

**2.2 Trouble Shooting**

Error Indication	Error Cause	Possible Error Source	Corrective Procedure
displays remain dark	no mains voltage supply	mains fuse or circuit breaker failed	check fuse or circuit breaker and replace or switch on again
		defective mains cord or switch or instrument socket	check instrument cord, switch and socket, replace defective parts
		faulty mains cord or instrument socket	check instrument cord and socket, replace defective parts
	no low voltage supply for indication board	faulty connection from CPU to indication board	check connections on CPU, indication board and connecting leads, replace defective parts
		faulty indication or CPU board	replace main board completely
	interrupted program	NV-RAM out of socket or not correctly placed	insert the valid NV-RAM and push it correctly into socket
all display elements are shortly illuminated	CPU program reset may be caused by EMI	reduced voltage supply (<10%)	remedy the failure if the voltage drops often, use a voltage stabiliser
		bad or missing ground connection	check all ground connections and the ground connection of all boards
constant	interruption	parameter NV-RAM	no or defective NV-RAM
drive makes noises -no good separation result	mechanics	wear out of motor rubber mount	replace motor rubber mounts (at least every three years)
		motor bearings	replace motor completely
	electrical	defective terminal connection, faulty lead or motor winding	check voltage on motor terminal and winding resistances -see test points on boards
		faulty power electr.	replace main board
lid cannot be opened by key at standstill ->"E-17"	lid coil is not or not sufficiently supplied with voltage	Missing mains voltage	remedy see above, manual opening only at standstill
		PTC resistor has released	after a waiting time of 1-2 minutes press key again
		faulty driving circuit	replace main board
	faulty lid coil	faulty coil winding	replace complete locking assy
	lid is not correctly locked	lid bolt is jamming	push lid centrally into lock and press the key again
		lid is deformed	re-adjust the lid centrally

## 2.3 Error Codes

Error Indication	Error Cause	Possible Error Source	Corrective Procedure
„rotor“ in speed display	wrong selection of detected rotor	inadmissible speed or rcf value was pre-selected	press start again (within 15s), else wait for rotor standstill, lid OPEN/CLOSE, set value, start
“bAL“ message appears in speed display	imbalance run	rotor not symmetrically loaded	open lid, check rotor loading, close lid again and restart
		base is not sturdy enough and comes into vibrations	change or reinforce the base (table, lorry with lockable wheels, etc.)
		centrifuge drive is not correctly levelled	level the centrifuge correctly, use a spirit level on top of unit
		rotor itself has imbalance	rotor must no longer be used, send back to factory
		drive shaft or rotor fixing is damaged	centrifuge must no longer be used, replace nut and/or motor
	signal fault	imbalance NV-RAM	no or defective NV-RAM
		imbalance sensor, sensor board	replace sensor board
circuits of main board		replace the main board	
imbalance but no “bAL“ message	no imbalance cut-off (see 2.4)	imbalance NV-RAM	wrong NV-RAM data
		imbalance sensor	replace sensor board
		circuits of main board	replace the main board
“Lid“ appears in speed display	lid was opened manually during run	forbidden intervention emergency opening device must only be used at standstill	close lid immediately, turn power OFF/ON, press lid down for locking, press start key, press stop to finish run
	protection circuit (15V) interrupted during run	defective micro switch or leads or connectors to micro switch are interrupted	check leads and connectors to micro switch, in case of a faulty micro switch, replace lid lock device completely
		motor over-temperature switch has tripped (no sufficient air flow or motor has run on 2 phases only)	let motor cool down, then check temperature switch and leads with Ohmmeter
			check air cooling and circulation
„OPEn“ appears in speed display by supposedly closed lid	15V supply for protection circuit is interrupted at standstill	loose plug connectors	check plug connectors XA1 and XA2
		interrupted leads to micro switches	check leads to micro switches for continuity
		defective micro switch	in case of faulty micro switch replace lid lock completely

**Error Codes continued**

<b>Error Indication</b>	<b>Error Cause</b>	<b>Possible Error Source</b>	<b>Corrective Procedure</b>
„E-00“, „E-03“ message appears in speed display	rotor didn't turn	rotor is jammed	check for easy movement, remove any jamming objects
		motor is jammed	replace motor
	missing speed signal test: turn rotor by hand, then close the lid	faulty plug or lead connection to speed detection board	check plug contacts and leads, measure speed signal on XW1/3, replace defective parts
		faulty processing circuit	replace main board
	motor didn't start	connections motor to power electronics	check plug contacts and leads, replace faulty parts
		motor windings	Replace motor
driving circuit, FETs		Replace mainboard	
„E-02“ message	program sequence was disturbed	bad ground connect. EMI troubles	check all ground connections tighten loose screws
		internal program error	replace the CPU replace the main board
„E-06“ message	data lines to key board were disturbed	data lines or soldering connections	check lines and soldering points, replace faulty parts
		CPU is defective	CPU exchange
		faulty key or faulty CPU board	replace the main board
„E-08“ message	over-voltage of intermediate circuit	defective leads or brake resistor	check leads and brake resistor, replace defective parts
		driving and/or braking circuits	replace the main board
„E-10“ message	NV-RAM is not initialised	Initialising of NV-RAM is not valid	check NV-RAM and socket, insert the correct NV-RAM
„E-11“ message	NV-RAM is faulty	no data transfer from NV-RAM to CPU	replace the NV-RAM
„E-14“ message	wrong or faulty rotor detection	a wrong rotor was installed	wait for standstill, open the lid and install a correct rotor
		mains voltage failure	press stop key, wait for standstill and restart
		wrong motor phase condition	check rotation direction, if necessary change 2 leads
		faulty detection circuit	replace the main board
„E-15“ message	checksum error	NV-RAM is wrong or defective	replace NV-Ram and insert correctly into socket
„E-16“ message	program interruption	CPU disturbed or defective	replace CPU and /or eliminate disturbance
„E-17“ message, lid didn't open	micro switch does not open after pressing lid	lid is blocked or jammed	press lid centrally in front down again, re-adjust if necessary
		defective micro switch or lid lock	replace lid lock device
		faulty driving circuit	replace the main board
„E-19“ message	wrong key board indication	wrong NV-RAM	Replace the correct NV-RAM
		wrong key board (incl./without cooling)	replace the correct key board

## Error Codes continued

<b>Error Indication</b>	<b>Error Cause</b>	<b>Possible Error Source</b>	<b>Corrective Procedure</b>
„E-22“ message	NV-RAM and CPU didn't match	wrong NV-RAM	Replace the correct NV-RAM
		wrong CPU	Replace the correct CPU
„E-24“ message	2. NV-RAM is missing	NV-RAM for curves is not (correctly) in place	insert the NV-RAM including acceleration./deceleration curves
„E-25“ message	pulsing fault of rotor detection	no rotor installed	install rotor correctly
		loose rotor screwing	tighten rotor sturdy
		big imbalance on start	rotor, spindle or motor bearing
		faulty pulse detection	distance hall sensor, magnets
„E-26“ message	Failure of CPU imbalance	Checksum error NV RAM	Replace the NV-RAM
			Replace the main board

**2.4 Test Points**
**2.4.1 Test Points 120V model**

Test Points	Unit Value	Conditions
mains terminal <b>XN</b> board's resistance	120V AC 337 Ω	all given values are related on 120V (±10%) mains voltage for board's supply
terminal <b>XM</b> motor voltage - values must be the same between all 3 motor leads ( <b>U,V,W</b> )	65V AC 90V AC 165V AC 130V AC 210V AC 250V AC	in each case measured inter 2 motor leads after reaching selected speed - <b>no effective values!</b> 1000 rpm , swing-out rotor #5197 2000 rpm 5000 rpm 5000 rpm, microliter-rotor #5195 10000 rpm 15000 rpm
motor current <b>I<sub>M</sub></b> cable ( <b>1,2,3</b> )	3 * 2,2A 3 * 1,2A 3 * 0,9A 3 * 2,5A	soft iron or digital effective measuring instrument Maximum during acceleration (#5197, 17s) rotor #5197, set speed = 4000 rpm , 200W rotor #5195, set speed = 15000 rpm, 330W maximum during braking phase (#5197, 17s)
intermediate voltage <b>U<sub>D</sub></b> (inter brake resistor's solder pin and control resistor <b>R41</b> )	320V DC 355V DC 310V DC 308V DC 295V DC	at standstill max. during braking phase (#5195, 30s) rotor #5197, set speed = 4000 rpm rotor #5195, set speed = 15000 rpm shortly at maximum acceleration (#5195, 30s)
current <b>I<sub>D</sub></b> of intermediate circuit, (measured as voltage drop across control resistor R41) <b>U<sub>M</sub> = I<sub>D</sub> * R<sub>M</sub></b>	5mV DC 15mV DC 70mV DC 15mV DC 55mV DC 120mV DC 280mV DC -120mV	1000 rpm, swing-out rotor #5197 2000 rpm 5000 rpm 5000 rpm, microliter-rotor #5195 10000 rpm 15000 rpm shortly at maximum acceleration (#5195) shortly at maximum braking (#5195)
motor winding resistance 20°C -insulation value	3x6,4Ω > 10MΩ	switch OFF unit, pull off motor plugs, measure inter 1 -> 2, 2 -> 3, 1 -> 3 resistance inter each phase and motor casing
brake resistor terminal <b>XD</b>	220Ω	switch OFF unit, solder protection O.K., resistance at 20°C
plugs <b>XC1/2</b> lid solenoid	34Ω	condition at rest, resistance at 20°C
lid micro switches plug <b>XA1/2</b>	15V DC	voltage drop by open lid

**2.4.2 Test Points 230V model**

Test Points	Unit Value	Conditions
mains terminal <b>XN</b> board's resistance	230V AC 1050 Ω	all given values are related on 230V (±10%) mains voltage for board's supply
terminal <b>XM</b> motor voltage - values must be the same between all 3 motor leads ( <b>U,V,W</b> )	65V AC 90V AC 165V AC 130V AC 210V AC 250V AC	in each case measured inter 2 motor leads after reaching selected speed - <b>no effective values!</b> 1000 rpm , swing-out rotor #5197 2000 rpm 5000 rpm 5000 rpm, microliter-rotor #5195 10000 rpm 15000 rpm
motor current <b>I<sub>M</sub></b> cable ( <b>1,2,3</b> )	3 * 2,2A 3 * 1,2A 3 * 0,9A 3 * 2,5A	soft iron or digital effective measuring instrument Maximum during acceleration (#5197, 17s) rotor #5197, set speed = 4000 rpm , 200W rotor #5195, set speed = 15000 rpm, 330W maximum during braking phase (#5197, 17s)
intermediate voltage <b>U<sub>D</sub></b> (inter brake resistor's solder pin and control resistor <b>R41</b> )	320V DC 355V DC 310V DC 308V DC 295V DC	at standstill max. during braking phase (#5195, 30s) rotor #5197, set speed = 4000 rpm rotor #5195, set speed = 15000 rpm shortly at maximum acceleration (#5195, 30s)
current <b>I<sub>D</sub></b> of intermediate circuit, (measured as voltage drop across control resistor R41) <b>U<sub>M</sub> = I<sub>D</sub> * R<sub>M</sub></b>	5mV DC 15mV DC 70mV DC 15mV DC 55mV DC 120mV DC 280mV DC -120mV	1000 rpm, swing-out rotor #5197 2000 rpm 5000 rpm 5000 rpm, microliter-rotor #5195 10000 rpm 15000 rpm shortly at maximum acceleration (#5195) shortly at maximum braking (#5195)
motor winding resistance 20°C -insulation value	3x6,4Ω > 10MΩ	switch OFF unit, pull off motor plugs, measure inter 1 -> 2, 2 -> 3, 1 -> 3 resistance inter each phase and motor casing
brake resistor terminal <b>XD</b>	220Ω	switch OFF unit, solder protection O.K., resistance at 20°C
plugs <b>XC1/2</b> lid solenoid	245Ω	condition at rest, resistance at 20°C
lid micro switches plug <b>XA1/2</b>	15V DC	voltage drop by open lid

## 2.5 Imbalance Behaviour

- **Install** in table available **rotor(s)** in unloaded condition

<b>Rotor</b>	<b>Run through weight</b>	<b>Cut off weight</b>
Swing-out 4x100mL #5197	10g	20g
Angle 24x2mL Alu #5195	5g	10g

- Insert rotor dependent **cut-off weights** into opposite buckets. Check this at all 4 possibilities by putting the weights pair by pair into the other buckets. The centrifuge must stop 4 times indicating "bAL" message - in case of false behaviour see trouble shooting: no "bAL" indication.
- Insert the **admissible imbalance weights** in the same manner, the centrifuge must run through 4 times to maximum rotor speed.

## 2.6 Cleaning of Instrument Parts

### **ATTENTION - WARNING!**

**The electrical and electronic components must not be cleaned with moist detergents!**

For Cleaning the centrifuge housing or its accessories see Operating Instructions section 1 (maintenance and care)

- **Electronic components**  
Clean dusty components carefully with a dry and soft brush and remove loose dust with a vacuum cleaner.
- **Vent holes**  
Remove dirt from the vent grid behind the front panel by using a brush and vacuum cleaner.