10 K | 300 V | | | |
| V 3 | 60.0230 | Varistor | S 10 K | 300 V | | | |
| | | | | | | | |
| G 1 | 60.0248 | Diode-bridge | Typ: DF 02 M | 2A/200 V | | | |
| G 2 | 60.0248 | Diode-bridge | Typ: DF 02 M | 2A/200 V | | | |
| G 3 | 60.0249 | Diode-bridge | Typ: KBP 06 M | 1.5A/600 V | | | |
| | | | | | | | |
| D 1 | 60.0260 | Diode | Typ: 1N4007 | | | | |
| D 2 | 60.0260 | Diode | Typ: 1N4007 | | | | |
| D 3 | 60.0259 | Diode | Typ: 1N4148 | | | | |
| D 4 | 60.0259 | Diode | Typ: 1N4148 | | | | |
| D 5 | 60.0259 | Diode | Typ: 1N4148 | | | | |
| D 6 | 60.0259 | Diode | Typ: 1N4148 | | | | |
| D 7 | 60.0259 | Diode | Typ: 1N4148 | | | | |
| D 8 | 60.0259 | Diode | Typ: 1N4148 | | | | |
| D 9 | 60.0259 | Diode | Typ: 1N4148 | | | | |
| D 10 | 60.0259 | Diode | Typ: 1N4148 | | | | |
| D 11 | 60.0259 | Diode | Typ: 1N4148 | | | | |

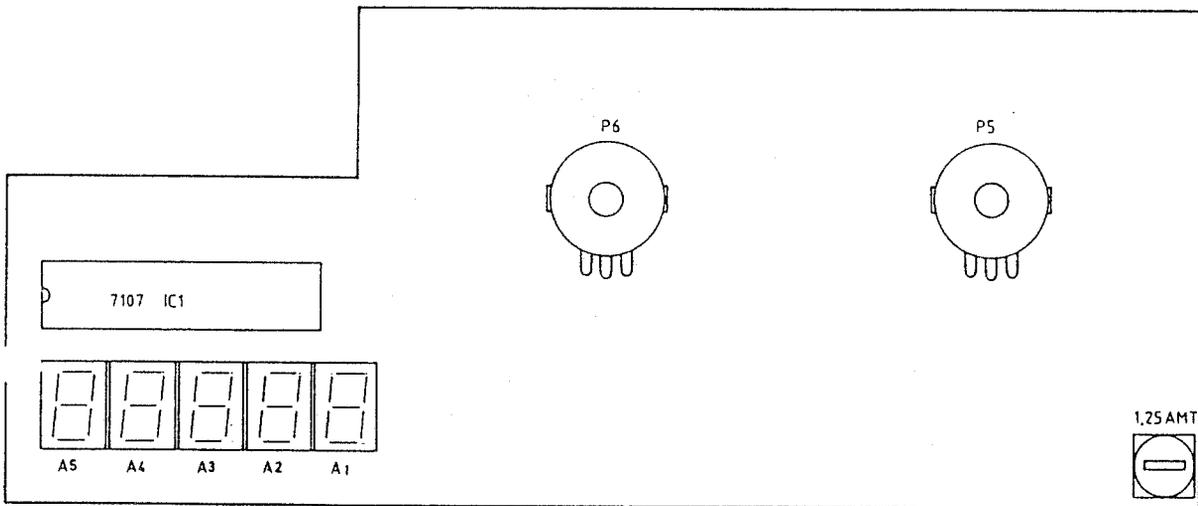
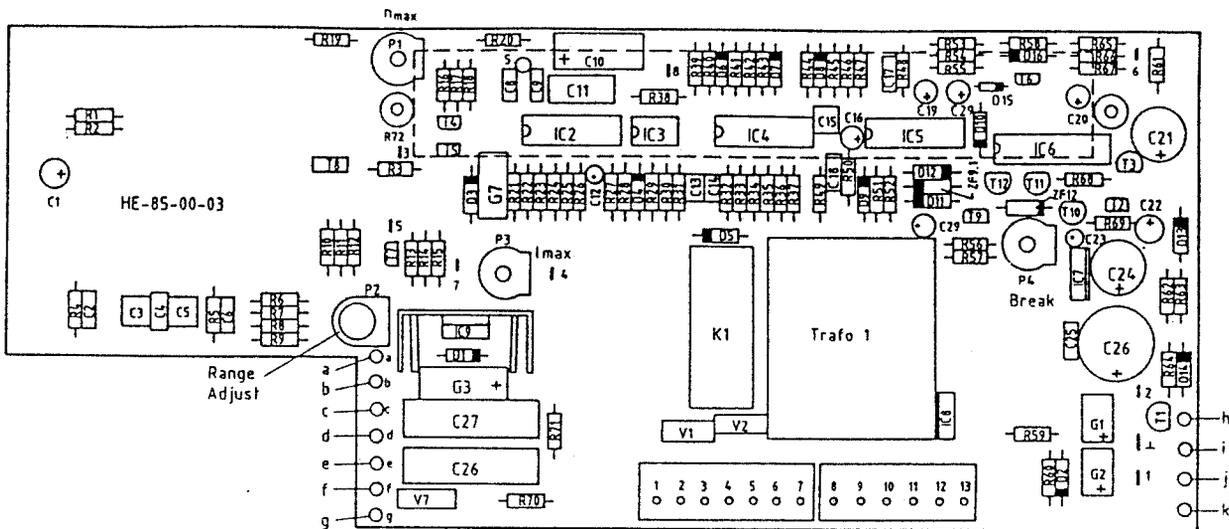
| Item | Part No. | Description | | |
|--------|----------|----------------|----------------------|---------------------|
| D 12 | 60.0259 | Diode | Typ: 1N4148 | |
| D 13 | 60.0259 | Diode | Typ: 1N4148 | |
| D 14 | 60.0259 | Diode | Typ: 1N4148 | |
| D 15 | 60.0259 | Diode | Typ: 1N4148 | |
| D 16 | 60.0259 | Diode | Typ: 1N4148 | |
| ZF 12 | 60.0258 | Zener-Diode | Typ: ZPD 12 | |
| ZF 9.1 | 60.0258 | Zener-Diode | Typ: ZPD 9.1 | |
| TR 1 | 60.0359 | Transformator | 220V/ 18V, 8V BV 359 | |
| F 1 | 25.0021 | Fuse | 1.25A - MT | 5 x 20 mm |
| K 1 | 60.0312 | Relay | 24V - 2XU | Typ: AZ 732-053-51 |
| A 1 | 60.0265 | LED-Indication | 13mm red | HD 1131 R/TDSR-5150 |
| A 2 | 60.0265 | LED-Indication | 13mm red | HD 1131 R/TDSR-5150 |
| A 3 | 60.0265 | LED-Indication | 13mm red | HD 1131 R/TDSR-5150 |
| A 4 | 60.0265 | LED-Indication | 13mm red | HD 1131 R/TDSR-5150 |
| A 5 | 60.0265 | LED-Indication | 13mm red | HD 1131 R/TDSR-5150 |
| IC 1 | 60.0178 | IC | ICL 7107 CPL | |
| IC 2 | 60.0179 | IC | TDA 2086 A | |
| IC 3 | 60.0177 | IC | 358 N | |
| IC 4 | 60.0172 | IC | 324 N | |
| IC 5 | 60.0187 | IC | 4011 B | |
| IC 6 | 60.0183 | IC | 4052 B | |
| IC 7 | 60.0234 | IC | 7805 TO 220 | Voltage-regulator |
| IC 8 | 60.0247 | Tyristor | T 7.5 N6 | FOB |
| IC 3 | 60.0177 | IC | | |
| IC 9 | 60.0245 | Triac | SC 124 M | |

| Item | Part No. | Description | | | | |
|------|----------|--------------------|--------|------|----------|-----|
| C 1 | 60.0160 | Capacitor,ELKO | 47uF | 10V | 12x6.5 | Ax |
| C 2 | 60.0169 | Capacitor,KT | 220pF | 160V | 5x12 | Ax |
| C 3 | 60.0147 | Capacitor,KT | 470nF | 63V | tol. | 5% |
| C 4 | 60.0147 | Capacitor,KT | 470nF | 63V | tol. | 5% |
| C 4 | 60.0143 | Capacitor,KT | 100nF | 63V | tol. | 10% |
| C 5 | 60.0152 | Capacitor,Tantalum | 1uF | 35V | | |
| C 6 | 60.0145 | Capacitor,KT | 0.22uF | 63V | tol. | 10% |
| C 7 | 60.0159 | Capacitor,ELKO | 22uF | 25V | 60x11 | Ax |
| C 8 | 60.0141 | Capacitor,KT | 47nF | 63V | tol. | 10% |
| C 9 | 60.0140 | Capacitor,KT | 33nF | 63V | tol. | 10% |
| C 10 | 60.0163 | Capacitor,ELKO | 220uF | 10V | 18.5x6.9 | Ax |
| C 11 | 60.0160 | Capacitor,ELKO | 47uF | 10V | 12x6.5 | Ax |
| C 12 | 60.0152 | Capacitor,Tantalum | 1uF | 35V | | |
| C 13 | 60.0147 | Capacitor,KT | 470nF | 63V | tol. | 5% |
| C 14 | 60.0135 | Capacitor,KT | 4.7nF | 63V | tol. | 5% |
| C 15 | 60.0147 | Capacitor,KT | 470nF | 63V | tol. | 5% |
| C 16 | 60.0152 | Capacitor,Tantalum | 4.7uF | 35V | | |
| C 17 | 60.0145 | Capacitor,KT | 0.22uF | 63V | tol. | 5% |
| C 18 | 60.0145 | Capacitor,KT | 0.22uF | 63V | tol. | 10% |
| C 19 | 60.0154 | Capacitor,Tantalum | 10uF | 16V | | |
| C 20 | 60.0153 | Capacitor,Tantalum | 4.7uF | 35V | | |
| C 21 | 60.0162 | Capacitor,ELKO | 100uF | 40V | 13x10 | Ax |
| C 22 | 60.0160 | Capacitor,ELKO | 10uF | 35V | | |
| C 23 | 60.0152 | Capacitor,Tantalum | 1uF | 35V | | |
| C 24 | 60.0162 | Capacitor,ELKO | 100uF | 40V | 13x10 | |
| C 25 | 60.0143 | Capacitor,KT | 100nF | 63V | tol. | 10% |
| C 26 | 60.0388 | Capacitor,ELKO | 1000uF | | 15x25 | Rd |
| C 27 | 60.0151 | Capacitor,Mp | 150nF | 250V | | |
| C 28 | 60.0151 | Capacitor,Mp | 150nF | 250V | | |

| Item | Part No. | Description | |
|------|----------|-------------|-----------|
| T 1 | 60.257 | Transistor | BC 257 |
| T 2 | 60.241 | Transistor | BC 547 B |
| T 3 | 60.257 | Transistor | BC 257 |
| T 4 | 60.241 | Transistor | BC 547 B |
| T 5 | 60.241 | Transistor | BC 547 B |
| T 6 | 60.241 | Transistor | BC 547 B |
| T 7 | 60.241 | Transistor | BC 547 B |
| T 8 | 60.244 | Transistor | BD 136-16 |
| T 9 | 60.241 | Transistor | BC 547 B |
| T 10 | 60.257 | Transistor | BC 257 |
| T 11 | 60.257 | Transistor | BC 257 |
| T 12 | 60.257 | Transistor | BC 257 |



Diagram D



| | | | | |
|----------|-----------------------|-------|------------|---------|
| HERMLE | Board Layout for Z320 | | Datum | 19.3.85 |
| | HE-85-00-03 | | Gez. Gepr. | Shawab |
| Änd. Nr. | Z320 | S 230 | | |
| Menge | | | | |



ACCESSORIES FOR Z320 CENTRIFUGE

| | | |
|-------------|--------------|---|
| C-0320-2 | C-0320-2 | Rotor, 24 x 1.5 ml |
| C-0320-18 | 220.58 V02 | Hematocrit rotor with reader |
| *C-0320-72 | 220.72 V01 + | Rotor, complete with 4 buckets |
| *C-0320-72A | C-0320-72A | Same, but with screw cap for infectious containment |
| C-0320-720 | 220.72.70.04 | Insert for 1 x 100ml tube |
| C-0320-728 | 220.72.78.04 | Insert for 1 x 50ml (conical) |
| C-0320-725 | 220.72.75.04 | Insert, 7 x 5ml (12 x 75, 10 x 75mm) |
| C-0320-724 | 220.72.74.04 | Insert, for 4 each 16 x 100 or 17 x 100mm |
| C-0320-726 | 220.72.76.04 | Insert, for 2 x 15ml tubes |
| C-0320-730 | 220.72.80.04 | Insert, for 4 each 13 x 100mm tubes |
| C-0320-36 | 220.36 V01 | Economy swing-out rotor |
| C-0320-365 | 220.36 V05 | Carrier, 4 x 10-15 ml |
| C-0320-366 | 220.36 V06 | Carrier, 7 x 3-5 ml |
| C-0320-367 | C-0320-367 | Carrier, 4 x 7 ml |
| C-0320-37 | 220.37 V01 | Angle rotor 12 x 15ml, with shields |
| C-0320-38 | C-0320-38 | Angle rotor, 24 x 15ml, with shields |
| C-0320-50 | 220.5 V01 | Rotor, with carriers for micro titration plates |
| C-0320-503 | 220.50.03 | Spare micro plate carrier |
| C-0320-42 | 220.42 V01 | Swing out rotor, 8 x 15ml |
| C-0320-73 | 4473 | Angle rotor, 5,000 RPM, 4 x 50ml |

Table A

