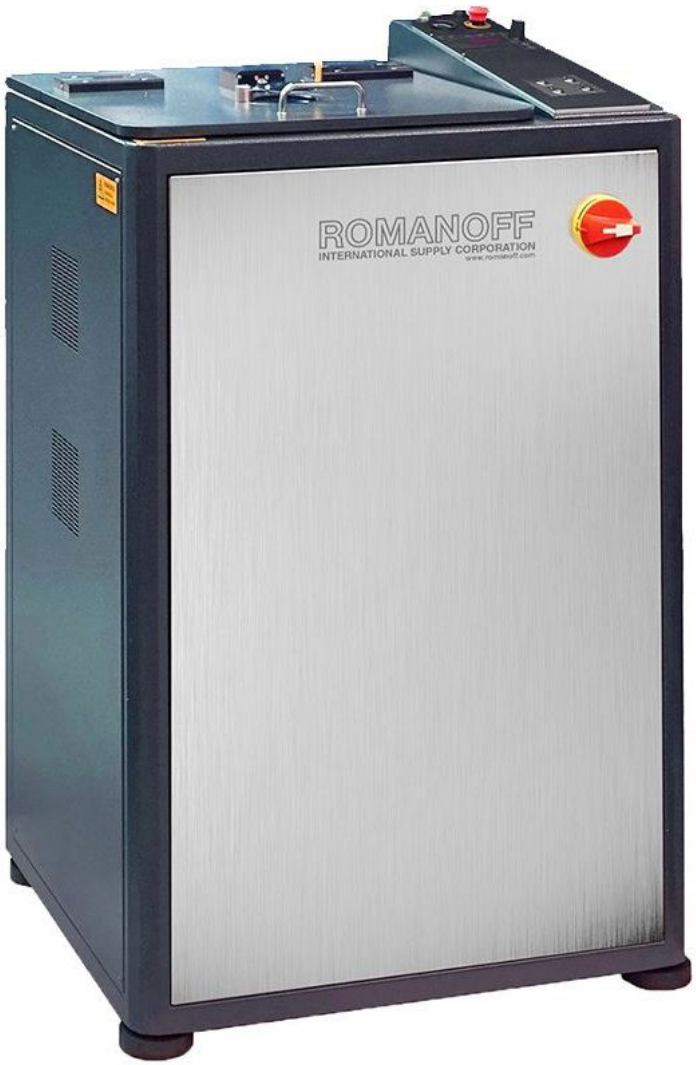
Romanoff RCS LITE: Centrifugal Casting Machine *Operation Manual*



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Dear Customer,

Congratulations for choosing the Romanoff RCS LITE Centrifugal Casting Machine. We wish to remind you that this machine is a very advanced product with regard to the casting system, the temperature reading device, the automatic controls, and the safety devices.
Romanoff RCS Centrifugal Casting Machine is compact, multi-purpose machine that allow you to cast in atmosphere, vacuum or argon, by setting the various parameters.
These multiple functions require an accurate and detailed reading of this operation manual. Only by doing so will you be able to draw the maximum potential from your machine and to achieve high quality casting.
We thank you for choosing our machine, and we wish you a fruitful work.
Romanoff International is always at your disposal for any request you may have.

1 GETTING STARTED GUIDE

1.1 SAFETY INSTRUCTION

1.1.1 IMPORTANT NOTES

1. This operation manual is addressed to the owner, for a correct installation, use and maintenance of the machine.
2. The operation manual contains useful information to specify the recommended use of the machine according to the project hypotheses and technical features, to supply instructions for the installation, assembly, regulation and use, personnel training, to direct the maintenance intervention and to supply information on residual risks.
3. It also supplies complete information for Romanoff RCS LITE Centrifugal Casting Machine; you are therefore advised to refer to all the paragraphs concerning the model in your possession.
4. For a professional use of the machine, this manual can never replace the operator specific experience, however it supplies all the information required for a correct installation and is a useful reminder of the main basic operations.
5. This manual is an integral part of the machine and should be ‘’kept for future reference’’ until the final disassembly of the machine. Therefore, its consultation should be allowed near the machine and it should be kept with due care (protected, in a dry place, away from sun rays or atmospheric agents, etc.). In case of loss or damage, you can request a new copy from our dealers, technical service centres or directly from Romanoff.
6. This manual reflects the state-of-the-art at the moment of the machine commercialization, and cannot be considered inappropriate only because it has been subsequently amended on the basis of new experiences.
7. In this document period “.” will be used as a decimal point delimiter.
8. The manufacturer reserves himself the right to amend or update his own production and relative manuals, without being obliged to update previous productions, unless in exceptional cases.
9. You can request further details or updates to this manual from our dealers, technical service centres or directly from Romanoff.
10. Any criticism or suggestion at improving the machine can be sent in writing to our office. We will be pleased to read them and send our comments to the persons concerned.

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1.1.2 SAFETY WARNINGS

To guarantee the utmost operating reliability, Romanoff has carried out an accurate selection of materials and components to be used in the machine manufacture. The machine has undergone regular checks before being delivered. The machine's productivity over the years also depends on its correct use and an appropriate preventive maintenance according to the instructions contained in this manual.

All manufacturing elements, connecting components and controls, have been designed and made with such a safety level that they can resist abnormal strains or strains higher than those specified in this manual. The materials are of the best quality and their acceptance, storage and use in the workshop are continuously controlled in order to guarantee the absence of damage, wear and tear, faulty operation.

In any event, respect the following measures:

NEVER USE THE MACHINE OR CARRY OUT ANY INTERVENTION ON THE MACHINE IF YOU HAVE NOT CAREFULLY READ AND WHOLLY UNDERSTOOD THIS MANUAL IN ALL ITS PARTS.

IN PARTICULAR, TAKE ALL THE NECESSARY MEASURES LISTED IN SECTION 1 - SAFETY INSTRUCTIONS AND INFORMATION.

IT IS FORBIDDEN TO USE THE MACHINE IN CONDITIONS OR FOR A USE OTHER THAN THAT STATED IN THE MANUAL, AND ROMANOFF INTERNAITONAL SHALL NOT BE DEEMED RESPONSIBLE FOR ANY FAILURE, FAULT OR ACCIDENT DUE TO THE NON OBSERVANCE OF THIS PROHIBITION.

This manual is made up of three parts:

SECTION 1: deals with the SAFETY INSTRUCTIONS AND INFORMATION
SECTION 2: illustrates the MACHINE CHARACTERISTICS - OPERATION - TRANSPORT - AUXILIARY EQUIPMENT ASSEMBLY – EQUIPMENT - SHUTDOWN - CIRCUIT DIAGRAMS.
SECTION 3: deals with the MAINTENANCE INTERVENTIONS, LUBRICATION and includes the SPARE PARTS LIST AND DESCRIPTION.

NOTE: IT IS FORBIDDEN TO TAMPER WITH, ALTER OR CHANGE, EVEN PARTIALLY, THE MACHINE OR EQUIPMENT REFERRED TO IN THIS OPERATOR'S MANUAL, AND IN PARTICULAR THE GUARDS FITTED FOR THE PERSONS' SAFETY.

IT IS ALSO FORBIDDEN TO OPERATE IN A WAY OTHER THAN THE SPECIFIED WAY, OR TO NEGLECT SAFETY RELATED OPERATIONS.

Operations, for which the non-observance of the instructions can lead to damages to the machine or other parts related to the machine or to the surrounding environment, will be indicated in the manual by this sign.

Operations, for which the non-observance of the instructions or the tampering with the equipment parts can lead to injuries to people, will be indicated in the manual by this sign.

During the machine operation, the operator is protected by the centrifugation chamber closed lid. The working cycle is only possible after the lid has been closed and locked. The protection remains locked in closed position until the cycle is over.

DURING THE WORKING CYCLE, THE PROTECTION LID SHOULD NOT BE FORCED OPEN. IF, AT THE END OF THE CYCLE, THE LID REMAINS LOCKED, DO NOT FORCE THE OPENING AND CONTACT OUR SERVICE DEPARTMENT.

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The compartment underneath the centrifugation chamber houses the control and power electric circuits and the arm rotation motor. This compartment is isolated from the operator by fixed bulkheads. The bulkheads are kept in position with screws that can only be removed with special wrenches supplied with the machine.

EMERGENCY LID OPENING: In case of a black out, to unlock the cover, see chapter 2.2 ACCIDENT PREVENTION PROTECTIONS.

	**EMERGENCY LID UNLOCK SHOULD BE USED ONLY IN CASE OF POWER SUPPLY FAILURE, DURING THE CASTING OPERATION. WHEN THE LID IS UNLOCK MANUALLY THE ARM ROTATION IS NOT ALLOW.**

1.1.3 GROUNDING

This product is a Class 1 device which utilizes protective grounding to earth to ensure operator's safety.

	**PROTECTIVE EARTHING CONDUCTOR TERMINAL** -This symbol indicates the point on the product to which the protective grounding conductor must be attached.
	**EARTH (GROUND) TERMINAL** -This symbol is used to indicate a point which is connected to the PROTECTIVE EARTHING TERMINAL. The component installer/assembler must ensure that this point is connected to the PROTECTIVE EARTHING TERMINAL.
	**CHASSIS TERMINAL** -This symbol indicates frame (chassis) connection, which is supplied as a point of convenience for performance purposes. This is not to be confused with the protective grounding point, and may not be used in place of it.

1.1.4 Magnetic Field

	a) **<u>Warning: Magnetic field!</u>** b) ***Can be harmful to pacemaker wearers and people with metallic implants!*** c) ***Pacemaker and metallic implants wearers stay back 30SM (12IN)!***

1.2 GENERAL INFORMATION

1.2.1 RECOMMENDED USE

Romanoff RCS LITE is a centrifugal casting unit with medium frequency inductive heating, designed to melt wide range of metal alloys.
The safety devices fitted on the machine make it safe and reliable in time.

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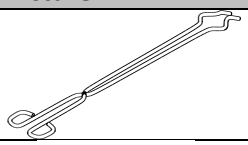
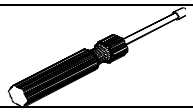
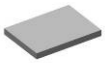
1.2.2 SUPPLIED ACCESSORIES

Table 1.1 Accessories Romanoff RCS Centrifugal Casting Machine

№	Description	Qty	Picture
1	**Tongs for cylinder and crucible**	1	
2	**Graphite crucible**, Part Number: 79-702	1	
3	**Ceramic crucible for Platinum**, Part Number: 79-701-LG	1	
4	**T- type allen key 5mm**	1	
5	**feet for the centrifuge**	4	
6	**Blue protection lens**	1	
7	**Screwdriver system "ZERO"**	1	
8	**Pad for Pt crucible**	1	

1.2.3 UNAUTHORISED USE

The metal cannot undergo centrifugation melting if the top lid is opened.

1.2.4 PERSONNEL TRAINING

The Romanoff RCS Centrifugal Casting Machine melting unit have been designed and built to be used by qualified personnel; these persons are supposed to be perfect acquainted with the work execution procedures and with the characteristics of the materials to be used.
An accurate reading of this manual and a short training under the supervision of qualified personnel is recommended.

1.2.5 SAFETY DEVICES

The machine is supplied complete with the devices required to guarantee the operator safety:

1. Top lid locking during rotation.
2. No melting start in case of insufficient water flow.
3. No melting start if the water temperature is above 50°C.

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4. Red mushroom emergency stop on yellow background. It should be used:
   4.1. To avoid, as soon as they arise, dangers to people;
   4.2. To reduce, when they arise, damages to the machine or the on-going operation. USE MODERATELY.

1.2.6 NOISE LEVEL

The measure has been taken with the machine in the centrifugation phase, as this is the operation with the highest noise emission.

1. Phonometric measurement in compliance with UNI 9432.
2. Noise meter: Bruel & Kjaer 2218, with wad filter 1613 № 895445.
3. Weighting filter: Curve A.
4. Measuring system: The exposures are calculated starting from noise pressure measures and integrating for the time of exposure.
5. Estimated equivalent continuous noise level A in the working station.
6. $L_{Aeq1}T_p = 68.7$

1.2.7 RESIDUAL DANGER AND EMERGENCY SITUATION

1. **Avoid direct contacts with the melting coil during the heating phase (ELECTRIC HAZARD).**
2. **Avoid introducing metal objects inside the melting coil without the appropriate crucible (ELECTRIC AND THERMAL HAZARD).**
3. **Avoid direct contacts with the mechanical parts situated near the crucible; use supplied prongs and wear suitable gloves to manipulate crucibles and cylinders (THERMAL HAZARD).**
4. **Avoid any type of intervention on the machine before the machine has been disconnected from the electric supply.**

Note: The residual dangers are indicated on the machine by specific labels.

2 INFORMATION ON THE MACHINE OPERATION

2.1 TECHNICAL DESCRIPTION OF THE MACHINE

Casting unit consists of a steel framework supporting the centrifugation chamber, and a steel plate panelling closing the machine. On top of the machine, a lid opens in a compasses movement to give access to the working compartment. This lid is fitted with a safety lock.
The melting circuit, based on the current oscillation about (100 kHz) in such a way as to create a alternate magnetic field, uses the new generation IGBT transistors technology , which guarantees a better yield of the power circuit, lower consumption and excellent reliability in time.
This type of circuit offers two essential advantages:

1. Low current consumption.
2. In the melting point the metal begins to rise slightly and form a dome, thus giving clear evidence of the melting.

Lastly, the machine is fitted with some automatic functions, for an easier work, such as:

1. Adjustable centrifugation time out.
2. Adjustable speed and acceleration for centrifugation.
3. Maintain set temperature.

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2.1.1 TECHNICAL DATA

Table: 1 Technical Data Romanoff RCS Centrifugal Casting Machine

SPECIFICATION	DESCRIPTION
Frequency	90÷110 kHz
Weight	154 kg
Width	670 mm
Depth	560 mm
Height	1050 mm
Electric power supply	230±10% Vac single phase - 50/60 Hz
Maximum absorbed power	6.0 kVA
Operating temperature	+10°C ÷ + 40°C
Crucible maximum capacity	Pt = 150g; SS = 105g; Au = 150 g; Ag = 80 g
Crucible minimum capacity	Pt = 40g; SS = 30g;
Admitted cylinders diameter	Min. 20 mm - Max. 80 mm
Cylinder length	Min. 50 mm – Max. 80 mm

2.1.2 IDENTIFICATION OF THE CENTRIFUGATION TANK COMPONENTS

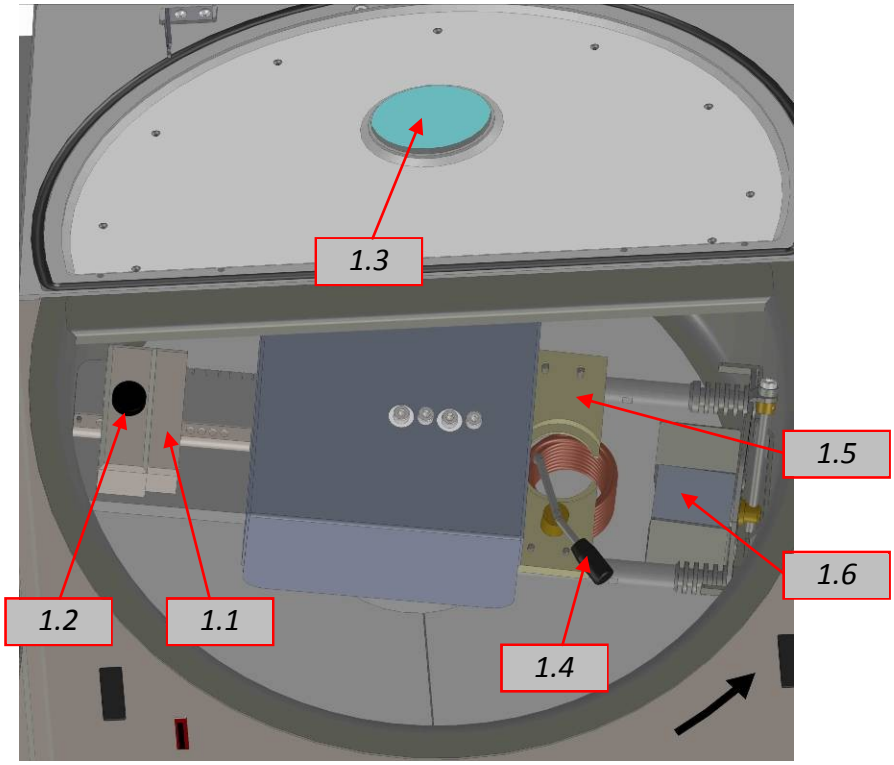

Fig. 1 Centrofugal tank components

1.1	Counterweight	1.4	Crucible lid locking lever
1.2	Counterweight retainer	1.5	Crucible support
1.3	Viewing window	1.6	Supporting sleeve

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2.2 CONTROLS AND OPERATION

2.2.1 FRONT PANEL OVERVIEW

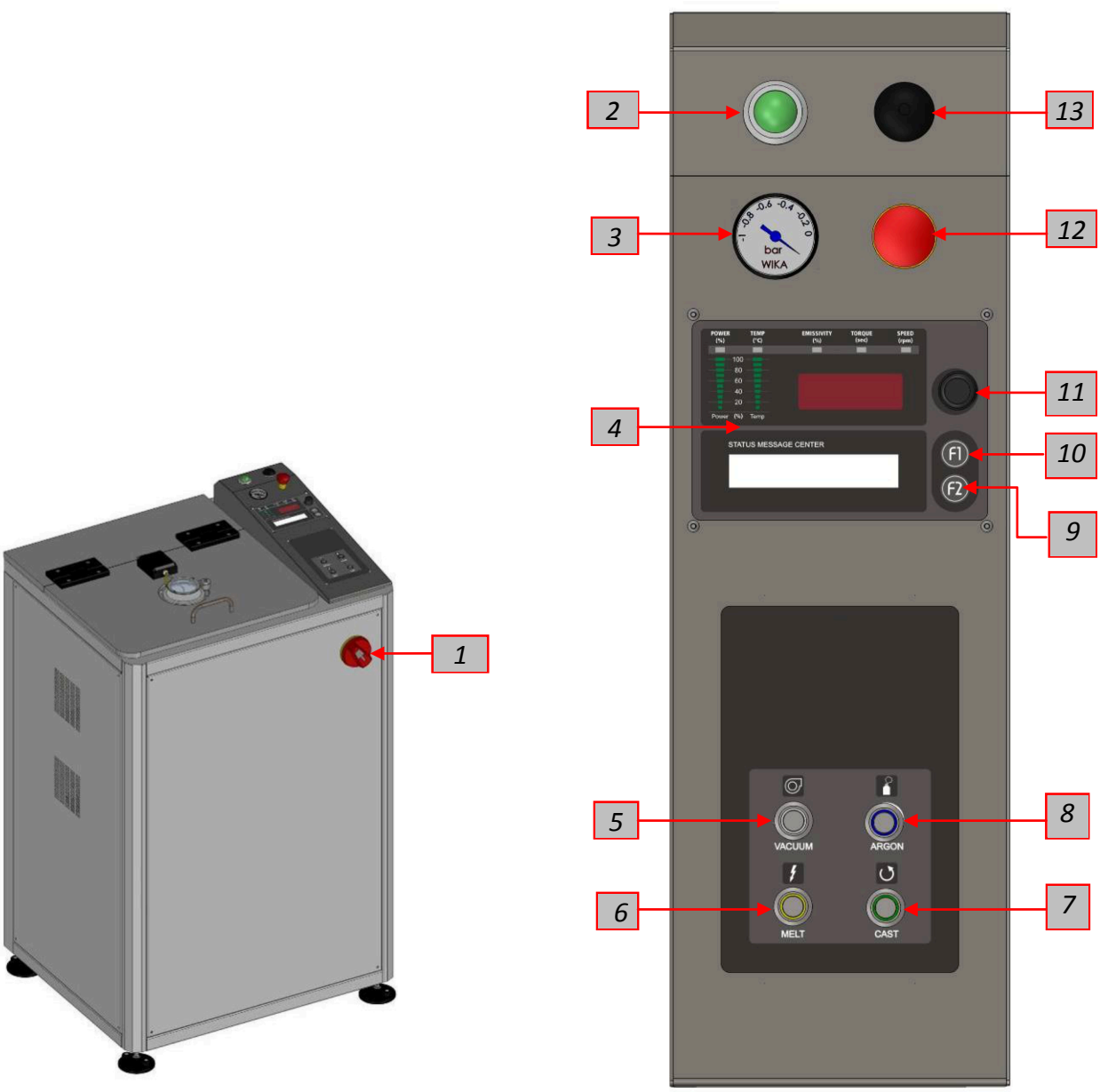

Fig. 2 Front Panel Romanoff RCS Centrifugal Casting Machine

The above drawing represents the control section of Romanoff RCS LITE Centrifugal Casting Machine

Table: 2 Front panel Romanoff RCS LITE Centrifugal Casting Machine

№	Description
1	Power On Switch
2	Green Lamp – Power On Light (electric supply)
3	Vacuum meter
4	Control Panel
5	Vacuum / Devacuum button
6	Melting start/stop button

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7	Centrifugal start/stop (Injection) button
8	Inert Gas button
9	F2 – “STOP” button
10	F1 – not used
11	Control Knob
12	Red mushroom emergency push-button, on yellow background. To be used: 1) To avoid dangers, when they arise, to the persons; 2) To reduce damages, when they arise, to the machine or on-going operations. USE WITH MODERATION
13	Alarm Buzzer

2.2.2 CONTROL PANEL OVERVIEW

The unit is digitally controlled through a control panel located on the front panel of device. The control panel utilizes the latest microprocessor technology. The control panel is designed to display vital parameters and alpha-numeric messages providing intuitive and informative visual feedback. The users can also navigate through easy to use service, diagnostics and setup menus.

2.2.3 CONTROLS AND INDICATORS

The Control panel has the following controls and indicators:

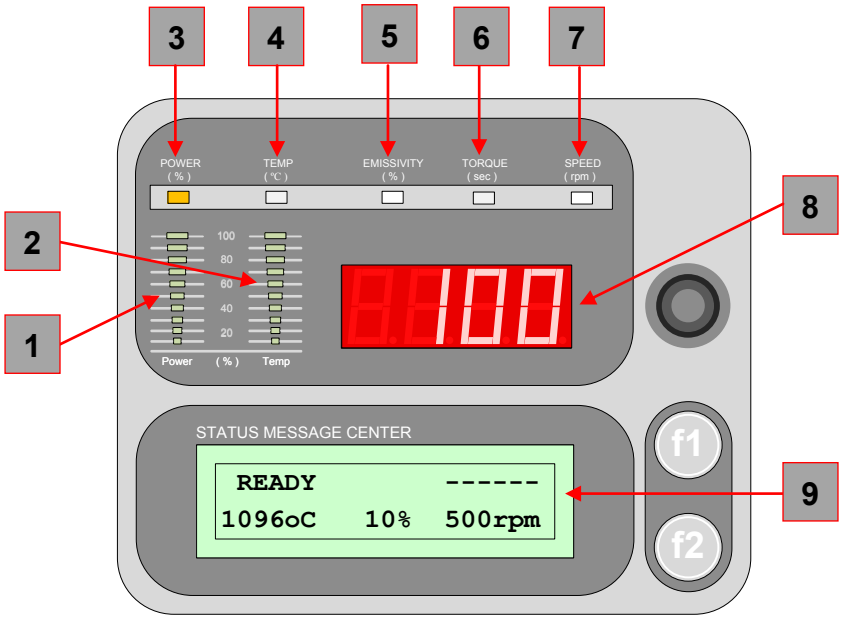

Fig. 3 Control panel

Table: 3 Control and indicators Table

№	Name/Function	Description	Indicator/ Control
1	Output Power	BAR-GRAPH: The reading corresponds to the percentage of the measured power.	INDICATOR
2	Regulating Temperature	BAR-GRAPH: The reading corresponds to the percentage of the measured temperature.	INDICATOR

3	Power LED	Power: LED [AMBER] - Illuminated when display (8) is showing the output power set point.	
4	Temp LED	Temp: LED [AMBER] - Illuminated when display (8) is showing the thermo regulator set point	
5	Emissivity	Emissivity: LED [AMBER] - Illuminated when display (8) is showing the set point of Emissivity. Emissivity is not available when External Pyrometers is active.	INDICATOR
6	Torque	Torque: LED [AMBER] - Illuminated when display is showing the set point of Torque [s].	INDICATOR
7	Speed: LED [AMBER]	Speed: LED [AMBER] - Illuminated when display is showing the Set Point of rotating Speed [rpm].	INDICATOR
8	Segment LED indicators showing Output Power, Speed or Temp	Four red 7 segment LED indicators showing Output Power, Temp, Emissivity, Torque or Centrifugal Speed depends on items 3, 4, 5, 6 and 7.	INDICATOR
9	Alphanumeric LCD display	Alphanumeric LCD display (20 characters / 2 rows) for displaying measured parameters, status messages, fault messages and menu screens.	CONTROL

2.2.4 OUTPUT REGULATION SELECTION

The following diagram describes a typical LCD display screen with message types and locations on the screen.

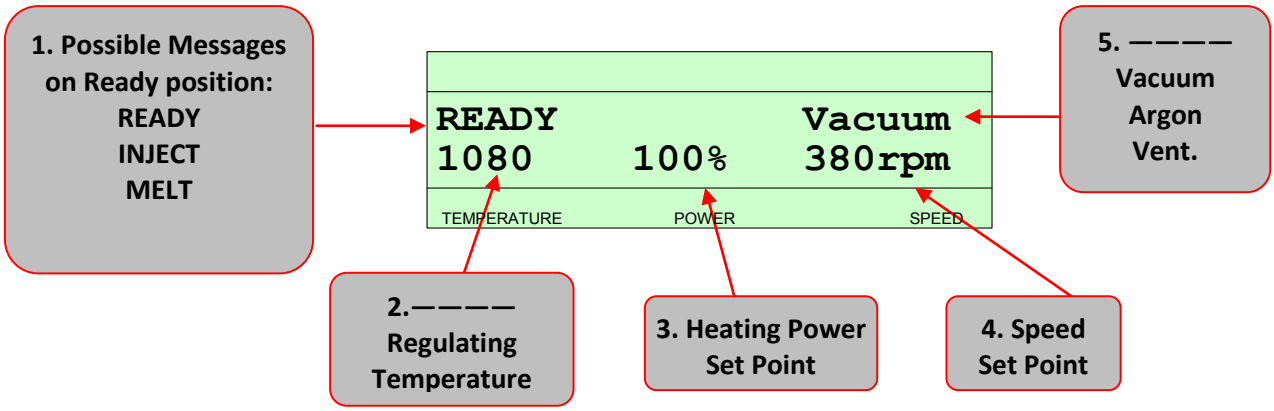

Fig. 4 LCD Display functions

Table: 4 Control Modes and Messages Table

№	Name/Function	Description	Indicator/ Control
1	Status Messages	Shows the current status of the system when in operational mode: READY – When there are no faults the machine is ready for use; MELT – After pushing button MELT. If there are no faults, inverter starts; INJECT – After pushing button INJECT. If there are no faults, coil goes down and centrifugal motor starts.	INDICATOR
2	Regulating Temperature Set point	Temperature. The set point of temperature regulator can be adjusted by rotating the Control Knob while the Amber “Temp °C” LED is illuminated. Temp range – The Temp value can be adjusted from 750° to 2000° in steps of 1°C.	INDICATOR

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3	Current Output Power	The Output power can be adjusted by rotating the Control Knob while the Amber “Output, %” LED is illuminated. Power range – The Power value can be adjusted from 10% to 100% in steps of 1%.	INDICATOR
4	Speed	The Centrifugal Speed can be adjusted by rotating the Control Knob while the Amber “Speed rpm” LED is illuminated. Speed range – The Speed value can be adjusted from 10 to 500 rpm in steps of 10 trn.	INDICATOR
5	Control Vacuum, Devacuum , Gas Argon	VACUUM – After pushing button VACUUM, vacuum pump starts; DEVACUUM – After pushing and hold for 1.5 sec. button VACUUM, the pressure in the chamber was recovering; ARGON – After pushing button ARGON, the chamber starts to be filled with argon gas; TIME OUT VACUUM – Time Out for Vacuum is 1.0 min.; TIME OUT DEVACUUM – Time Out for Devacuum is 10 sec.	INDICATOR

2.2.5 MENUS AND NAVIGATION

2.2.5.1 General Navigation Rules

Rotate Control Knob Clockwise or Counterclockwise to scroll through the menus; change values.
Push shortly Control Knob to select menu item or accept the changes.
Push rotated knob to switch between different displaying modes of 7 segment LED indicator: POWER, TEMPERATURE, EMISSIVITY, ACCELERATION and ROTATION SPEED.
Push and hold for 1,5s Control Knob to go to the SUB MENUs.

When scrolling through service menus:

- Pushing the Control Knob selects the parameter;
- Selecting the Exit option will return to the previous menu;

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2.2.5.2 Main Menu

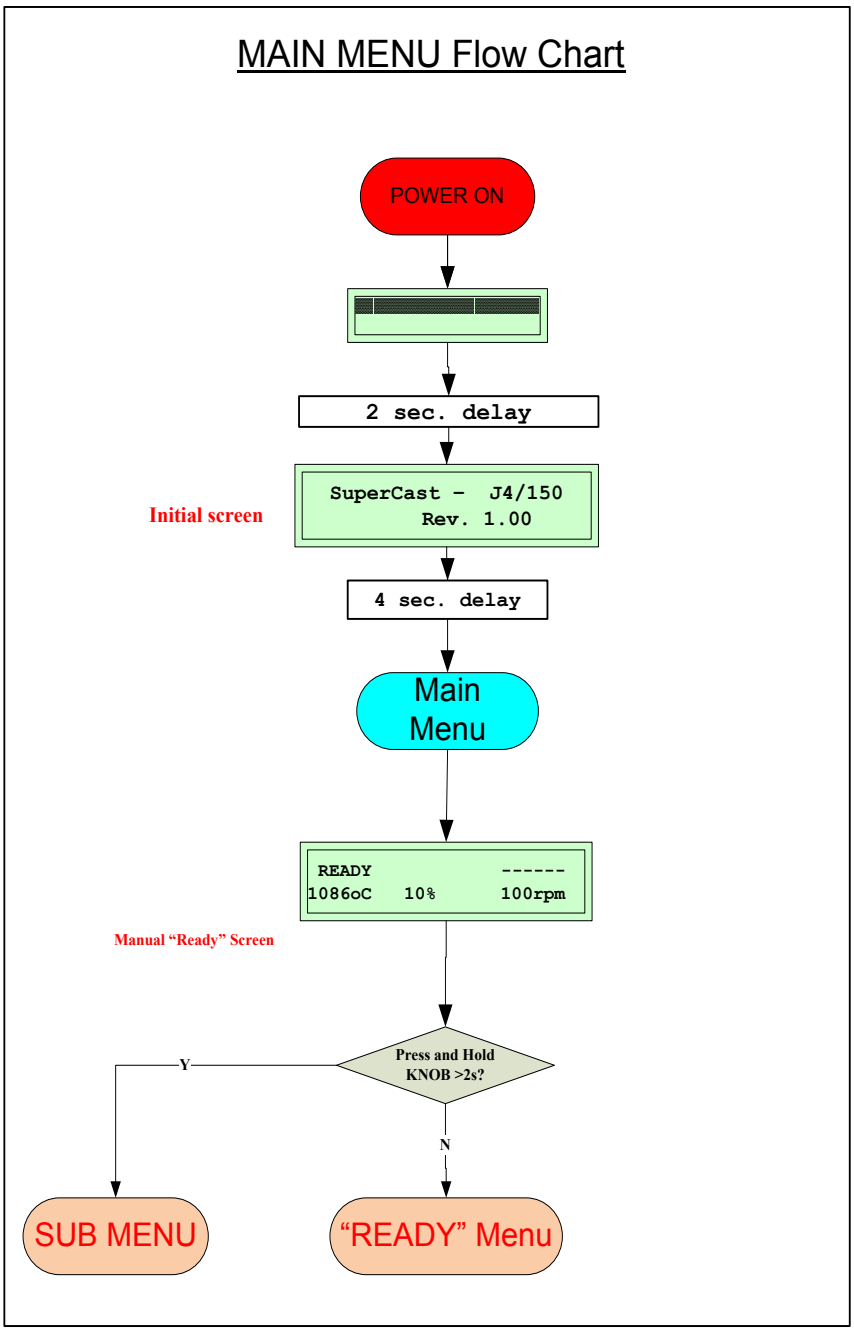

Fig. 5 **Main Menu Flow Chart Diagram**

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2.2.5.3 MANUAL "READY" Menu

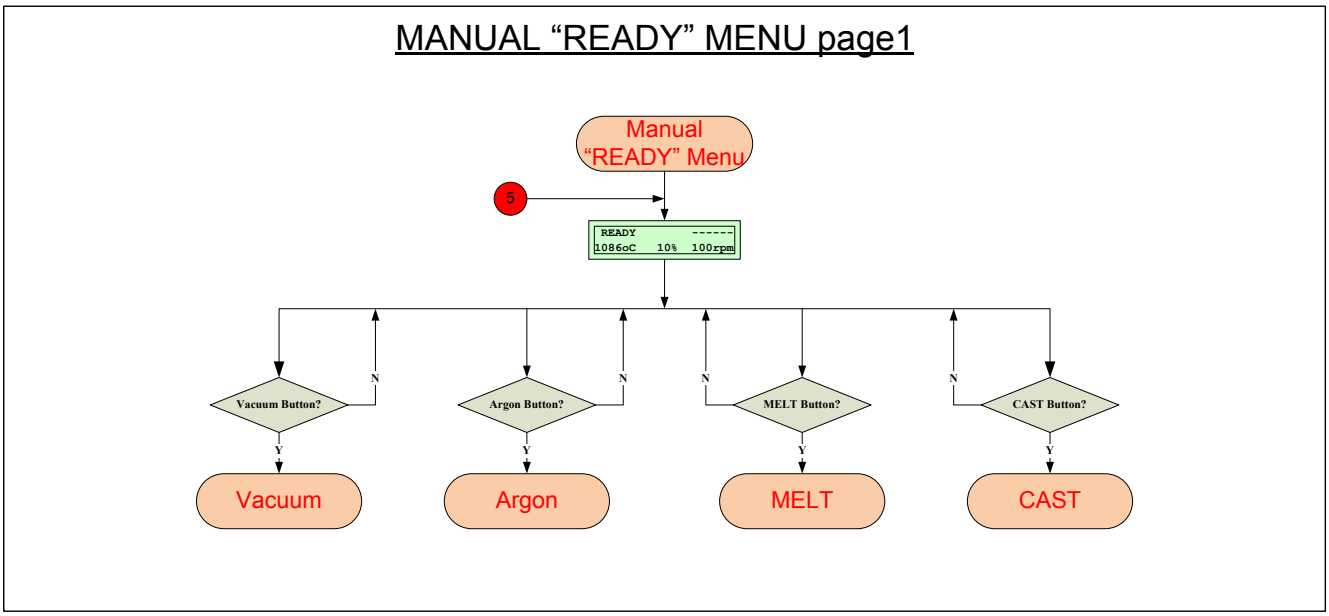

Fig. 6.1 **MANUAL "READY" Menu Flow Chart Diagram – page 1**

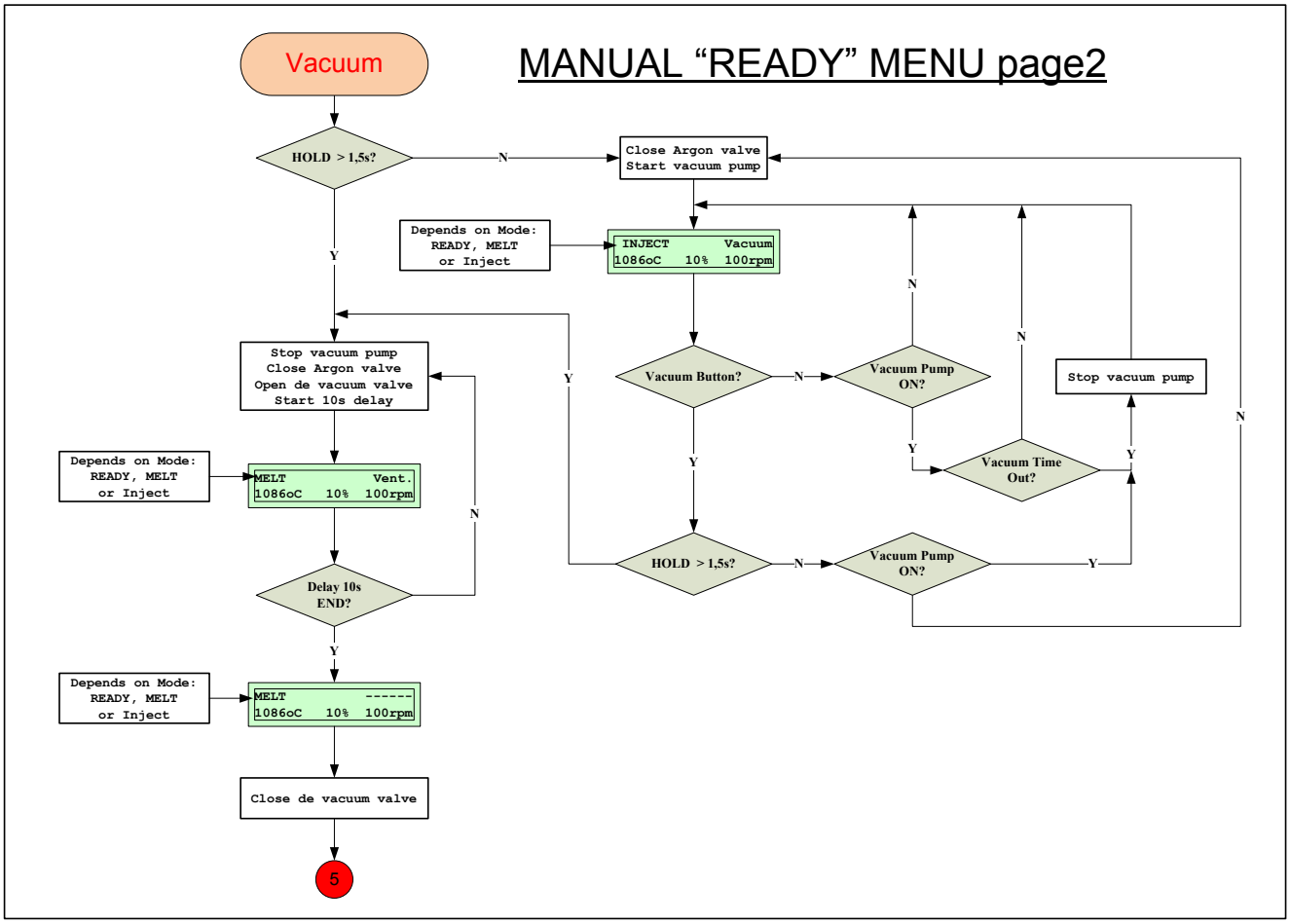

Fig. 6 .2 **MANUAL "READY" Menu Flow Chart Diagram – page 2**

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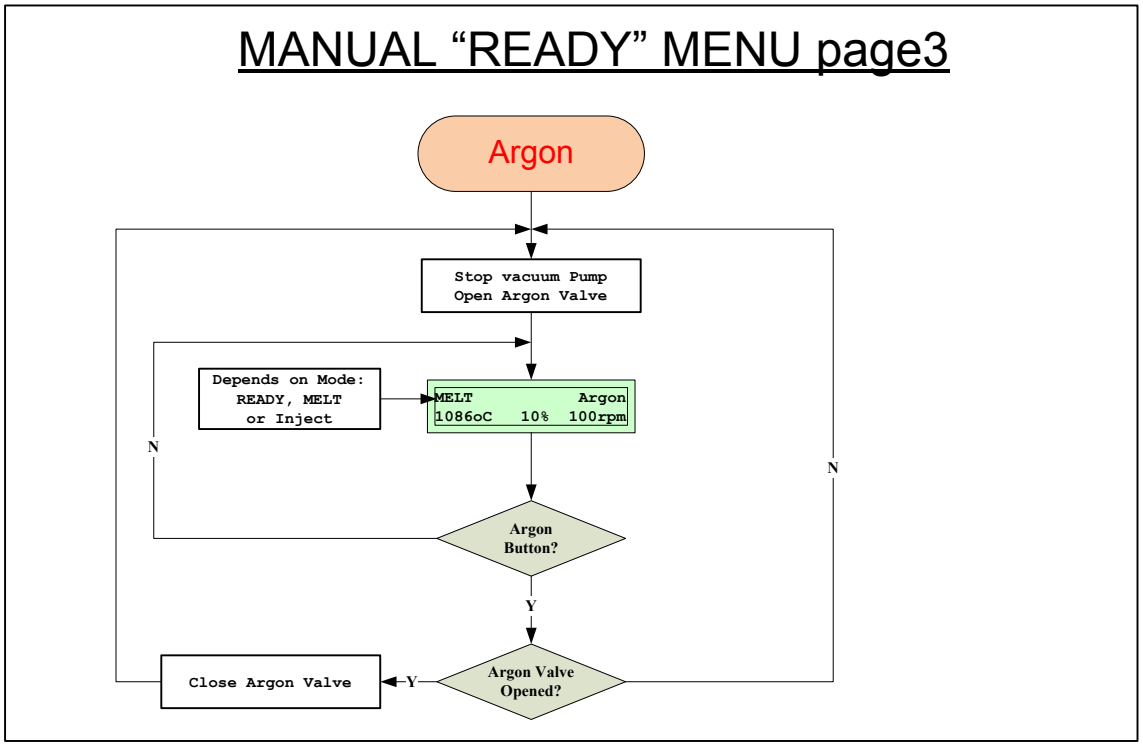

Fig. 6.3 **MANUAL "READY" Menu Flow Chart Diagram – page 3**

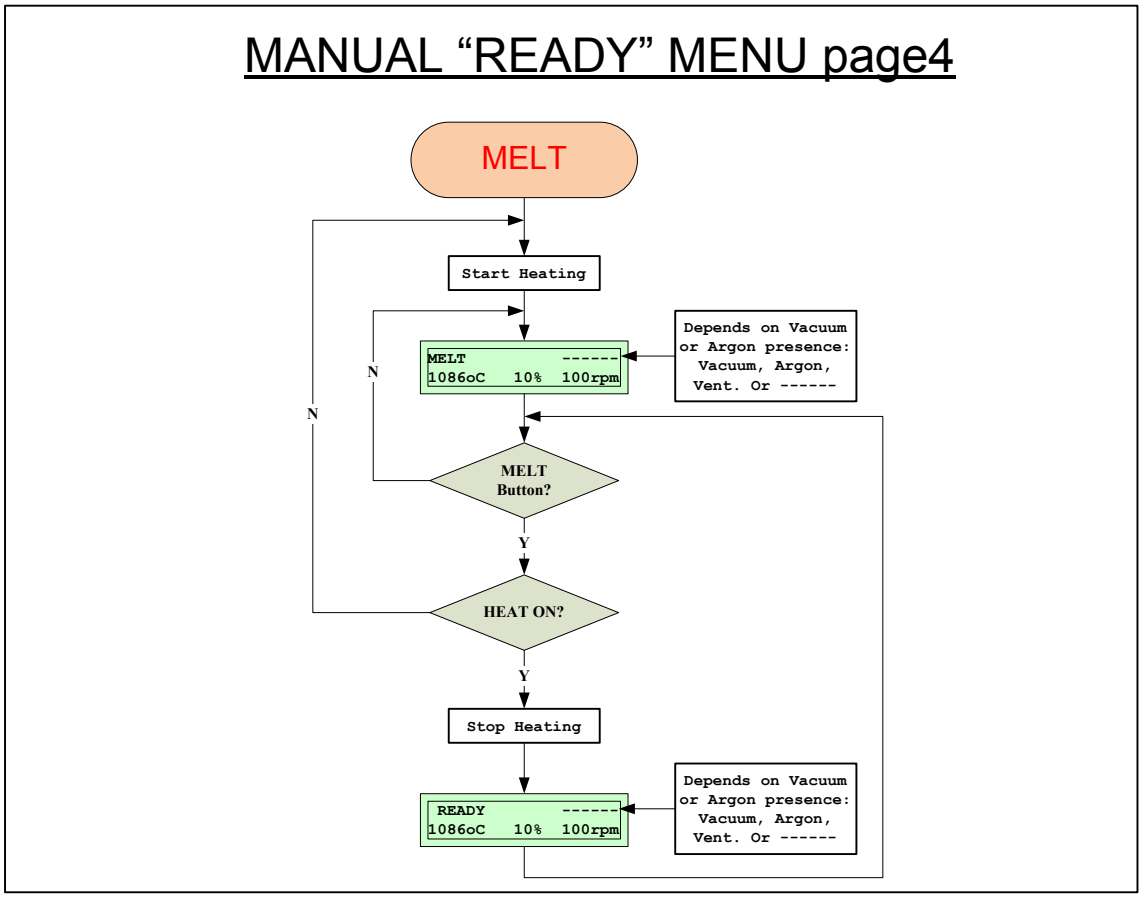

Fig. 6.4 **MANUAL "READY" Menu Flow Chart Diagram – page 4**

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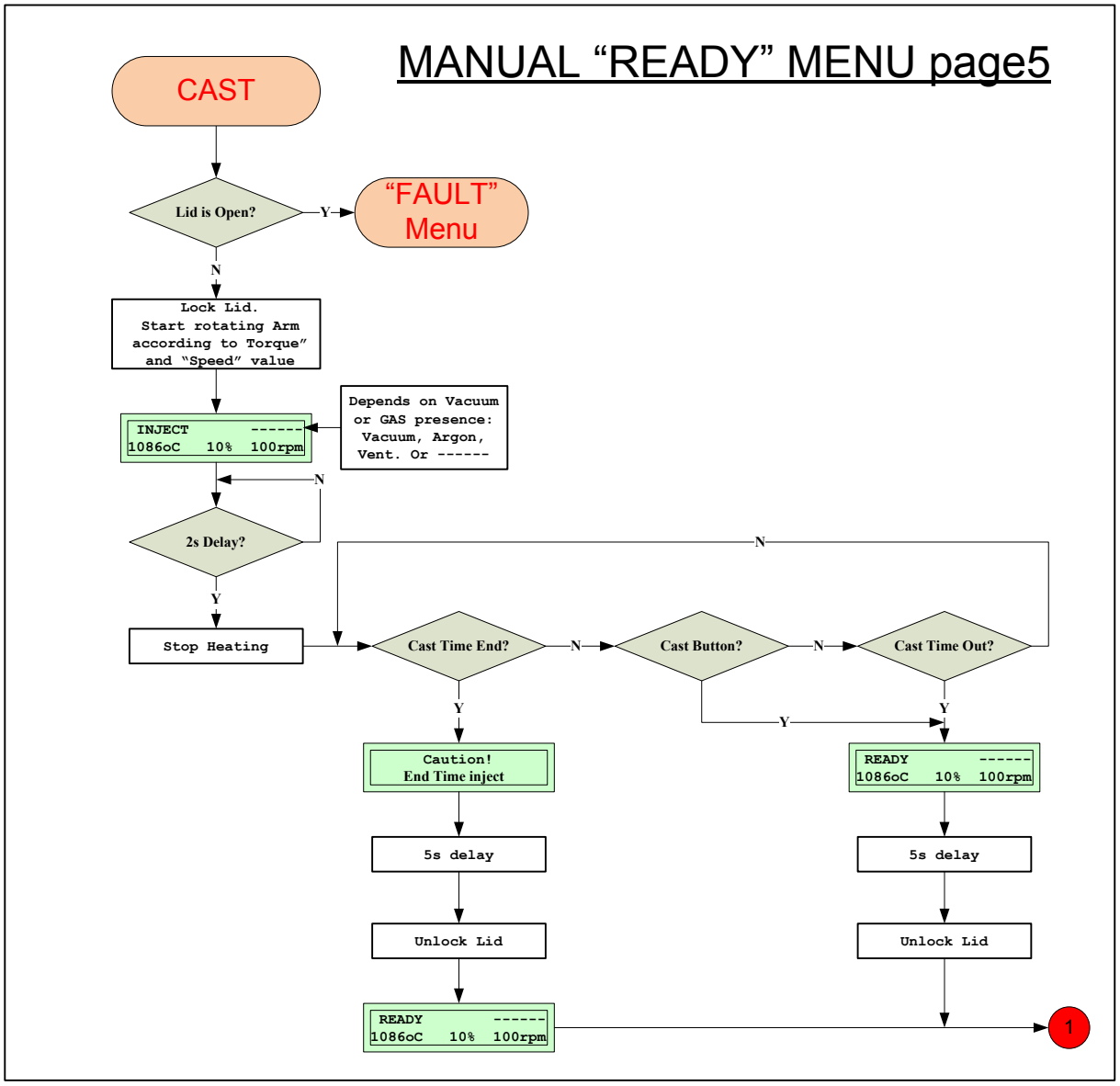

Fig. 6.5 **MANUAL "READY" Menu Flow Chart Diagram – page 5**

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2.2.5.2.3 7 SEGMENT LED DISPLAY MODES

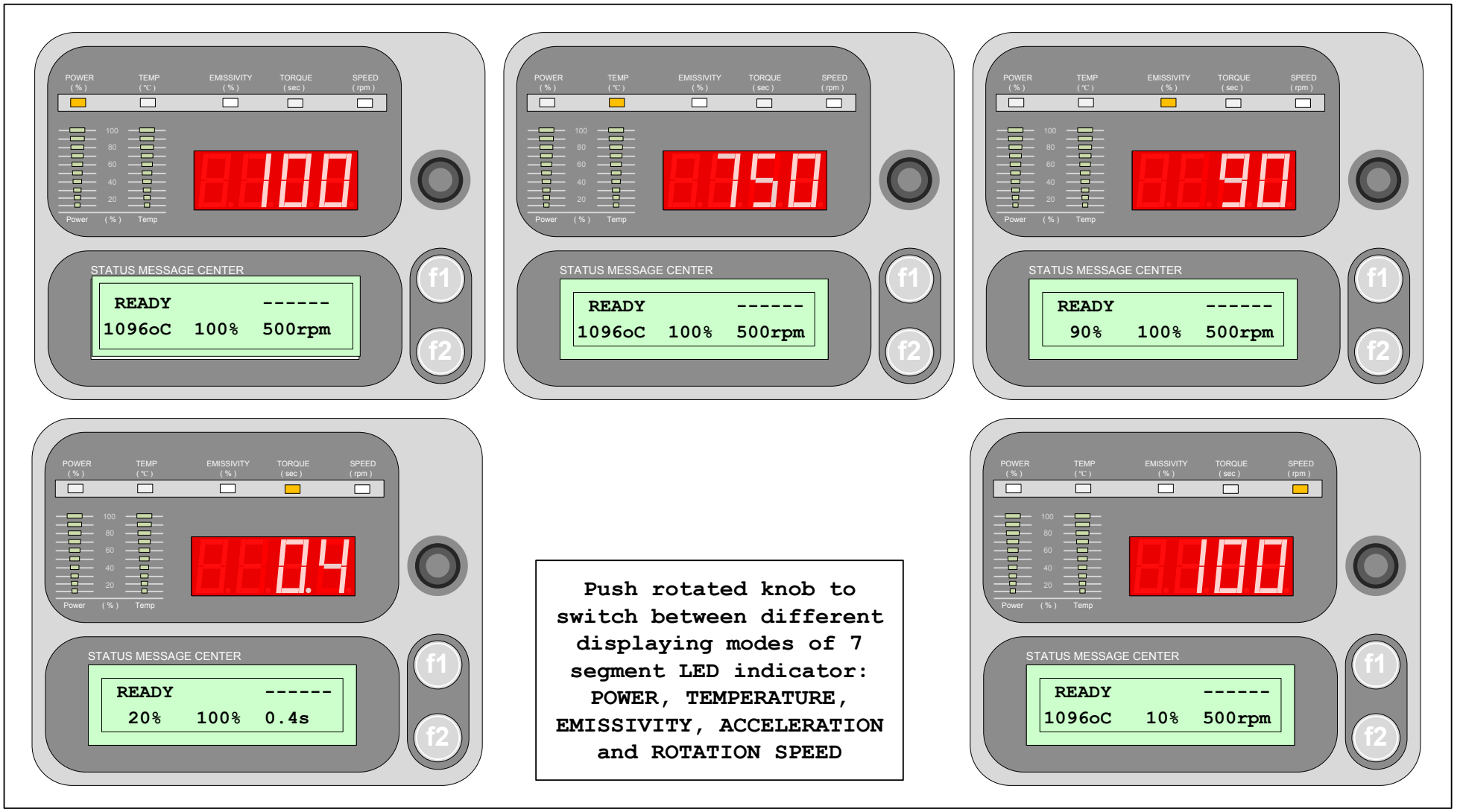

Fig. 6.6 **7 Segment LED Display MODES**

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2.2.5.4 SUB Menu

SUB Menu is accessible from Main Menu, by pressing and holding Control knob for 2 sec. It is shown on Fig. 7. The programmable parameters (in blue) will be highlighted when selected for editing.

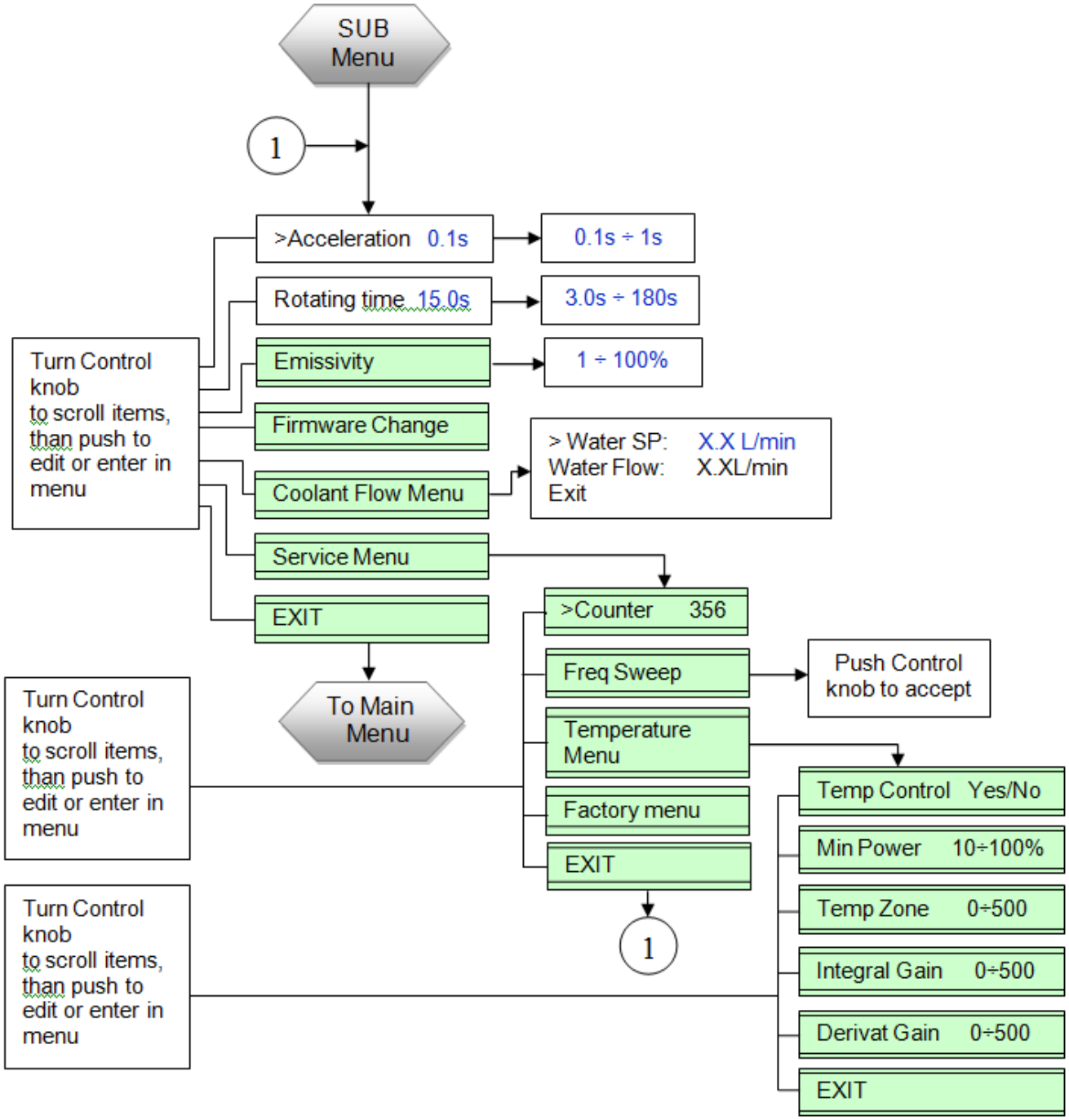

Fig. 7 **SUB Menu Structure**

2.2.5.5 SUB Menu Options

1. **Acceleration –** defines the time for reach the preset RPM.
2. **Rotation Time –** set rotation time for centrifuge in seconds.
3. **Emissivity** – emissivity coefficient for certain alloy.
4. **Firmware Change –** Service menu for updating the software control panel.

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5. **Coolant Flow Menu –** show set point of min flow rate of cooling water and current water flow rate.

6. **Service Menu:**

6.1 **Counter –** accumulation of cycles casting;

6.2 **Freq Sweep –** automatically lock the resonant frequency of tank circuit;

6.3 **Temperature Menu:**

6.3.1 Temperature Control – switching on and off temperature regulator, all other parameters are valid the regulator is switched on and are not valid when it is "Off";

6.3.2 Min Power –minimum permissible power that can be fed to the output;

The parameters 6.3.3, 6.3.4 and 6.3.5 are parameters of PID Control law;

6.3.3 Temp Zone – Zone for proportional part of PID control law of the regulating;

6.3.4 Integral Gain – integral gain of PID control law;

6.3.5 Derivat Gain – derivat gain of PID control law;

6.3.6 EXIT – returning to SUB Menu.

6.4 **Factory Menu–** Only for factory staff.

6.5 **EXIT –** Returning to Coolant Flow Menu.

6.6 **Factory Menu**– This option is accessible for a service staff only.

6.7 **Exit –** Returning to Coolant Flow Menu.

7. **EXIT – Exit** – Returning to Main Menu.

Every ERROR messages that appear during normal operation of the device are shown in the flowchart in Fig. 8**.**

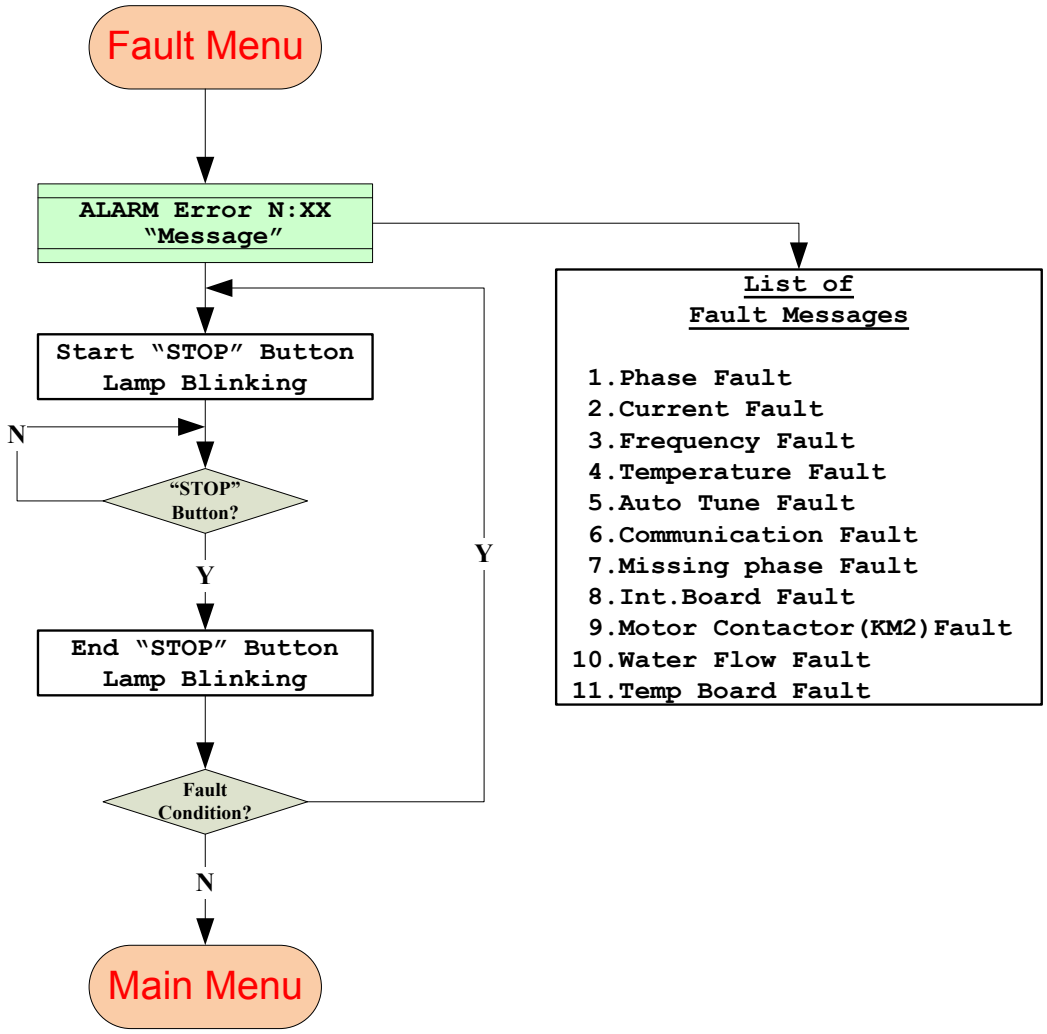


Fig. 8 **Fault Menu Flow chart Diagram**

Every WARNING messages that appear during normal operation of the device are shown in the flowchart in Fig.9.

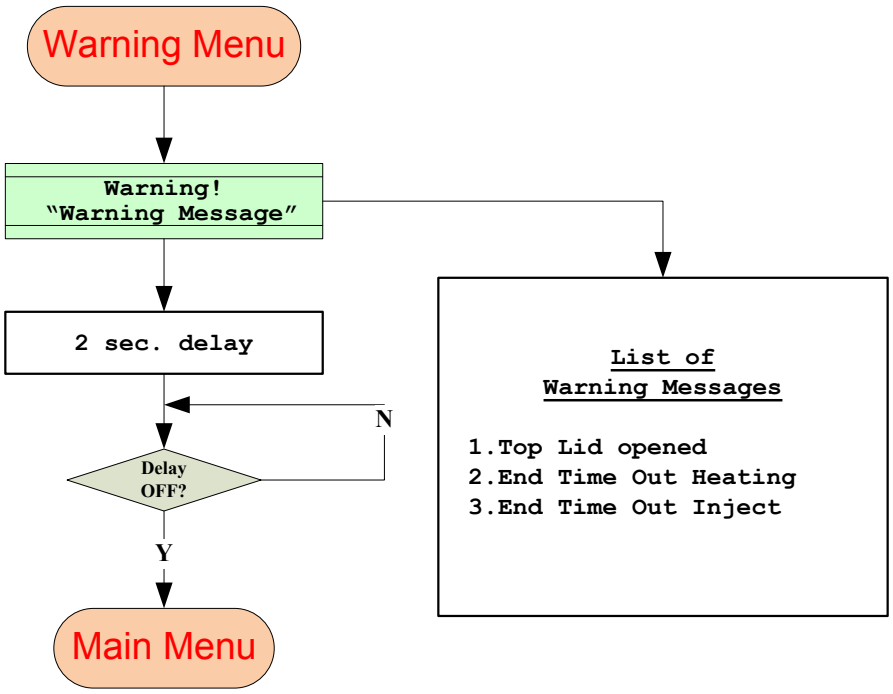


Fig. 9 **Warning Menu Flow chart Diagram**

2.2.6 TUNING AND TROUBLESHOOTING

2.2.6.1 LOAD TUNING GUIDE

Since is the fixed tank circuit and load (graphite crucible) device is factory tuned and does not need additional load tuning.

2.2.6.2 ERROR, FAULTS AND WARNINGS

Table: 5 Error, Warnings (W) and Fault (F) Messages

№	Fault Description	W F	Condition	Cause	Advice
1	Top Lid Opened	W	Top Lid Opened	You tried to cast with open cover	Close the lid and try again
2	End Time Out heating	W	Melting has reached 3 minutes	Expired time out for melt before manual stop	This quantity of metal is not proper /too small or too much/
F01	End Time Inject	W	Casting has reached 180 seconds in manual mode and Casting time in Program mode	Expired time out for casting before manual stop	---
F02	Current Fault	F	I primary > I Max	Output current exceeds the limit	Possible FET/IGBT failure in the Power supply. Contact our Service department
F03	Frequency	F	F < Fmin or F > Fmax	Frequency goes out of	Check resonant loop values, tank

	Fault			the pre-programmed range during Heat On	capacitors or control board. Check load coil for shorted turns.
F04	Temperature Fault	F	T°heat sink >50°C	The heat sink of the power supply exceeds the max allowed T°	Wait until it cools down the cooling water.
F05	Auto Tune Fault	F	Primary U & I out of phase	Can't find resonant frequency	Check resonant loop connections – load coil, tank capacitors. Transformer taps
F09	Communication Fault	F	Communication Error Between Panel and Control Board	No acknowledgment is received after the last command	Check cables and RS connectors between boards
F28	EU Water Flow Fault	F	Water Flow < 2 l/min (0.5GPM)	Restricted or no water flow	Check cooling water flow rate. Check hoses and external water filter for blockages. Check flow switch.
F32	Missing phase	F	The machine is off	Missing Main Power Supply	Check Main Power Supply cable.
F36	Int. Board Fault	F	No connection with Interface Board	No acknowledgment is received after the last command	Check cables and RS connectors between boards
F67	Motor Contactor (KM2) Flt	F	Motor Contactor is welded	Contactor damage	Change contactor

2.3 INSTALLATION AND SET-UP

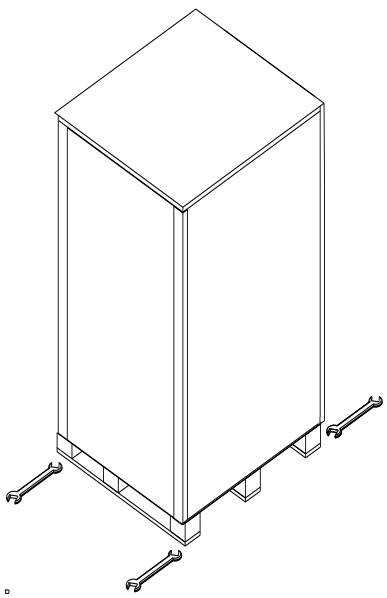
2.3.1 UNPACKING THE MACHINE

The machine is fixed with bolts to a wooden pallet to garant a safe transport. Use a wrench n. 17 to unscrew the bolts and free the machine from the Pallet before the installation.

ATTENTION: be careful and keep the machine in vertical position.

Control that the machine has not been damaged during transport. In case of damages, contest it to carrier and give immediate written communication to the manufacturer and reseller.

Take four feet from Accessories and fit them on place instead of transport feeds.



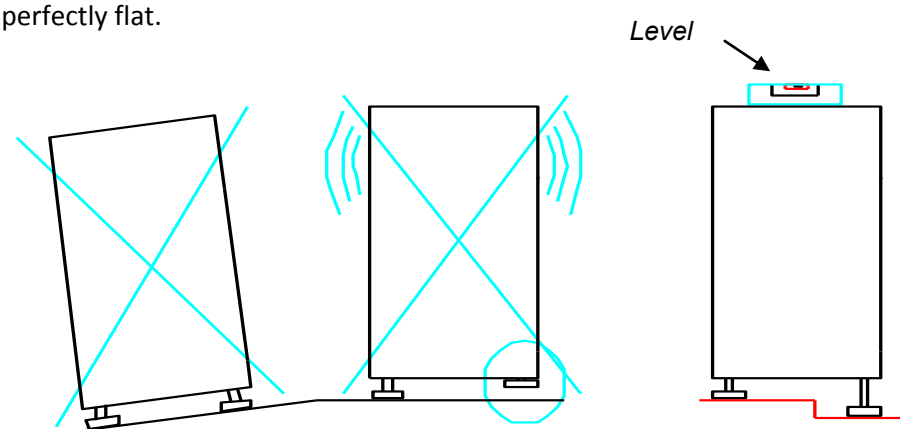
2.3.2 POSITIONING IN THE ROOM

The machine must be installed in a properly ventilated room for a correct scavenging of fumes and steams that build up during the melting process. In order to reduce possible risks in handling hot materials, it is recommended to install the machine near the heating furnace and the service sink.

1. **PLACE THE MACHINE ON A PERFECTLY FLAT SURFACE.**

2. When the machine is installed, check ***THAT IT IS PERFECTLY STABLE AND HORIZONTAL.*** A total stability is absolutely essential during the centrifugation arm rotation. If necessary, adjust the machine position with the feet fitted on the place instead of transport feeds, to adapt it to the floor.

DO NOT INSERT ANY SHIM BETWEEN THE FEET AND THE FLOOR. With a level gauge, check that the upper surface is perfectly flat.



2.3.3 MAINS CONNECTIONS

Make sure the power supply voltage is the same as the voltage indicated on the identification plate on the machine rear panel. Check that the available power is sufficient (see table: Technical data).

USE AN AC MAINS OUTLET, type 30A, 230 VAC, 1-PHASE.

Using an AC current supply other than the specified supply may damage the machine.

Remember the machine must be grounded. Check the efficiency of your electric supply installation.

2.3.4 IN-BUILT COOLING CIRCUIT

The cooling system is built-in. In order to fill water tank proceed as follows:

1. Unscrew the access door of the rear panel, marked with “Water Tank”, and remove the cap of the tank – see Fig. 10.
2. Start to fill water in the tank using a funnel.
3. Fill in the tank with approximately 20 liters of demineralized water.
4. Check the water level every 12 months.
5. The water filter must be cleaned every 6 months.

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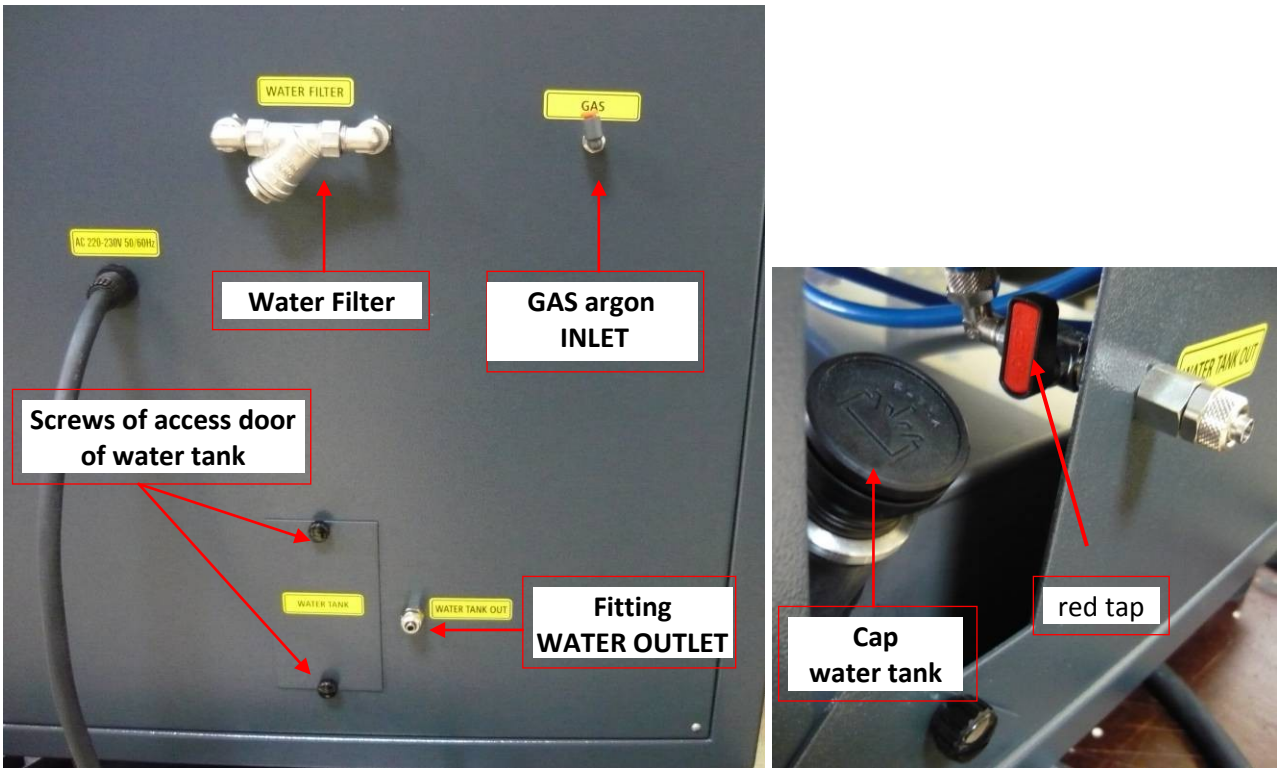

Fig. 10 Rear Panel

ATTENTION!
DO NOT FILL THE WATER TANK UNDER WATER PRESSURE!

A completely full tank allows carrying out about 15 consecutive melting operations (depends on ambient temperature and time for melting). If the laboratory needs to carry out more melting operations can be built in internal HEAT EXCHANGER.

To empty the cooling circuit, proceed as follows:

1. Connect the Fitting, situated at the rear of the melting machine, marked with"WATER OUTLET" with a suitable hose.
2. Open the red tap (see Fig. 10), situated under access door to water tank and insert other end of the hose into sewage or a container of about 20 liters.
3. Start the machine with the main switch ON (Fig.2-1); the machine starts draining water (The machine will generate Fault message "Water Flow Fault").

2.3.5 PRELIMINARY CONTROLS

1. Check that the water circuit have been connected (there must be no leaks, bleeds, etc.) and the power supply is on.
2. Check that the centrifugation chamber is free from any objects.
3. Check that the emergency push-button (Fig.2-12) is not pushed down; to unlock the emergency, rotate the push-button in the direction of the arrow.

4. IN CASE OF FAILURE.

If a malfunction is observed during the operation, immediately disconnect the machine and check troubleshooting section.

5. EMERGENCY STOP CONTROL.
6. This mushroom type push-button is red on yellow background. It should be used:
   - to avoid, as soon as possible, danger to persons;
   - to reduce, as soon as possible, damages to the machine or to on-going operations.

   USE WITH MODERATION!

2.4 OPERATING INSTRUCTIONS

2.4.1 CRUCIBLES

We strongly recommend following strictly the following useful hints in order to obtain the best results from your casting machine.
We recommend using the referred in Table 1 Crucibles to get the best results from your casting machine. For any questions, please contact the factory referred to in Section 3.3.2 phones.

Note: The introduction of pieces which, due to their shape and/or dimension can get stuck between the crucible walls may cause the crucible to break.
During the heating process, these pieces will expand and going to exert a strong pressure on the crucible walls thus causing them to crack.

2.4.2 MELTING AND CENTRIFUGATION PREPARATION

Before attempting to melt any type of alloy, refer to the technical data and processing data relevant to the metals used, supplied by the alloys manufacturers.
Choose the type of crucible to be used according to the alloys chemical characteristics (see attached table for details).

Note: Always refer to the indications supplied by the alloy manufacturer.

Use a crucible in good working conditions. If necessary, replace the crucible with a new one to prevent it from breaking, which could damage the melting unit or produce bad melting.

1. Introduce the metal to be melted into the crucible;
2. Check that the metal reaches the bottom of the crucible and does not remain stuck at the top of the crucible;
3. Reuse of old alloy: Check with the alloy manufacturer if previously melted metal (in vacuum, argon or atmosphere) can be reused and if a percentage of new metal should be added. If this is possible, it is advised to eliminate all oxide traces (for example through sandblasting), and to cut it in appropriate portions to introduce it inside the crucible in such a way as to achieve the maximum contact between the various metal parts;
4. Place the crucible in its support (Fig.1-1.5) and direct it toward the muffle.
5. Balance the weights: Adjust the position of the counterweights (1.1), to find the balance point.
6. The arm balancing has some tolerance; this allows storing the counterweight position on the numbered arm for each type of flasks, notwithstanding the metal quantity.

	**The more accurate balance the lower is the machine vibrations.**

The table below shows the operator the work acceleration adjustment according to the metal used:

Table: 6 Adjustment acceleration according to the metal used.

METAL	ACCELERATION
Gold alloys	0,25...0,5s
Palladium alloys, steel	0,1 ...0,25s

NOTE: Acceleration should be adjusted according to the weight and type of the material to be centrifuged (specific weight). In general, low accelerations for heavy weights and higher accelerations for lighter weights.

The table below shows the operator the work speed adjustment according to the metal used:

Table: 7 Adjustment speed according to the metal used.

METAL	SPEED
Gold alloys	400rpm
Palladium alloys, steel	500rpm

2.4.3 CENTRIFUGAL ARM AND CRUCIBLE PREPARATION

	**DURING THE MELTING OPERATION, HIGH TEMPERATURES ARE REACHED IN THE CRUCIBLE. HANDLE WITH CARE AND USE APPROPRIATE GLOVES AND TONGS.**

1. Switch on the machine (and prepare it for work) turning the main switch (Fig. 2-1) up.

	**The green light "ON" (Fig.2-2) must light up.**

2. Move the centrifuge arm in zero position. (Align the centre of the crucible and centre the protective glass on the lid (Fig.1-1.3).

	**If the arm position is not correct, the pyrometer will not work correct.**

3. Place the crucible in to the holder (Fig.1-1.5).
4. Place the material to be melted into the crucible.
5. Lock the crucible with the lever (Fig.1-1.4) on the crucible side.
6. Place the muffle in to the sleeve.

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2.4.4 MELTING

1. Close the lid.

During the melting process, a light gas formation is released from the metal mass. This can be dangerous only when the operator performs the melting process, willingly and consciously, with the lid open and directly breathes above the crucible.

2. Press the melt-button (Fig.2-6). The green light of the button turns on and, after 1 or 2 seconds, the LED bar (Fig.3-1) shows the power; the power should be set according to the type and quantity of metal, by rotating the knob (2.11) to the right to increase the melting power (and thus the melting speed).

For a direct view of the melting process, use the anti-UV screen on the lid. In case of lid open to be used appropriate safety glasses.

Once the metal is melt, the centrifugation process can be carried out (refer to section “CENTRIFUGATION”).

2.4.5 VACUUM MELTING

1. Prepare the crucible in its support (Pic.1-1.5) with the metal to be melted. Place the muffle in to the sleeve, lock it and close the lid.
2. Press the push-button Vacuum (Pic.2-5) to start the air suction process from the centrifugation chamber. Once a negative pressure of – 0.8 bars is reached (see vacuummeter Pic.2-3), the pump can be switched off by pressing again the push-button (Pic.2-5).

2.4.6 INERT GAS INTRODUCTION

Check that the gas bottle is connected, the valve is open and it is fitted with the appropriate pressure regulator.

When the protection lid is closed, press the Vacuum-button (Pic.2-5). As soon as the vacuum meter shows a negative pressure of - 0.8 bars press the argon-button (Pic.2-8) to start the gas introduction process, checking the pressure inside the centrifugation chamber. When the vacuum meter shows a pressure close to -0.2 press argon-button again to interrupt the gas introduction. Press the melt-button (Pic.2-6) to start the metal heating process.

2.4.7 CENTRIFUGATION

1. Make sure that the muffle is perfectly positioned, close the protection lid and wait until the metal is completely molten.
2. Press the Cast-button (Fig.2-7) to start the centrifugation process.
3. When the centrifugation is completed automatically, or if it is stopped with the push-button F2 (Fig.2-9), wait until the safety locking system to unlock the lid. Open the lid and remove the muffle with the appropriate tongs.

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3 INFORMATION ON MAINTENANCE AND REPAIR

3.1 MAINTENANCE

BEFORE PERFORMING ANY KIND OF MAINTENANCE INTERVENTION, SWITCH OFF THE MACHINE AND DISCONNECT THE POWER SUPPLY.

1. Carefully clean the inside of the centrifugation chamber, removing all coating fragments or metal residues. Clean with the upmost care the PTFE bushing where the coil slides, using the compressed air gun.

2. Every 12 months, check the cooling water tank and top up the water evaporated during the melting operation, through the filler cap situated at the rear of the machine.

3.2 ACCIDENT PREVENTION PROTECTIONS

1. During the melting operations, the operator is protected by the centrifugation chamber closing lid. The arm rotation cycle is enabled only when the lid is locked. The lid remains locked in closed position until the centrifugation is completed.

DURING THE WORKING CYCLE, DO NOT FORCE THE PROTECTION LID OPENING.
IF THE LID REMAINS LOCKED AFTER THE CYCLE IS COMPLETED, DO NOT FORCE IT OPEN AND CONTACT THE AUTHORISED ASSISTANCE SERVICE.

2. The side cover, front cover and rear cover are fitted in position by screws that can be removed whit the special screwdriver with the machine (see Table 1).

- To open the protection lid, perform the following operations:
- Remove the left side panel of the machine using the screwdriver system “ZERO” supplied with the machine.
- Loosen the crossed screw (1of Fig.11).
- Turn the screw 180° (2 of Fig.11) with an appropriate screw driver so that the arrows match each other and unlock the lock.
- Open the lid.
- Turn the screw 180° (2 of Fig.11) to bring back into use the safety device and then lock it again screwing the crossed screw.
- Re-assemble again the side panel.

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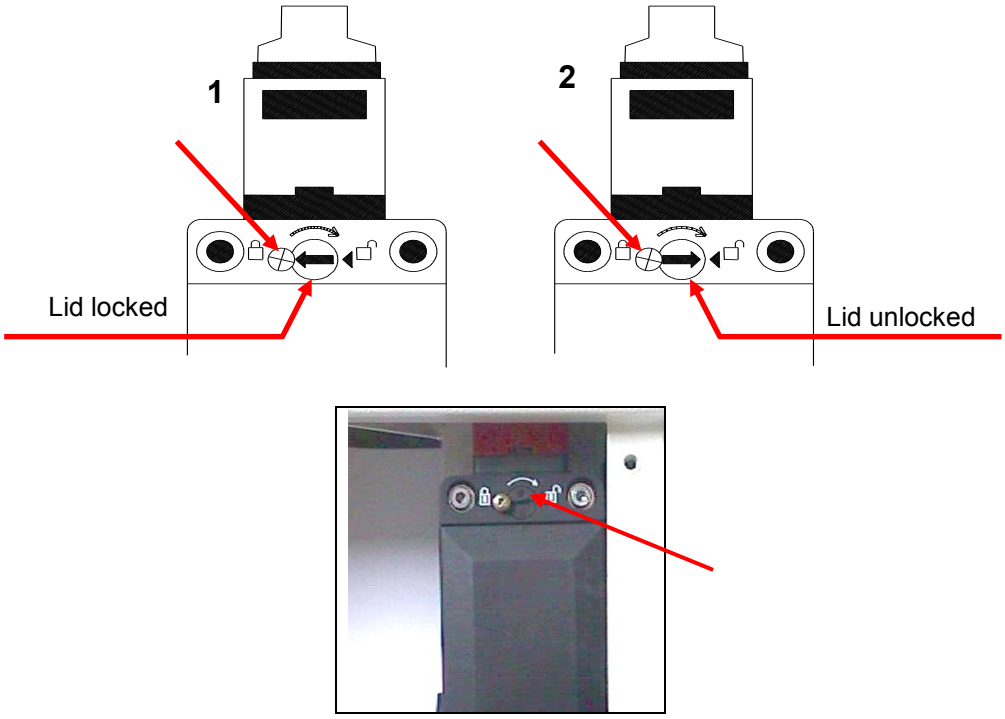

Fig. 11 Safety device to lock the lid.

TO PREVENT DAMAGES TO PERSONS, DUE TO HIGH TEMPERATURES AND ELECTRIC SHOCKS, AVOID DIRECT CONTACT WITH THE MELTING COIL DURING THE HEATING PROCESS.

3.3 SERVICE

3.3.1 GENERAL

If for some reason the unit fails in the field it is advisable that the unit be serviced by the manufacturer or its authorized service representative. Should that happen, please contact us immediately (see contact information in Section 3.3.2).

Please have the following information about your unit available upon calling:

1. Unit Model and Revision (located on the label on the back of the unit).
2. Unit's Serial Number (located on the label on the back of the unit).
3. Line Voltage and frequency.
4. Detailed description of the problem encountered including – load and ambient temperature at the time of the failure.
5. Detailed description of the actions taken.
6. Approximate time in service.

If our technical staffs are unable to help you over the phone, then a repair authorization number (RA#) will be issued for you. With this number enclosed in you return package you can ship the unit back for repair. Additionally, you may request a service engineer to repair the unit on site.

3.3.2 SERVICE CONTACT INFORMATION

For technical service questions, please call:

Tel: 631 842 2400

Or e-mail us at: websales@romanoff.com
You can also send you request through our website.
Note: Please, include your contact information so that you can be easily reached if necessary.

Appendix: MECHANICAL DIMENSIONS

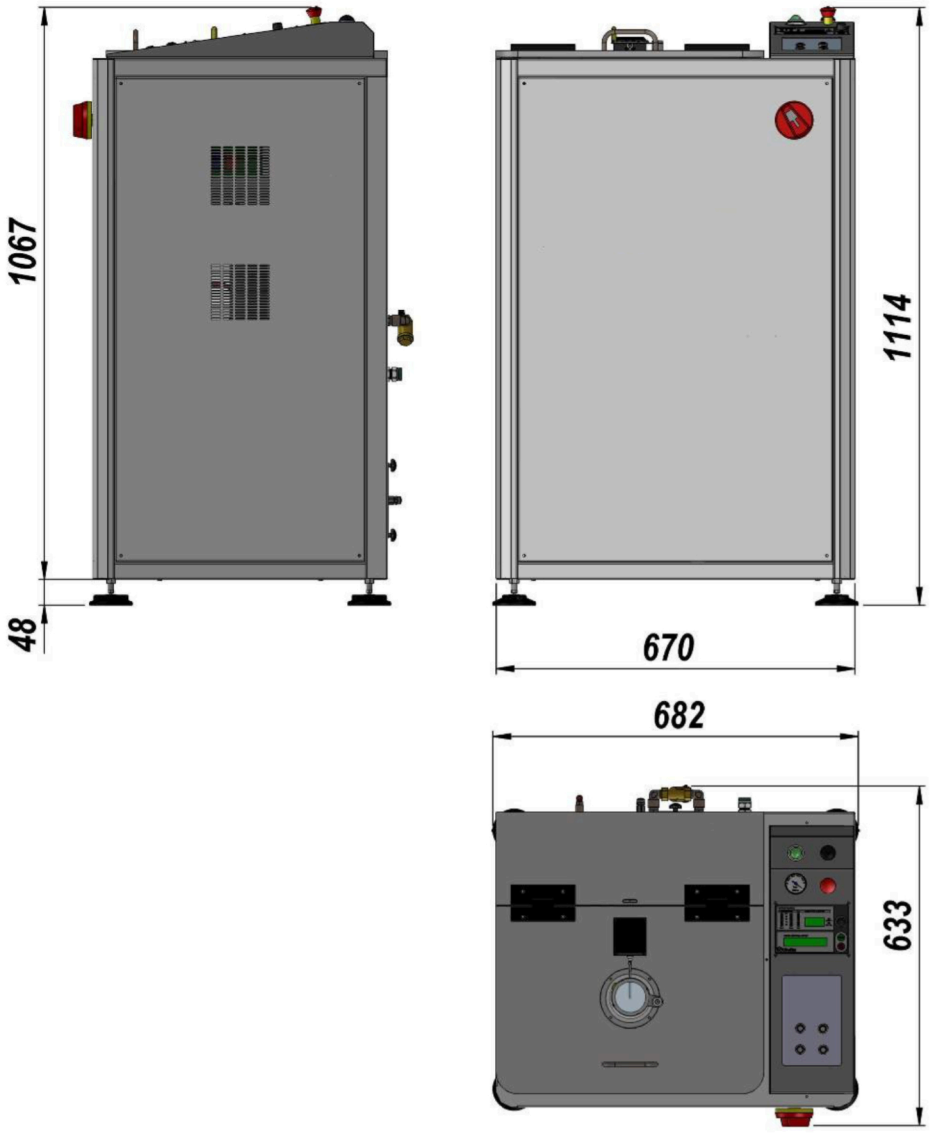

Fig. App.1 ***Romanoff RCS LITE Centrifugal Casting Machine Dimensions (in mm)***

Revision Table

№	Ver.	Date	Create/Change by:
1	1.0	06.2014	L. Mihova
2	1.1	06.2016	M.Nikolova