Chapter 1

STRIKE 5000 ATEX

Foreword

For use in areas where there is danger of explosion it is necessary to check that that the equipment is suitable for the area classification and for the characteristics of the inflammable substances present in the working area. The essential safety requirements against explosion risks in classified areas are established by European Directive 94/9/EC of 23 March 1994 (as regards equipment) and 1999/92/EC of 16 December 1999 (as regards systems).

The criteria for the classification of explosion risk areas are set forth by the EN 60079-10 standard. The technical requirements for electrical systems in classified areas are set forth by the EN 60079-14 standard.

1 INTRODUCTION

Intended Use and Purpose

STRIKE 5000 ATEX is a rotating evaporator for industrial use and may be used for processes regarding:

- **Evaporation and condensation of solvents**

No	INFLAMMABLE SUBSTANCES		Inflam-mability Temp	Density of gas or vapor compared to air	Absolute Gravity of the Liquid	Dif-fusion Coef-ficient	Specific Heat Ratio	Specific Heat Room Temp.	Heat of Vaporization	Molar Mass	Inflammability Limits in Air		Volatility			Ignition Temp.	**TEMPERATURE GROUP AND CLASS**
	NAME	FORMULA	°C		kg/m^3	m^2/h		J/(kg K)	J/kg	kg/kmol	LEL % vol	UEL % vol	Boiling point °C	Vapor Pressure at 20°C °C	Vapor Pressure at 40°C °C	°C	
1	**Ether***	$C_2H_5OC_2H_5$	-45	2.6	708	0.033	29	2328	$3.8*10^5$	74.124	1.9	48	34.6	58150	>101300	160	**IIBT4**
2	**Ethyl Acetate**	$CH_2COOC_2H_5$	-4	3.04	901	28	1.14	2010	$4.24*10^5$	88.1	2.00	11.50	77.1	9480	24400	460	**IIAT1**
3	**Acetone**	CH_3COCH_3	-20	2	792	28	1.14	2200	$5.36*10^5$	58.08	2.5	13.00	56.5	23117	54942	535	**IIAT1**
4	**Acetonitrile**	CH_3CN	2	1.4	783	28	1.19	2265	$7.65*10^5$	41.05	3	16	81.6	9223	22653	523	**IIAT1**
5	**Methyl Alcohol**	CH_3OH	11	1.11	792	0.057	1.2	2500	$11*10^5$	32.04	6.00	36.00	64.7	13371	35986	385	**IIAT2**
6	**Benzol (Benzene)**	C_6H_6	-11	2.67	879	0.032	1.1	1750	$3.94*10^5$	78.114	1.30	7.90	80.1	9935	24551	560	**IIAT1**
7	**Ethylene Chloride**	CH_2ClCH_2Cl	13	3.42	1256	28	1.19	1252	$3.23*10^5$	98.96	6.20	-	356.7	8241	18957	413	**IIAT2**
8	**Hexane**	$CH_3 (CH_2)_4CH_3$	-21	2.97	659	28	1.08	2638	$3.66*10^5$	86.178	1.20	7.50	68.7	14225	34548	233	**IIAT3**
9	**Pyridine**	$CH<(CHCH)_2>N$	17	2.73	982	28	29		$4.70*10^5$	79.1	1.8	12.4	115	2394	6500	483	**IIAT1**
10	**Tetrahydrofuran**	$O (CH_2)_4$	-20	2.49	888	28	1.08	2180	$4.10*10^5$	72.1	1.5	12.0	65	18335	42089	224	**IIAT3**
11	**Toluene**	$C_6H_5CH_3$	4	3.18	866	0.03	1.1	1842	$4.12*10^3$	92.14	1.2	7.10	110.8	14863	25474	535	**IIAT1**

***For these substances and others that bring the machine into a T4 temperature class, it is necessary ask the Steroglass S.r.l. company to change the thermostatic bath emergency bimetals. In this case the bimetals calibrated to 180°C should be replaced with bimetals calibrated to 130°C.**

Enclosed are the technical safety specifications for the individual products.

ALL OTHER PRODUCTS OR SOLVENTS MUST BE CHECKED BY STEROGLASS ACCORDING TO HOW, WHERE AND FOR WHAT PURPOSE THEY WILL BE USED, AND IN KEEPING WITH ESSENTIAL SAFETY REQUIREMENTS.

Specific parameters for protection against explosions

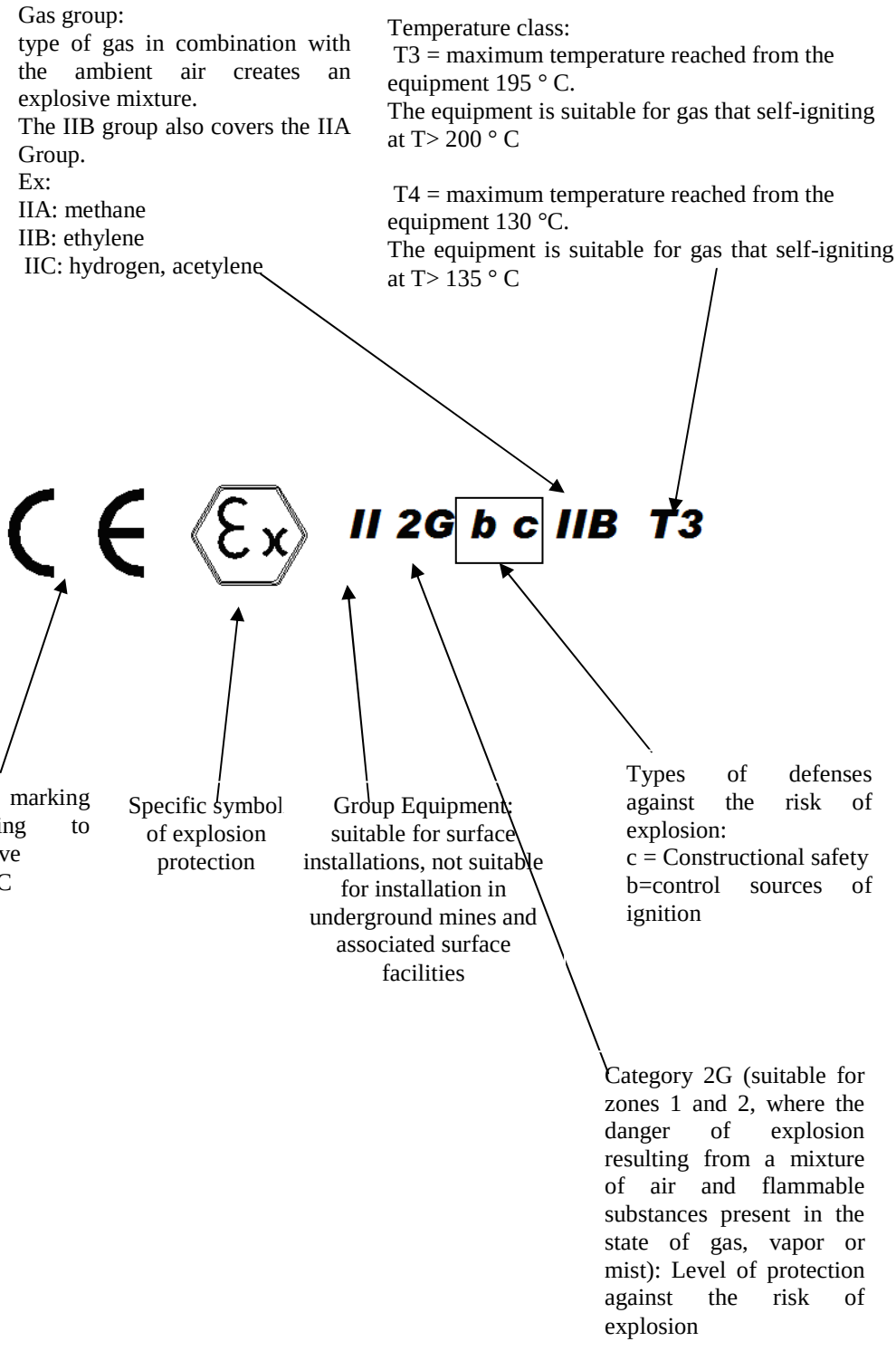
- *Ambient temperatures: –10 ÷ 40*
- *Maximum pressures: Pmax* = 0.5 bar for glass components
- *Protection against electrical hazards:* equipotential connections, grounding
- *Protection against mechanical hazards:* possible mechanical hazards can be caused by the seizing of the rotating head or the breaking of the lifting system. In the former case, self-lubricating bearings are installed to prevent the flask from immediately locking and breaking. In the latter case, the malfunctioning or breaking of the lifting system does not cause the pan to drop immediately and to spill boiling liquids, because the hydraulic circuit is equipped with a flowstat which causes the system to lower gradually.

Safety systems applied

- Open door sensor that prevents machine operation if the door is open.
- Thermostatic bath bimetal that locks out the power circuit in the event that the PLC no longer controls the temperature of the bath or when the temperature goes above the operating temperature (175°C for the T3 version, or 125°C for the T4).
- Fluid pump bimetal that locks out the power circuit when the temperature of the fluid in the hydraulic circuit exceeds the emergency temperature that has been set. There is also a mechanical timer in order to avoid having the oleodynamic pump motor keep running due to an electrical fault for longer than the preset safety time (30 s).
- Inverter safety: The reduction ratio provided by the belt-reduction unit was calculated such that even in the case of failure of the inverter controlling the evaporation flask rotation motor, resulting in the maximum working speed being supplied, the flask rotation speed will not exceed the maximum allowed (100 rpm).

- *Emergency shutoff systems*: the instrument is equipped with a red knob on the control panel. Pushing in this knob causes the instrument to shut off immediately and to move into the safety position . To restart the instrument it is necessary to release the shutoff knob and press Start.

Overview of ATEX marking



Classification of hazardous areas

The CEI EN 60079-10 (IEC-31-30) defines the following hazardous areas:

- Zone 0: where is present continuously or for long periods of explosive atmosphere in the presence of gas.

- Zone 1: where is likely to occur during normal atmosphere for the presence of explosive gases.

- Zone 2: where you can be an explosive atmosphere due to the presence of gas during normal operation, or if this happens is likely to occur only infrequently and for short period.

The instrument is equipped with valves and flange junction between the different parts of glass and / or PTFE. These components can cause leakage of vapors that could result in a classified area around the instrument depends on the degree of ventilation of the room where it is installed.

In particular, the vapors may escape from the structure that protects the glass from above the upper perforated panels, and / or below the base of the instrument, and / or laterally to the rear panel.

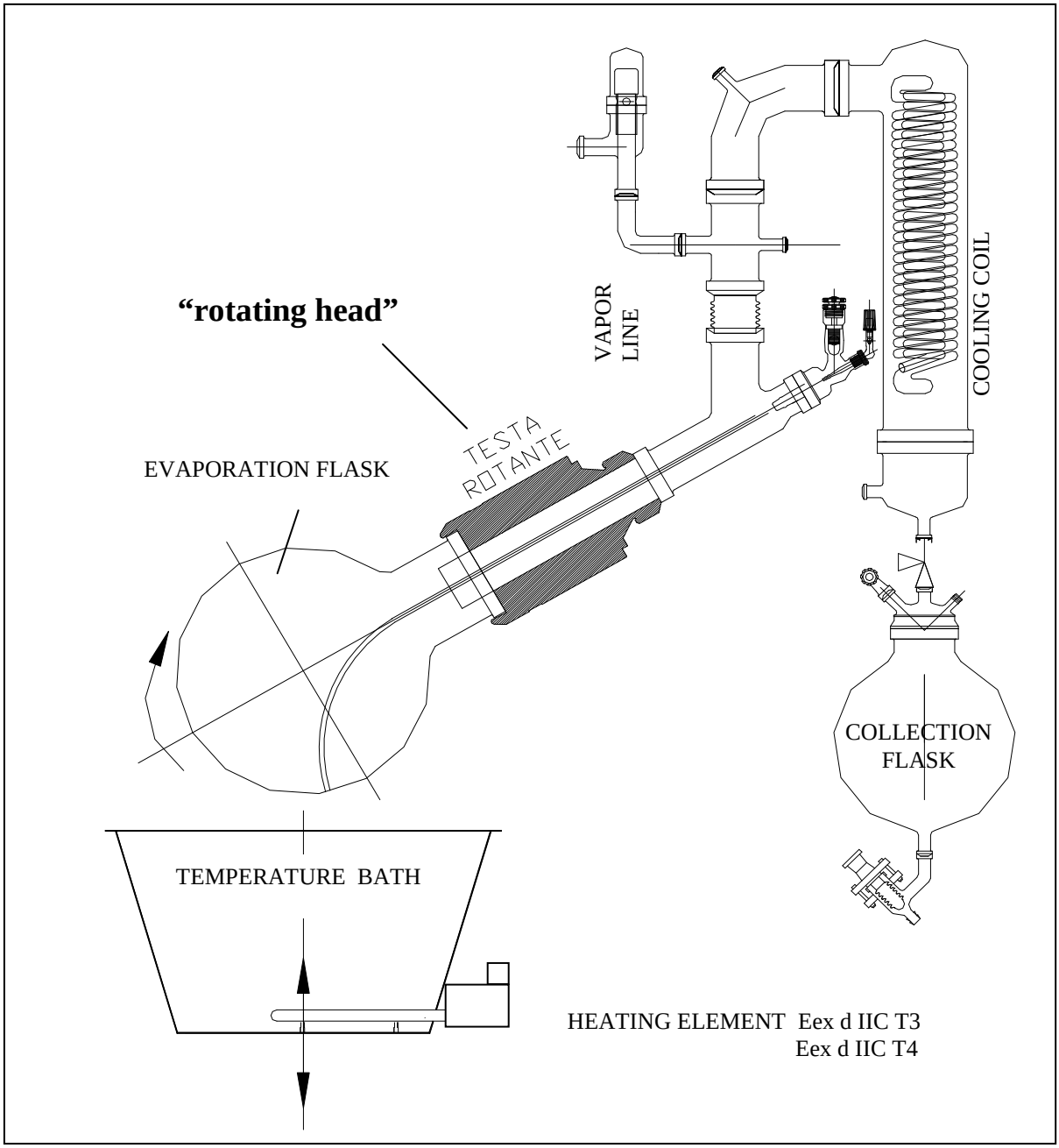
Source of emission

The CEI EN 60079-10 (IEC-31-30) defines the emitting source: a point or part which can be emitted into the atmosphere a gas, a flammable vapor or liquid in a way that an explosive atmosphere.

General Description of the Machine

The actual evaporation – condensation system is composed of an evaporation flask on one side, which is filled with a given amount of solvent to be evaporated and is then rotated and appropriately heated in a thermostatic bath, and on the other side a cooling coil which condenses the vapors developed, which are then collected in one or two collection flasks.

- **Thermostatic bath**: composed of a stainless steel pan with a capacity of about 100 liters, which is filled with water or diathermic oil. It acts as a heater for the evaporation-condensation system. The water is heated to the desired temperature by an exposed heating element installed inside the pan in a position so as to avoid contact with the evaporation flask .



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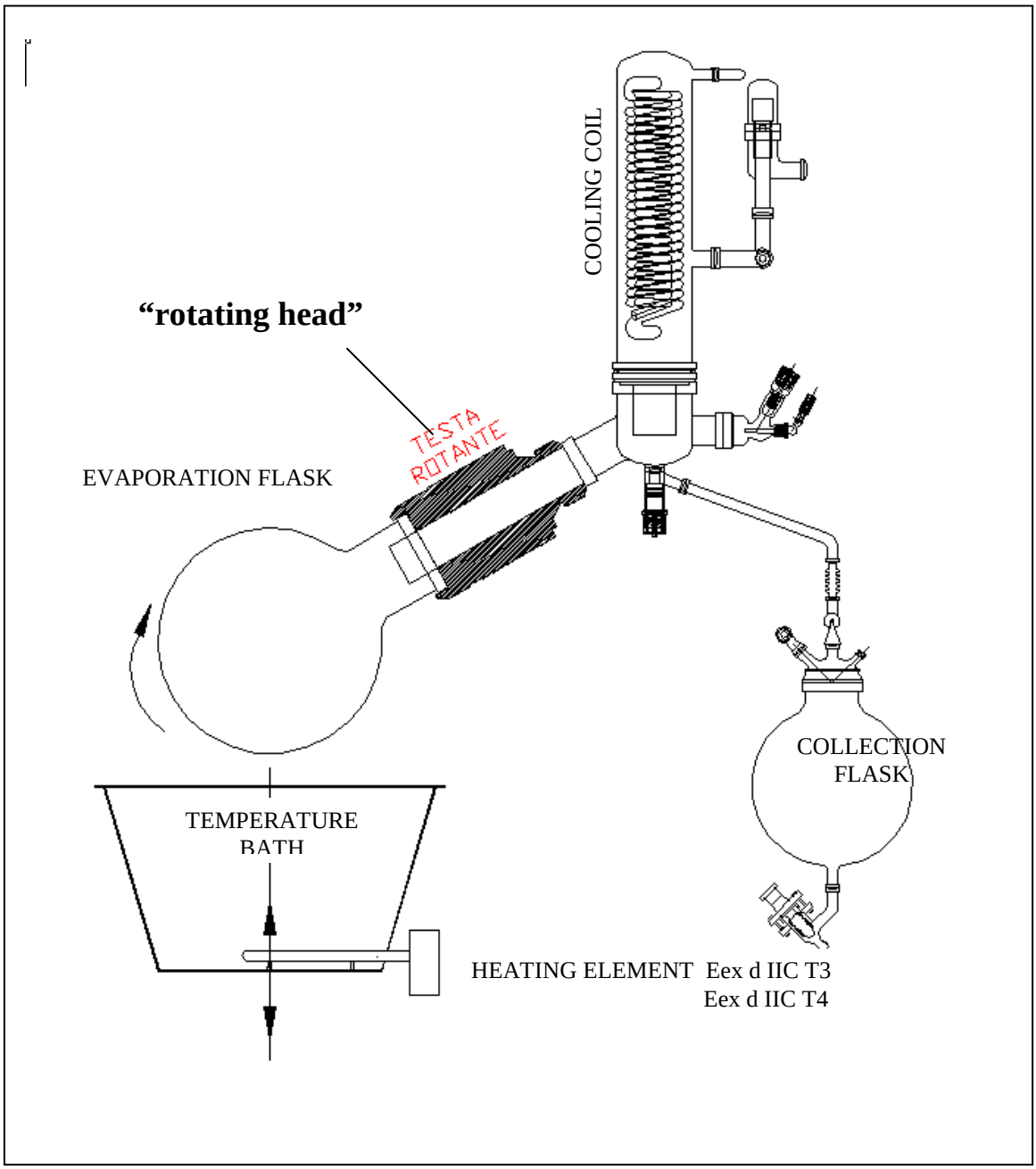

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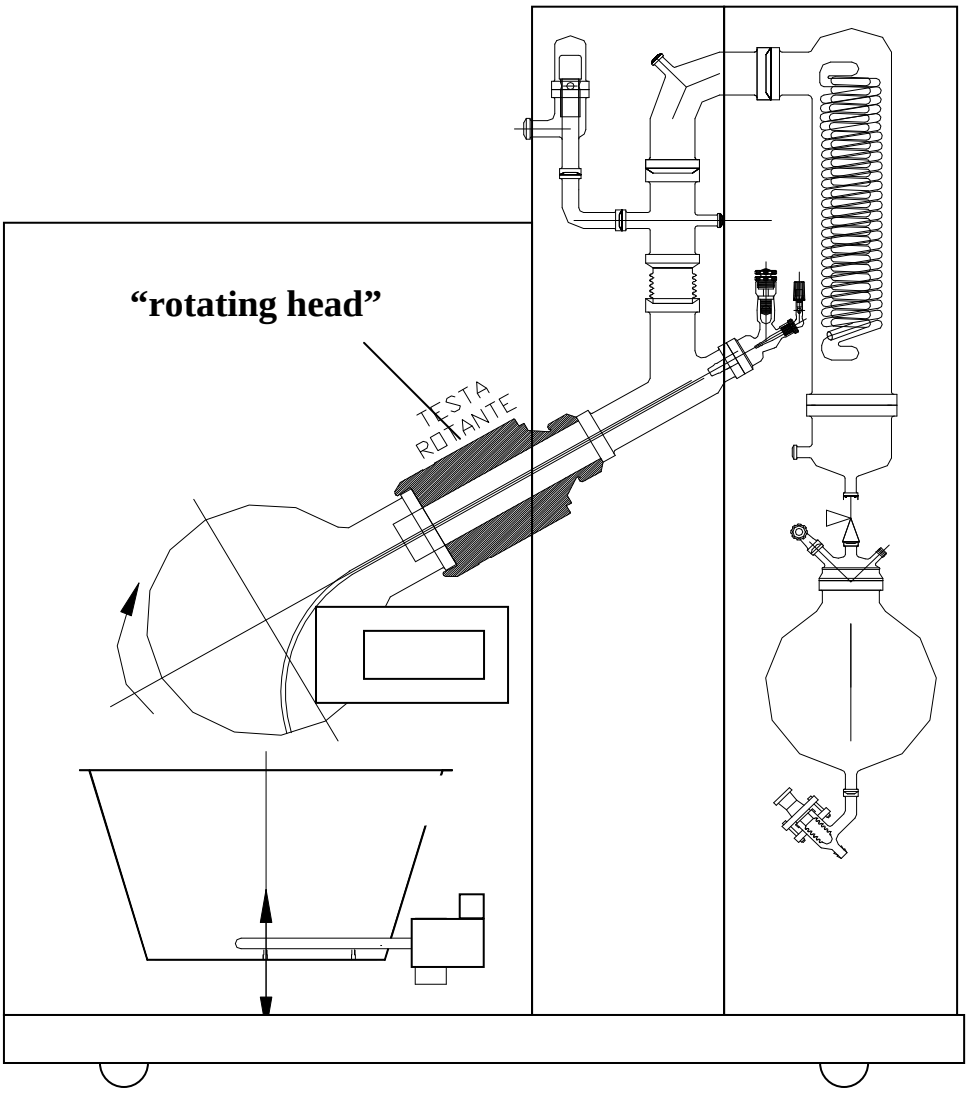
- **Electric immersion heater**: the instrument is equipped with 2 (two) immersion heating elements with an output of 5 kW (2.5 kW per element), and Eex d IIC T3 or T4 degree of protection, depending on the version of the instrument.
- **Rotating head**: this is the mechanical heart of the rotating evaporator. It makes it possible to obtain the ideal rotation for the evaporation flask.
- **Glass components:** All glass components (vapor line, couplings, valves, cooling coil, collection flasks) are in 3.3 ISO 4586 borosilicate glass.
- **Structure and frame:** the machine support structure is made from anodized anticorodal aluminum structural shapes and is mounted on wheels.
- **Panels:** the machine panels are made from anticorodal aluminum sheet painted with acid-resistant paint with low ohmic resistance.

- **Evaporation flask and thermostatic bath protective safety booth:** this safety device serves to protect the operator from any splashing or spraying of hot liquids (oil or water) or from any flying objects. The shield is equipped with a mechanical lock, which eliminates the risk of accidental opening. In addition, the shield has a magnetic safety sensor, which stops the instrument in the event of a non-programmed or accidental opening of the shield.
- **Glass components protection booth:** A booth in antistatic Lexan with a thickness of 5 mm provides protection against any implosions or breakage of the glass components.



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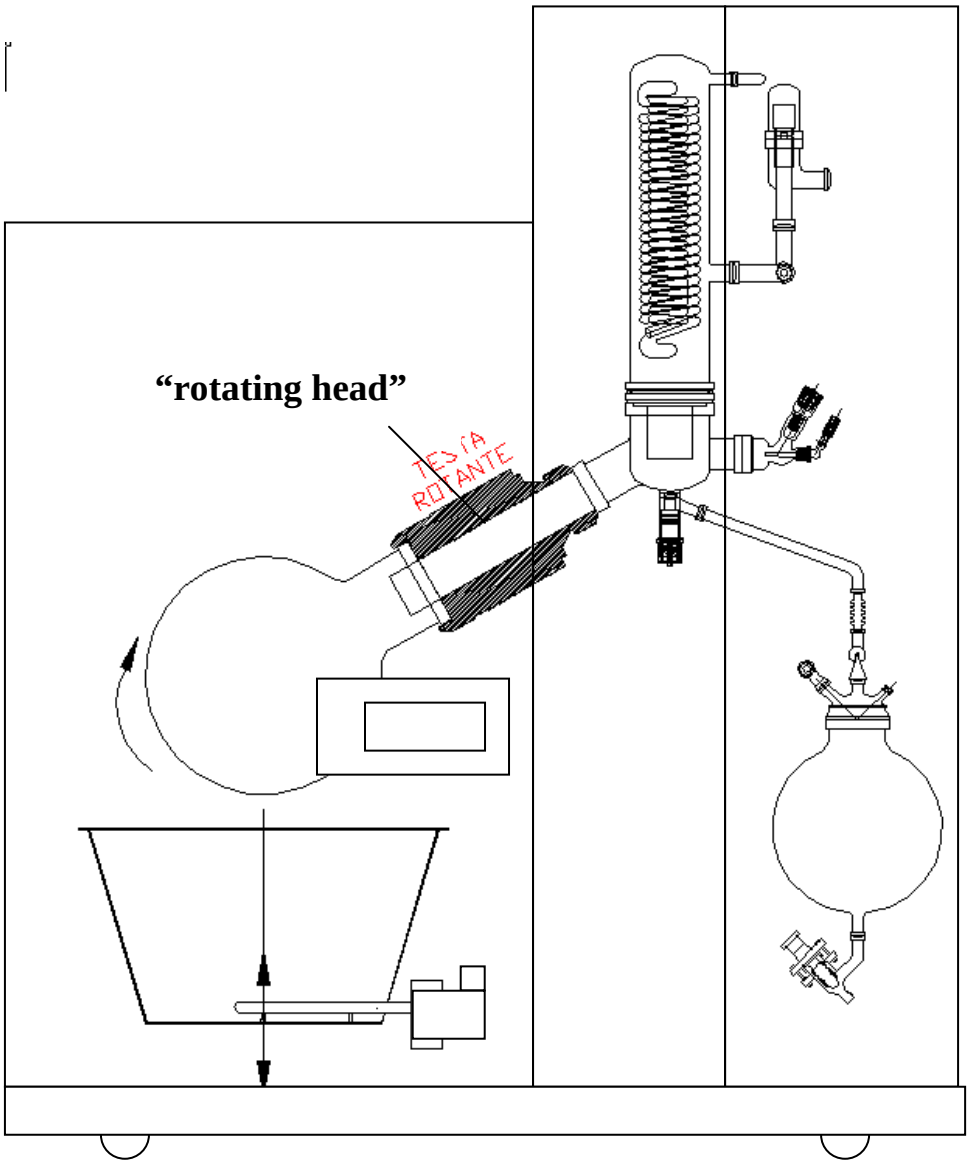

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2 General Description of the Process and Operation

The system is designed to allow the separation of more or less volatile solvents from mixtures of compounds.

The system operates under a vacuum and is controlled by an ATEX solenoid valve mounted on the machine.

The "STRIKE 5000 ATEX" can be equipped with a flask with a total capacity of either 100 or 50 liters (working capacity = 50 or 25 l) that when set in rotation allows even heating of the mixture. A heating capacity of 5 kW electrical power makes it possible to bring the mixture quickly to the temperature necessary for evaporation.

The temperature at which evaporation begins naturally depends on a number of factors, such as:

The nature of the initial mixture;

The working pressure of the system;

The quantity of solvent dissolved.

It appears evident, therefore, that since we are dealing with an evaporation process, the yield of the system is that much greater in proportion to how much greater the difference is between the boiling temperatures of the solvent (overhead product) and the solute (bottom product) under the preestablished pressure operating conditions.

The versatility of the "machine" makes it possible to work with vacuums of a very high degree (up to approx. 1 $mbar_{ass}$), so that the optimal working conditions can be chosen.

The oil bath in which the 5 kW electric heating element is immersed is equipped with a thermometric sensor which makes it possible to program and control the desired temperature.

Little by little, as the temperature rises the mixture of vapors emerging from the flask will be increasingly rich in solvent. When the solvent reaches the exchanger coil, it will be condensed and conveyed toward the collection flask.

The sensors for measuring the internal pressure (IP) and the temperature of the condensed liquid (IT) make it possible to display the value of the two quantities on the control panel. When the exchanger operates as a total condenser (without undercooling) the temperature indicated by IT should not be much different from that of the vapors emerging, and therefore from that of the liquid inside the collection flask (except for heat dispersions). Operating in this manner, the heat exchanger would in fact have the sole task of absorbing the latent heat of condensation, and the liquid will be brought to room temperature by the exchanger–undercooler before being stored in the two collection flasks placed behind the machine.

Actually, the exchanger will operate most often as a total condenser with partial undercooling every time that there is a latent heat of condensation that is not high.

The operating conditions of the condenser will depend also on the degree of the vacuum in the system and on the flow and temperature of the coolant

Vacuum Operation

The process of separating a solvent from a product with a high boiling temperature (solute) often requires operation of the system under a vacuum, depending on the chemical-physical characteristics of the solvent used.

Naturally, the maintaining of an internal pressure at a very low absolute value (e.g. P_{ass} = 5 mbar = 3.8 mmHg) makes it possible to work at moderate temperatures, given that the boiling point of the components (and thus of the mixture) lowers under absolute pressure.

The system has a number of vacuum intakes that can be used simultaneously or otherwise; in particular, *the main pressure tap is that placed on the head of the exchanger-condenser*.

The system has two outlets (valves with threaded couplings) which, when considered necessary, allow a direct connection to the pumps for the purposes of a compensation of the degree of the vacuum within the system.

In any event, the main pressure tap must always be connected to the pump in order to avoid preferential paths of the vapors emerging and poor process efficiency. If, however, it is desired to operate with fine adjustment of the vacuum with all of the intakes and outlets connected, even if there are by-passes of the vapors emerging from the starting flask toward the collection flasks, the undercooler, operating in this case as a condenser, will condense the vapors.

Setting the Functions

The process functions can be set directly from the **STRIKE 5000** control panel. In particular, it is possible to set::

1. **Speed of flask rotation** **(rpm)**
2. **Thermostatic bath temperature (IP)** **(°C)**
3. **Vapor temperature (IT)** **(°C)**
4. **Vacuum setting** **(mbar)**

The above functions are analyzed in detail:

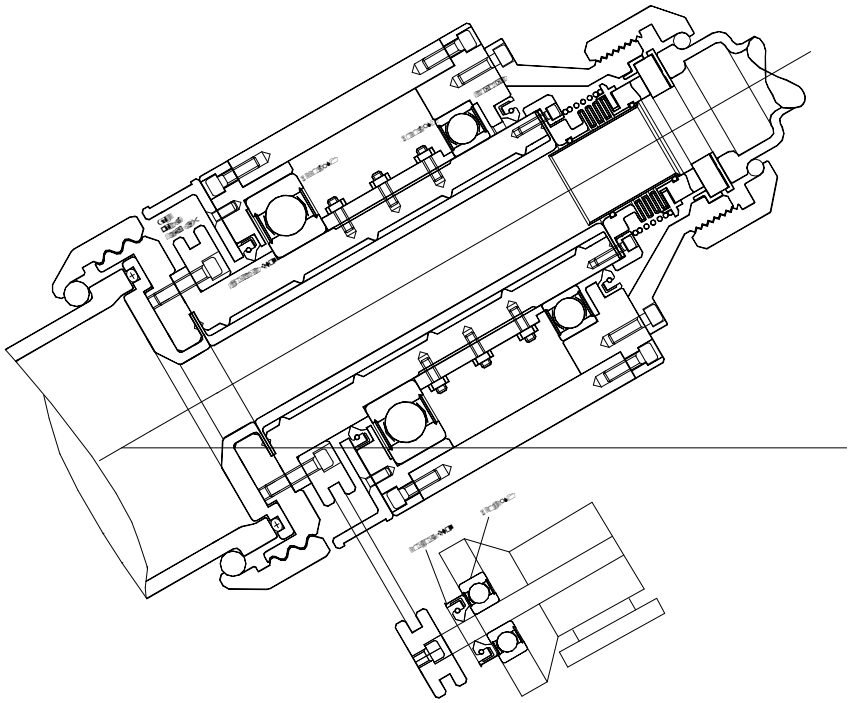
1. The rotation speed of the flask can be preset within an interval of **1–100 rpm**.
2. The temperature of the oil bath can be preset from **room temp. to 175°C** for the T3 version and **125°C** for the T4 version.
3. The IT temperature setting function can be used to stop the instrument at the end of the cycle.
4. The final function allows the defining of the degree of vacuum inside the system, modulating it by means of the valve and reading the vacuum level directly in the system by means of a pressure transducer.

Description of the Rotating Head and Mechanism

The rotating head performs the functions of rotating the flask and as a seal for the entering or exiting of vapors. This component offers the highest possible performance while providing total safety of operation..

The main mechanical parts of the rotating head are:

- ring nut for fastening the flask and the rear elbow
- front flange for screwing on the ring nut, in anticorodal aluminum coated with virgin PTFE
- central movement sleeve coated with glass-loaded PTFE
- front flange in anticorodal aluminum for protecting the vacuum seal
- main body of the rotating head in stainless steel
- bellows for face vacuum seal with body in virgin Teflon and seal in graphite-loaded Teflon
- induction motor with IP 55 isolation and ATEX protection.



The induction motor transfers the motion to the toothed pulley, anchored directly to the flange of the rotation shaft, by means of an antistatic belt which prevents the generating of parasite currents.

The rotating part is made to rotate on sealed bearings, the ends of which are protected in Viton oil retainers, which guarantee the seal for the entering of vapors and the exiting/entering of liquids.

The central movement sleeve coated with PTFE guarantees a certain resistance to chemical solvents and/or vapors and allows them to pass through during rotation.

The bellows for the face vacuum seal adheres to the central movement sleeve.

The bellows is composed of two parts of different materials: the part which adheres to the central movement sleeve is in glass-loaded PTFE, and the part which adheres to the ground glass disk is in graphite-loaded PTFE.

As graphite is self-lubricating, the rotation generates a vortex and seal surface on the ground glass, so as to make a perfect vacuum seal.

The force exerted by the spring guarantees perfect adherence to the glass disk, so that the seal is maintained even at minimum pressures.

For programmed stopping, the induction motor (with a reduction ratio of 1:8) has a gradual deceleration generated by the inverter that controls it, thus avoiding any damaging stress to the glass components.

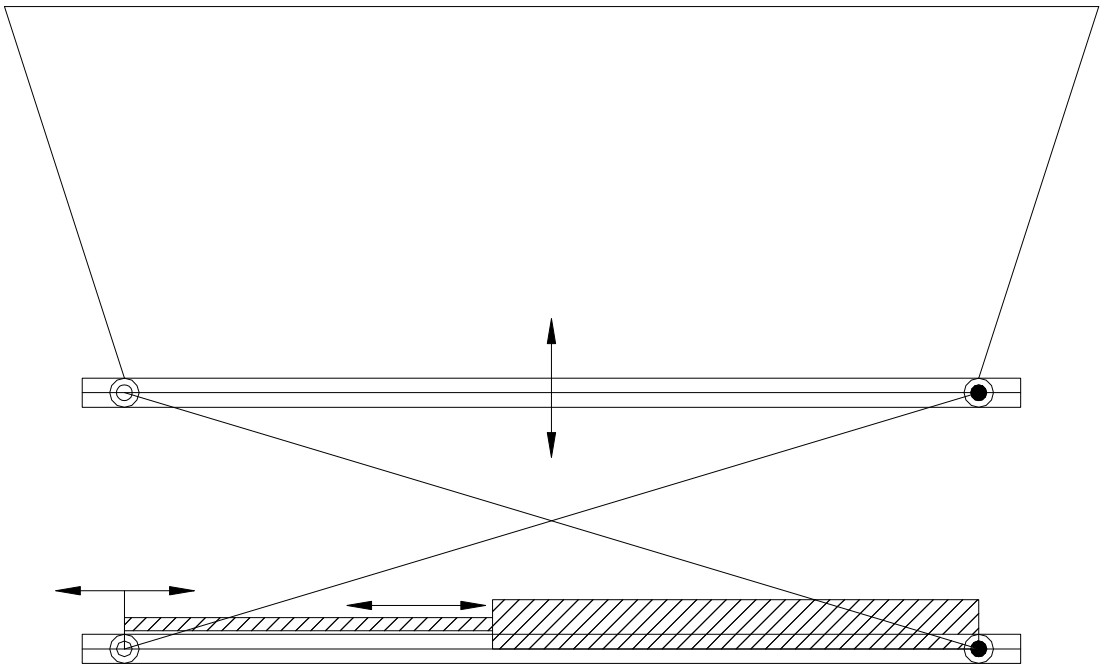
In the case of the accidental loss of power the motor, due to its transmission ratio, will abruptly stop the glass flask. To prevent this, idler gears are inserted inside the flask so as to generate a single direction of rotation and to allow the glass flask to spin freely

Description of the Thermostatic Bath Hydraulic Lifting System

The lifting system has a pantograph-type mechanism which uses the force applied by a piston, thus raising the thermostatic bath.

The main mechanical parts of the hydraulic lifting system are:

- lifting arms and guides in 304 stainless steel
- movement transmission shafts in 304 stainless steel
- transmission and rotation pins in B14 bronze
- hydraulic lifting unit controlled by ADPE solenoid valves
- motor-pump unit with 0.37 kW power with ADPE degree of protection and which can guarantee a pressure of 100 bar - F=950kg
- hydraulic fluid reservoir, 2.5-liter capacity
- hydraulic piston with a stroke of L=250mm.

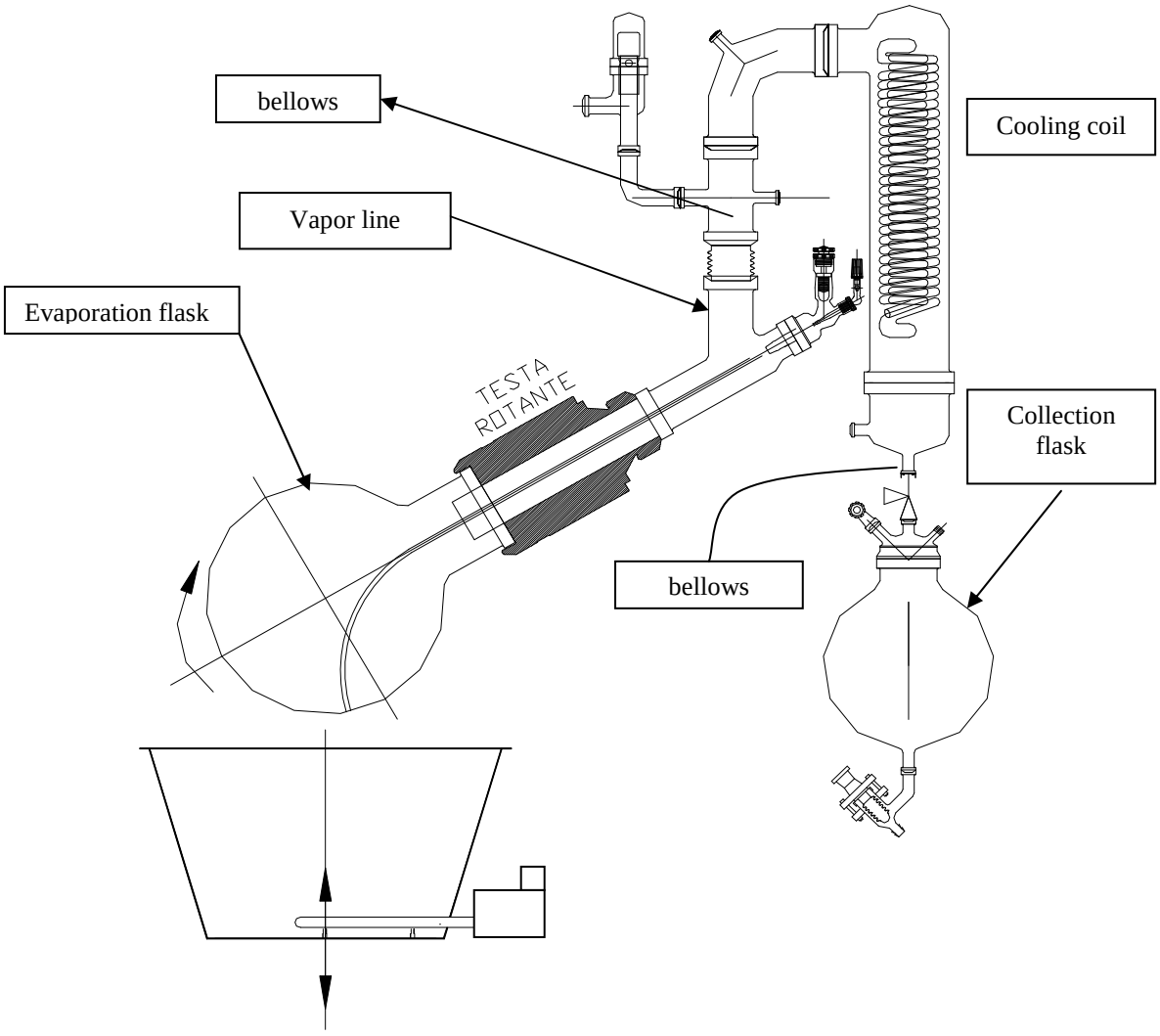


All moving parts have B12 bronze bushings in order to avoid contact between equal materials.

The piston is driven by the hydraulic unit, causing the carriage to slide and the pantograph to rise. This lifts the pan and thus the thermostatic bath (start of the working cycle and heating of the liquid inside the pan).

At the end of the cycle the thermostatic bath is lowered back into the "resting" position, with the descent being slowed by the constriction of the piston. This also takes place when the electric power supply is interrupted.

Description of the Glass Components



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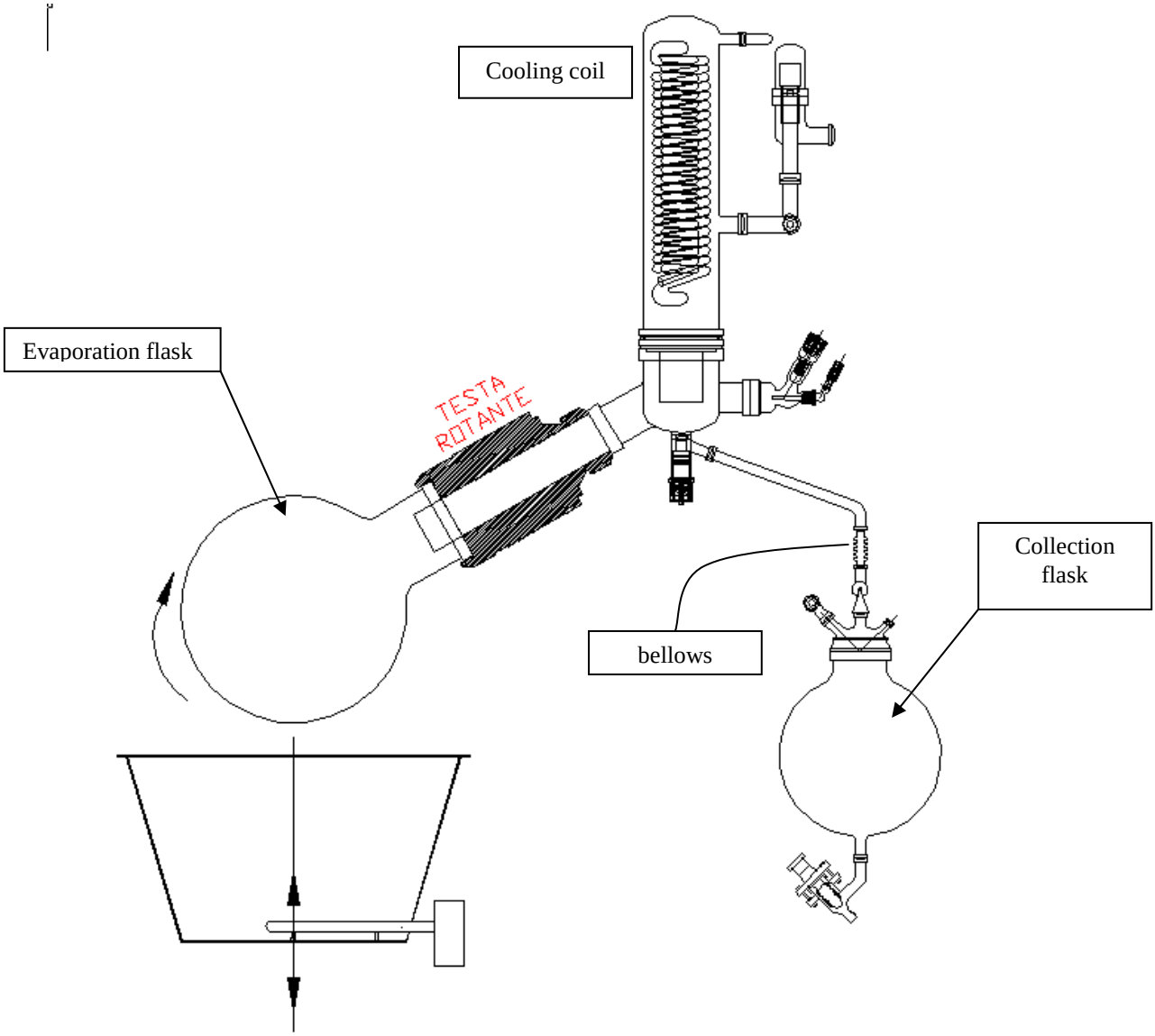

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The heart of the entire array of glass components is the evaporation flask into which the solvents are introduced. Through the heating and rotation of the evaporation flask the solvents evaporate and rise up the vapor line to the exchanger-cooling coil.
Water at a lower temperature flows inside the cooling coil, causing the vapors to condense and drip into the two collection flasks.

Any vibrations that could be generated due to the rotation of the evaporation flask and that could affect the glass components are dampened by bellows in virgin PTFE both on the vapor line and above the collection flasks.

List of Apparatus Supplied

The system includes the following apparatus:

- Thermostatic bath equipped with **2 (two) 2.5 kW heating elements.**
  Power input 380 V three phase, 50 Hz (ADPE EEX d IIC T4 or EEX d IIC T3)
- Starting solution flask in borosilicate glass. **Working capacity = 50 l.**
- Rotation unit and GLASS/PTFE mechanical seal
- DN 80 vapor line with expansion tank.
- Coil-head vertical exchanger-condenser in borosilicate glass. **Exchange surface = 1.5 m^2**.
- Condensate collection and vacuum intake.
- Condensate liquid collection flask in borosilicate glass. **Capacity = 20 l**.
- Safety valve calibrated 1/20.

The system is also equipped with all the connections necessary for proper functioning, on-off valves, instruments, rapid connections and couplings for easy connection to service fluids.

3 INSTRUCTIONS FOR OPERATING THE MACHINE

General Remarks

The **STRIKE 5000 ATEX** rotating evaporator is characterized by apparatus, tubing and valves essentially in borosilicate glass which, due to the nature of the material, is fragile .

ATTENTION: all system assembly and disassembly operations must be done by specialized technicians.

STEROGLASS DOES NOT SUPPLY THE POWER CORD FOR THE MACHINE. THEREFORE IT IS THE RESPONSIBILITY OF THE USER TO HAVE THE POWER CORD INSTALLED BY QUALIFIED TECHNICIANS AND TO CHECK THAT IT IS DONE IN A WORKMANLIKE MANNER.

ATTENTION:

ONLY SPECIALLY TRAINED PERSONNEL SHOULD START AND OPERATE THE MACHINE.

THIS PERSONNEL SHALL BE AUTHORIZED TO USE THE MACHINE ONLY IF IN POSSESSION OF A REGULAR "WORK PERMIT" ISSUED BY MEANS OF THE SPECIAL FORM.

ATTENTION:

LOCK THE MACHINE IN PROPER POSITION DESIRED BY WORKING BRAKES WHEELS

ATTENTION:

DO NOT OBSTRUCT PERFORATED PANELS THAT ALLOW THE RELEASE OF ANY GAS INSIDE THE MACHINE

ATTENTION:

BEFORE OPERATING THE MACHINE MAKE SURE THAT THE EXTERNAL GROUND TERMINAL IS CONNECTED TO THE GROUND OF THE STRUCTURE/LABORATORY/BUILDING.

ATTENTION:
ALL START, STOP, LOADING, AND UNLOADING OPERATIONS OR ANY OTHER OPERATIONS MUST BE MADE BY QUALIFIED PERSONNEL THAT IS AUTHORIZED BY THE SPECIAL *WORK PERMIT FOUND IN APPENDIX 1A*

ATTENTION:
BEFORE OPERATING THE INSTRUMENT ALWAYS CHECK THE LEVEL OF LIQUID IN THE TANK. THIS MUST NEVER BE BELOW THE MARK ON THE PLATE LOCATED ON THE WALL OF THE TANK

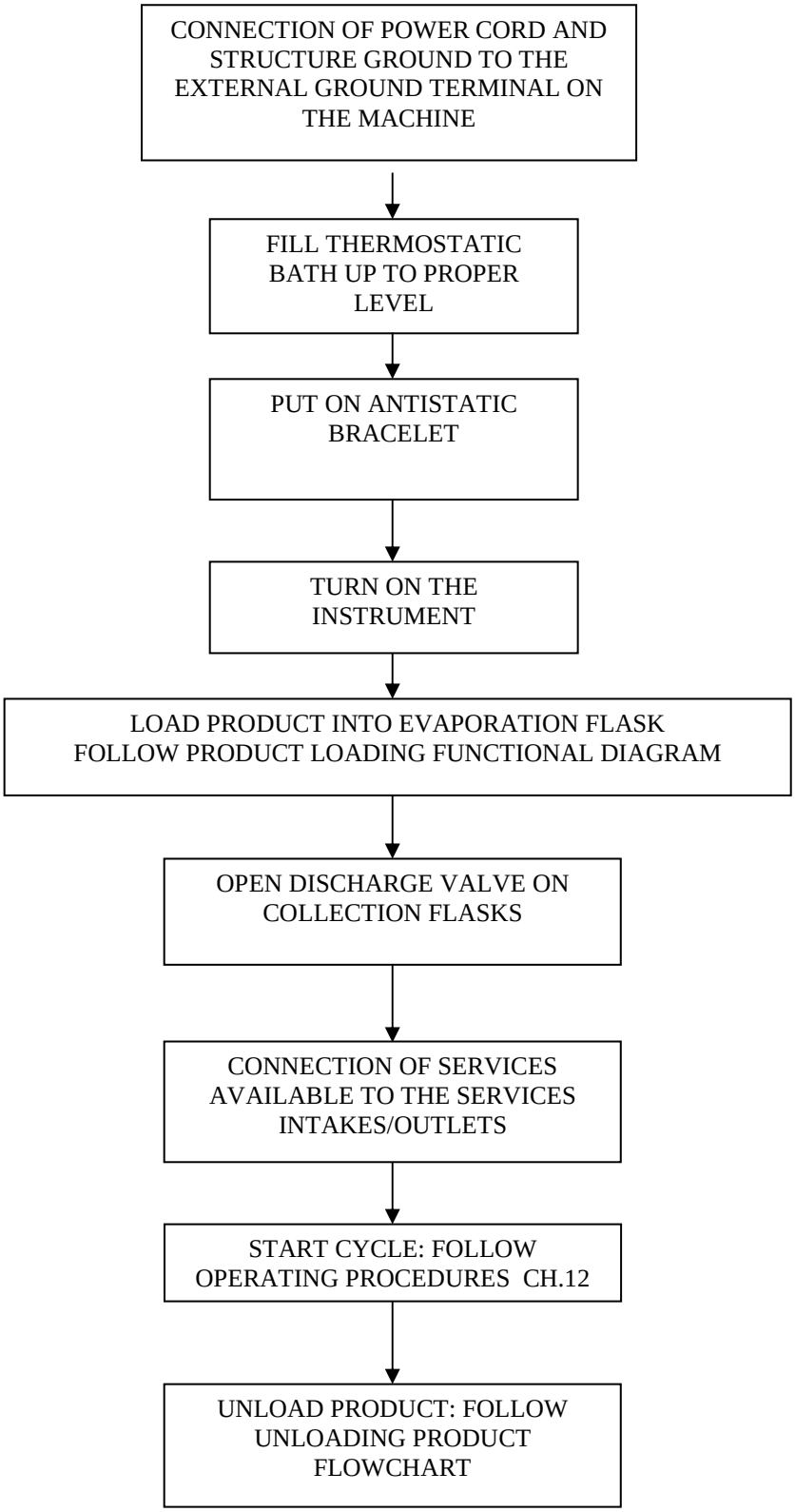
ATTENTION:
BEFORE OPENING THE THERMOSTATIC BATH SHIELD CHECK ON THE DISPLAY TO MAKE SURE THAT THE TEMPERATURE OF THE LIQUID IS BELOW 70°C

CAUTION:
IN COMMON USE FACILITY IS STRICTLY PROHIBIT THE USE OF SUBSTANCES WHICH COULD HAVE EXOTHERMIC REACTION AND THAN TO HAVE IGNITION SOURCES

CAUTION:
CLEANSING THE INSTRUMENT MUST ONLY BE MADE USING WET BRACKET, THEREBY AVOIDING THE CREATION OF ANY IGNITION SOURCES

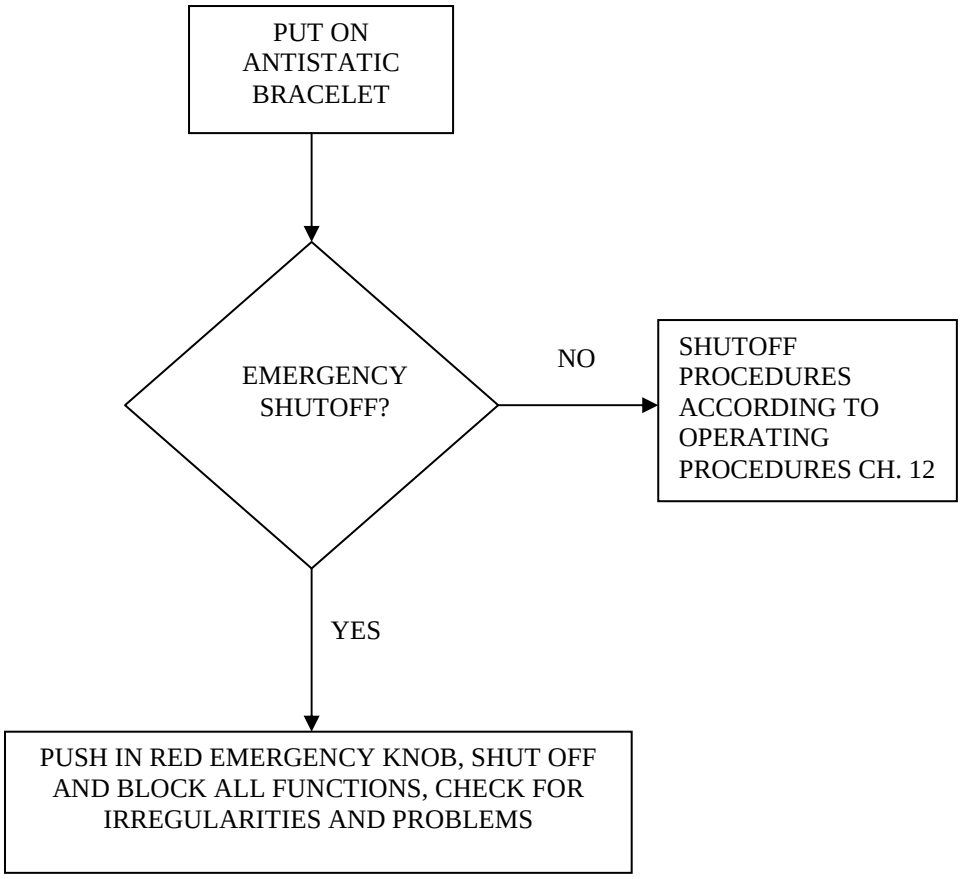
MACHINE STARTING FLOWCHART

Operations to be carried out by trained and authorized technical personnel:



MACHINE SHUTOFF FLOWCHART

Operations to be carried out by trained and authorized technical personnel:



All parts in glass making up the system are furnished assembled and functional inside their protective casing. The operator need only connect the tubing for external connections regarding service fluids and provide the settings for the start, operation, and shutoff procedures .

System Assembly

The system can be assembled and disassembled using simple mechanical antispark "cold" tools, i.e. without the need for any soldering or welding equipment.

The system assembly stages are divided into the following:

1. **Assembly of the system support structure**, i.e. the assembly of the oil bath support base and of the perimeter and central metallic structural members supporting the raised apparatus.

2. **Assembly of the individual apparatus mountings** on the support structure, i.e. the correct localization of the individual apparatus mountings based on the distances and heights shown in the drawings.

3. **Assembly of the apparatus**, i.e. the setting up of the apparatus listed above beginning with the oil bath and continuing with the motor unit/seal, and so on continuing with the tubing and the raised apparatus, taking care to proceed rationally with the assembly, both to facilitate the movements of the operators as well for a correct distribution of weight on the structure. As mentioned previously, the assembly is to be done using a few simple "cold" tools, as the flanged joints are to be fastened simply by tightening the nuts and bolts, which at this stage is not yet final. It should be noted that all of the flanges of the apparatus in glass have been protected; the protective cardboard should be removed piece by piece as the components are assembled to the structure, being extremely careful not to damage these surfaces.

4. **Assembly of the service fluids tubing**, i.e. connection of the tubing for the vacuum, refrigerated water (in and out) and nitrogen from the system threaded couplings to the system utility intakes/outlets placed on a plate welded to the support structure (**services rack**). To carry out this operation, first it is necessary to install the special pieces furnished for clamping the tubing to the support structure and attaching the quick connection couplings to the services plate.

5. **Cleaning of tubing with compressed air and tightening of components**. A quick cleaning done before tightening the flanges will remove any dust that might be in the system. Following this the final tightening of the bolts on the flanges may be done.

6. **Assembly of the room instruments and of the vacuum pump**. In particular, the system pressure sensor (**PT**) and the temperature sensor (**TT**) must be placed in position. If the

temperatures sensors included with the oil bath have been previously disassembled, these will similarly be placed in position

Once the system is set up, it is recommended that a vacuum pump cycle be run in order to eliminate any trace of impurities before proceeding with the loading of the product and a new working cycle.

Moving the System

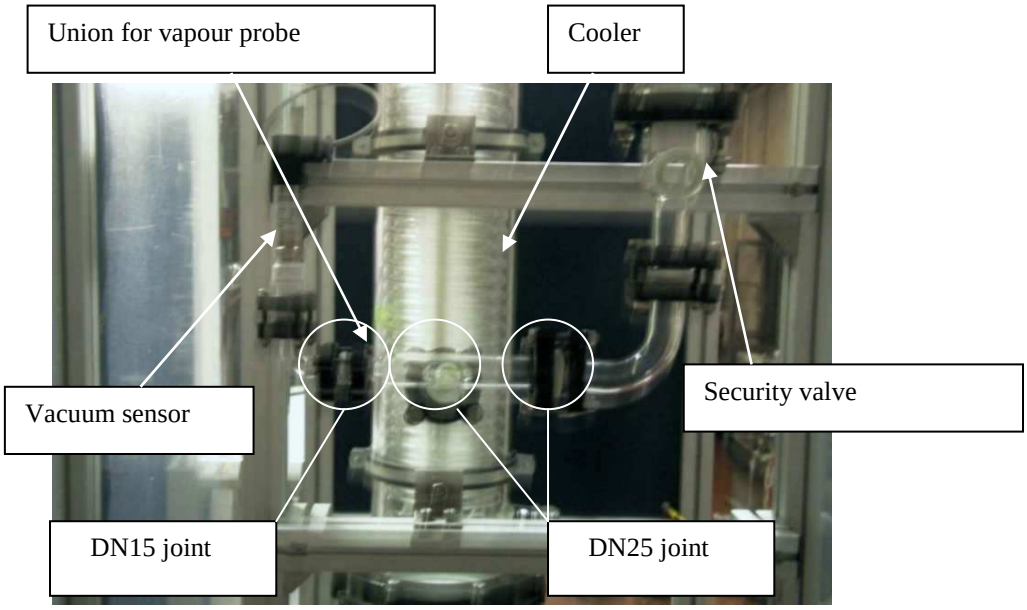
The system support structure is equipped with wheels to allow it to be easily moved within the production area (it will be sufficient to eliminate only the connections between the parts attached to the moveable structure and those that are part of the room, such as service fluids). The operations to be carried out when moving the machine to another area are listed below.

The moving of the machine is divided into the following stages:

1. **Disconnect the tubing** external to the **STRIKE 5000 ATEX** that connects the system to the service fluids (water, nitrogen, vacuum) collector and to the connection for the safety valve discharge to allow the machine to be moved on wheels.

2. **Disconnect the power cord** connecting the **STRIKE 5000 ATEX** electric control board to the external room outlet, and the ground wire, to allow the machine to be moved on wheels.

3. **Loosen the blocking system of the safety valve** in order to allow its oscillation of few millimetres compared to the structure



N.B. Loosen but not take away the blocking clamp of the valve completely otherwise vibrations could damage the glassware.

4. **Release the wheel clamps** that allow the **STRIKE 5000 ATEX** to be blocked in a stable position once the new working position has been established.

Partial Disassembly of the System

When it is desired to disassemble the machine, the possibility of moving the **STRIKE 5000 ATEX** on wheels allows the disassembly of all those parts not integral with the base support structure. The parts that can be disassembled will be the external protective casing along with all apparatus in glass, for purposes of replacement or maintenance.

The procedures for this operation are listed in following:

1. **Disconnect the tubing** external to the **STRIKE 5000 ATEX** that connects the system to the service fluids (water, nitrogen, vacuum) collector to provide space to operate freely.

2. **Disconnect the power cord** connecting the **STRIKE 5000 ATEX** electric control board to the external room outlet.

3. **Remove the upper protective casing** of the **STRIKE 5000 ATEX** so as to have free access to the glass apparatus.

4. **Number the upper parts of the system**, i.e. those not connected directly to the support base, as these will be removed as a precautionary measure. Take care to number the various components to be removed according to the numbering given in the technical drawings.

5. **Completely remove all the upper parts of the system** following the criteria used previously during assembly, and avoiding in particular an uneven distribution of weight and damage to the glass parts that remain attached to the lower part. The **STRIKE 5000 ATEX** is easily accessed from all sides, facilitating this operation.

6. **Place all the disassembled components in their wooden protective cases**, being careful to use a generous amount of Styrofoam in order to avoid contact between the glass parts during transport.

7. **Move the base structure with the fixed part of the system on wheels** up to the lifting device, checking to make sure that the structures and apparatus are stable.

8. **Load the base structure with the fixed part of the system onto the transport vehicle** using an appropriate mechanical lifting device with forks. Once the system is loaded onto the lifting device, it should be anchored in order to avoid as much as possible any movement or slipping from the lifting device during transport.

The operations to be carried out are very simple and only require sufficient caution due to the fact that the glass components are extremely fragile.

It should be remembered that any damage or breakage to the glass components or the flanges in phenol-formaldehyde resin may negatively affect the efficiency of the process (e.g. the maintaining of the vacuum) and require the replacement of the component.

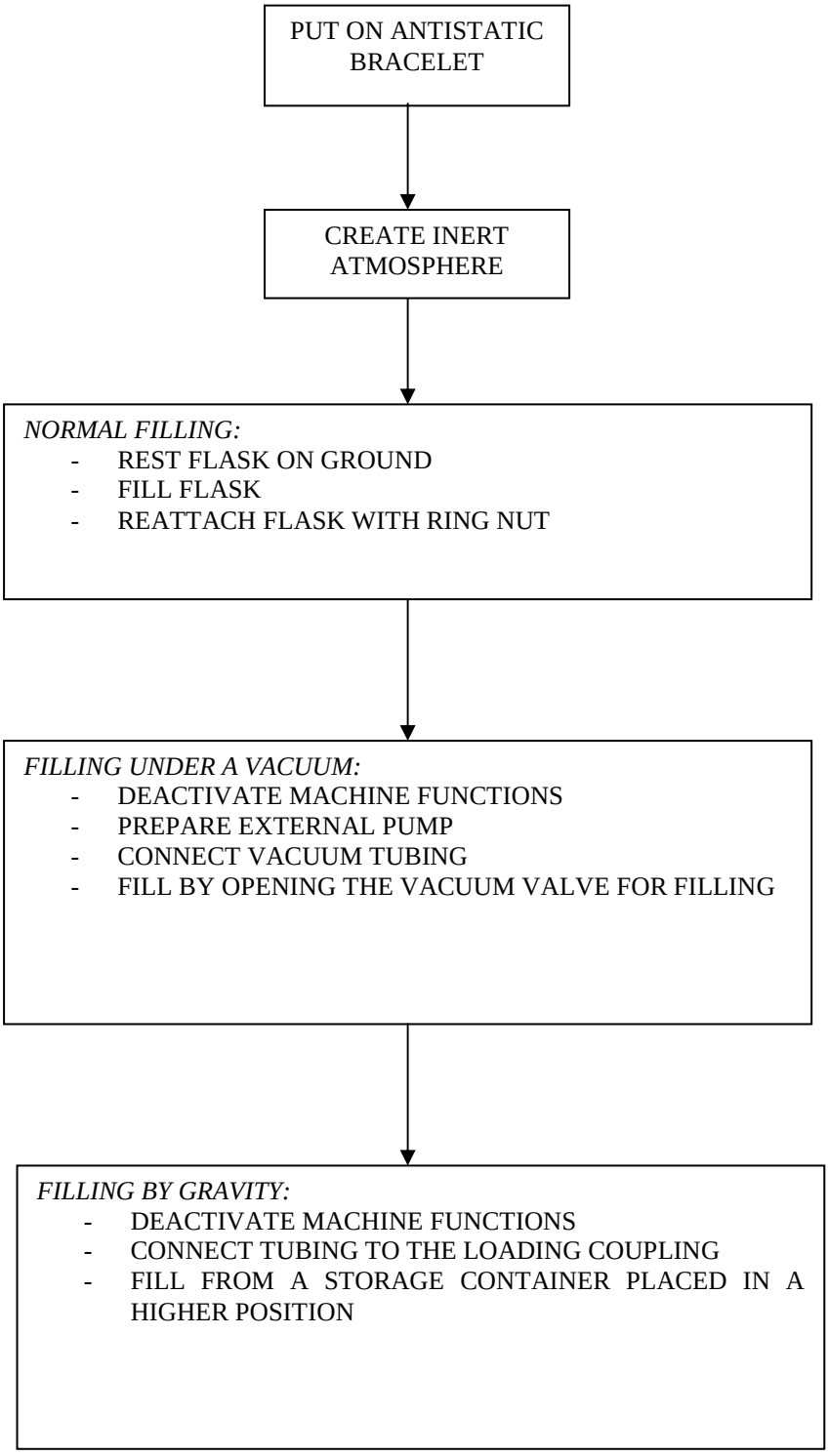
4 LOADING AND UNLOADING THE PRODUCT

General Remarks

- **BEFORE EVERY LOADING AND UNLOADING OPERATION PUT ON THE SPECIAL ANTISTATIC BRACELET PROVIDED WITH THE MACHINE**
- **ATTENTION: BEFORE CARRYING OUT PRODUCT LOADING AND UNLOADING OPERATIONS, CREATE AN INERT ATMOSPHERE INSIDE THE FLASK BY INTRODUCING AN INERT GAS (SUCH AS NITROGEN) COMPATIBLE WITH THE PRODUCTS BEING USED.**

PRODUCT LOADING FLOWCHART

Operations to be carried out by trained and authorized technical personnel:



Loading the Product

Due to the fact that the **STRIKE 5000 ATEX** is a rotating evaporator and has an extremely compact structure, it does not offer the possibility of manual loading of the product. It is not possible to provide for an opening of adequate size (e.g. DN 100) that would allow manual transferring of the product into the system.
Therefore it is possible to load the flask in the following different ways:

1. **Fill the flask and then attach it to the system**, knowing that especially when the product load is not too great, the flask can be loaded on the ground from the DN 150 opening, which is subsequently fastened to the unit using the ring nut. This operation might not be simple, but it makes it possible to avoid dirtying the vapor line when the product being loaded is very viscous.

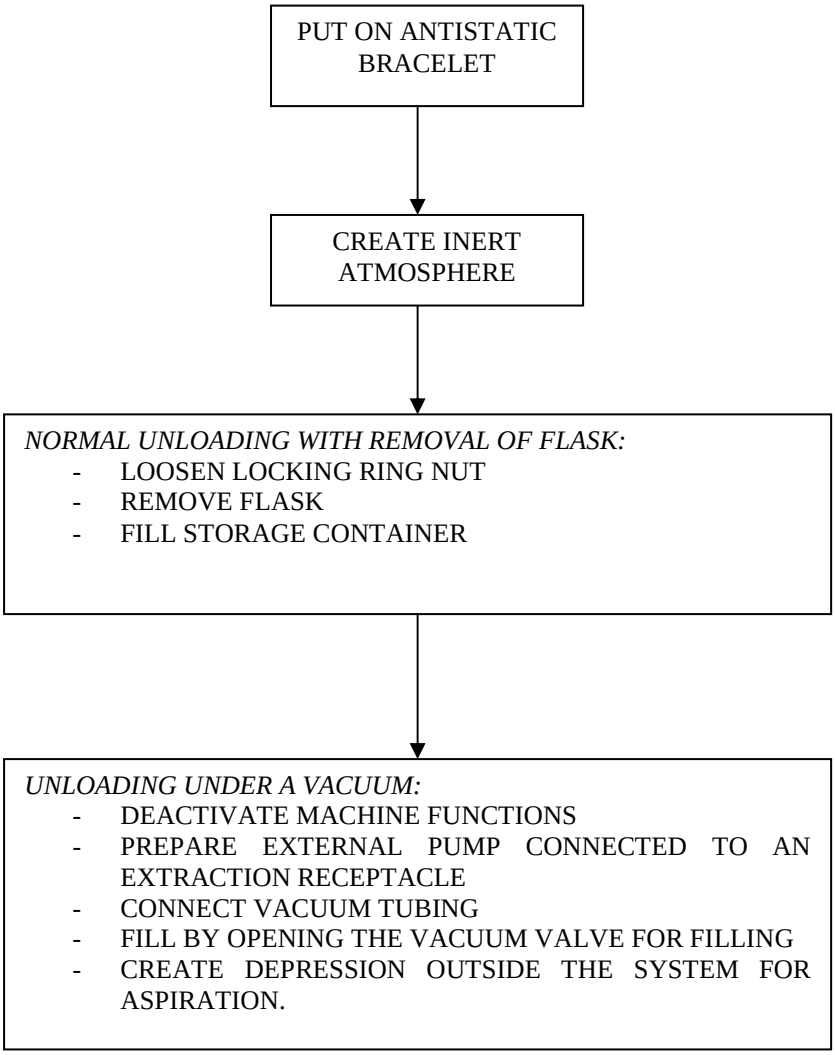
A height-adjustable trolley can be used to make it easier to connect the evaporation flask, adjusting it to a position so as to facilitate the connection.

2. **Filling under a vacuum** using a pump external to the **STRIKE 5000 ATEX**.
   In fact, if one opts for filling under a vacuum from an external container at atmospheric pressure, it becomes necessary to produce a degree of vacuum inside the system necessary for the liquid to enter the flask. In this case tubing should be connected to the coupling for the load attachment, connecting it to the external product container by opening the shutter (pos. 7). After making the connection, connect a vacuum pump to the machine attachment so as to allow the liquid to enter through the external conduit of the two concentric plastic tubes. While this is being done, the machine functions must be deactivated for safety reasons. In fact, while working with the protective shield open, in following with the regulations regarding "**Safety and health protection in the workplace**," (see D.Lgs. 626/94), the **STRIKE 5000 ATEX** is without electric power, and thus the system's vacuum pump cannot operate. Thus it is necessary to provide an external pump with its own power supply, or to use the **STRIKE 5000 ATEX** vacuum pump with an external power supply.

3. **Filling by gravity**, using tubing as in point 2, connecting it to the loading coupling and to a storage container placed in a higher position.

PRODUCT UNLOADING FLOWCHART

Operations to be carried out by trained and authorized technical personnel:



Unloading the Product

Once the **STRIKE 5000 ATEX** working cycle is finished, and the separation of desired product is obtained, we will have a solute and solvent respectively inside the starting and collection flasks.

The unloading of the solute inside the starting flask can be done in two different ways:

1. **Remove the flask** by loosening the ring nut that fastens it to the motor unit and pour the contents into a collection receptacle. Naturally, before doing this, it is necessary to lower the oil bath using the machine guides and making sure that the flask is cooled to near room temperature to avoid the risk of causing burns to the operator

2. **Unload under a vacuum** using a pump external to the **STRIKE 5000 ATEX** and a suitable receptacle (e.g. vacuum Erlenmeyer flask) from which it is possible to aspirate. In other words, contrary to the previous procedure for loading, it is necessary to create a depression outside the system (which in this case is put at atmospheric pressure) in order to permit the flow of the product. Like in the previous procedure, the vacuum pump will need its own electric power source, which cannot be that of the **STRIKE 5000 ATEX**. The pump must be connected to a container equipped with an opening with suitable tubing for the aspirated liquid

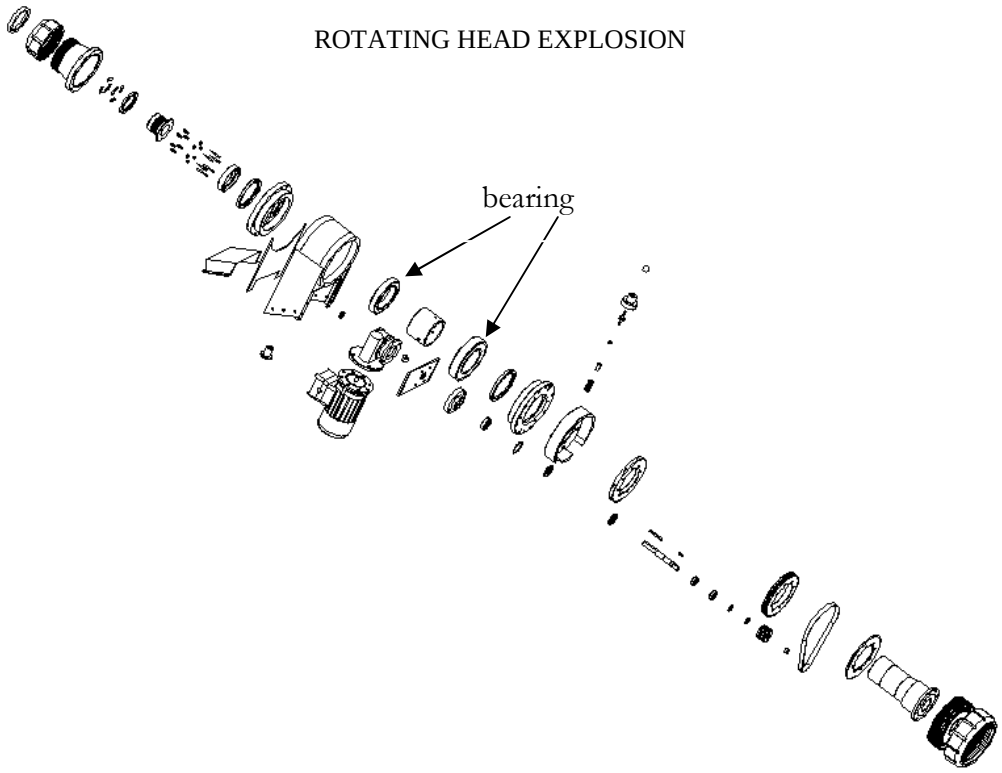
5 ROUTINE AND SPECIAL MAINTENANCE

Preliminary recommendations for maintenance

- Have maintenance work done only by specialized Steroglass personnel
- It is prohibited for unauthorized persons to open the boxes-panels and other electrical-electronic devices, whether or not they are still under warranty
- **Repairs done by anyone other than specialized Steroglass personnel will not be covered by the warranty and will invalidate any form of warranty still in effect**

A dirty or worn bearing greatly increases the resistance to movement of mechanical parts, besides adding very often vibration during motion. For this reason it is necessary to check the status of bearings and rotating head, replace them in case of deterioration and no later than three years of work.

ROTATING HEAD EXPLOSION



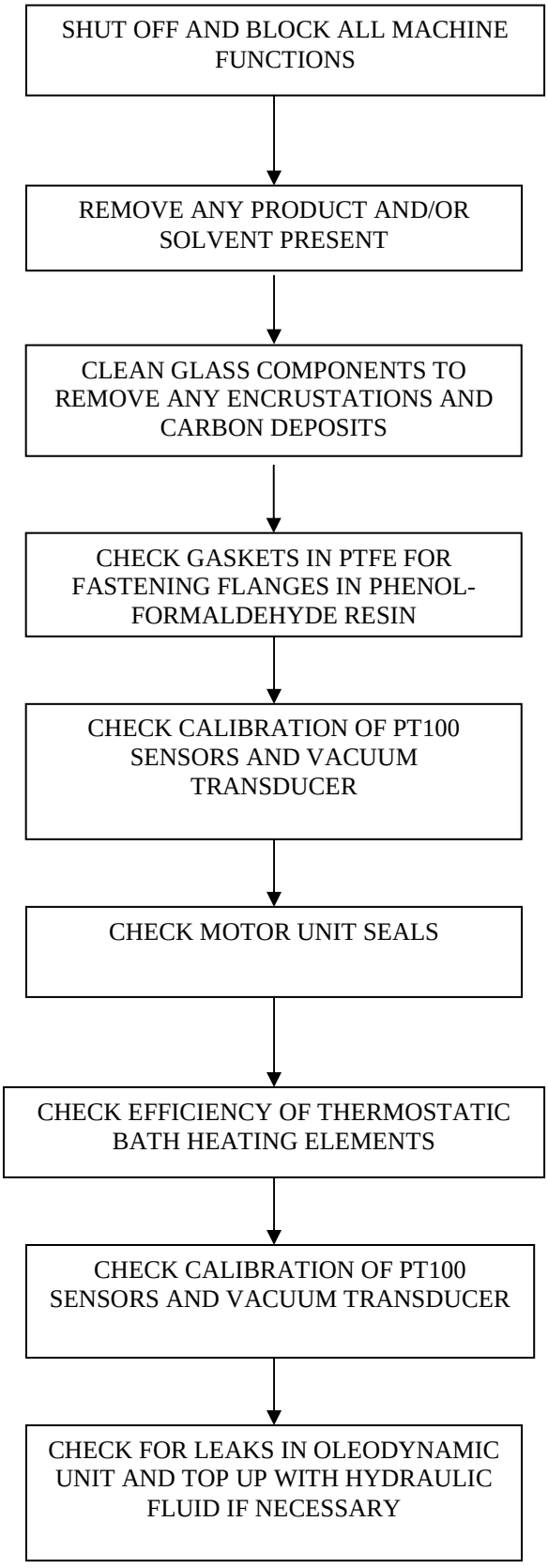
Operations and replacement of bearings should be made by technical staff Steroglass.

The hydraulic unit is supplied complete with oil tank HI46. The oil level should reach approximately an inch and a half from the filler cap. In case the oil level is lower than this value must be refilled. To change the total oil is necessary to unscrew the cap on the bottom of the instrument, bringing out all this oil, screw the filling of the tank and ensure compliance with the distance above the filler cap.

Do not use and do not mix oil of different kinds.

ORDINARY MAINTENANCE FLOWCHART

Operations to be carried out by trained and authorized technical personnel:



General Remarks

The routine maintenance operations for the **STRIKE 5000 ATEX** include an inspection of the moving parts, seals, measuring instruments, and parts exposed to high temperatures at least every 6 months.

If the machine operates in normal process conditions, the parts in glass are not subject to wear and thus offer a guarantee of efficiency for a long period of time.

Thus the inspection should regard in particular:

* the PTFE gaskets for the flanges in phenol-formaldehyde resin;
* seals for the motor unit;
* seals for the oleodynamic pump;
* the body of the manual valves;
* checking of the efficiency of the heating elements in the thermostatic bath;

It is recommended that special attention be given to any formation of carbon deposits and/or encrustations on the heating elements in the thermostatic bath, and that the heating elements be cleaned periodically.

Normal chemical washing after each use of the system will prevent the buildup of solid residues inside the apparatus and tubing.

If there is excessive wear of the metal of the heating elements, it is recommended that they be replaced. It is not possible to establish how often this needs to be done: it depends on the process temperatures and on the general use of the machine.

In order to prevent sparks and possible spark sources, the maintenance of the rotating head should be scheduled at least once for each year of operation.

6 ESTIMATED CONSUMPTION FOR SERVICES

The consumption for the services required are only approximate, and should be evaluated more correctly according to the type of process used, the function mode, and on the basis of the temperatures of the service fluids used.

In any event, for **evaporation and reflux condensation**, the following consumptions can be hypothesized:

*	Coolant water	1,000 kg/h
*	Electricity	6.3 kWh

The consumption of nitrogen depends on the process and the methods used, and therefore it cannot be estimated beforehand.

7 TABLE OF RECOMMENDED LUBRICANTS

The lubricants to be used in system maintenance operations need not have any particular characteristics of viscosity or resistance to heat, and therefore no particular list of lubricants is given.

8 RECOMMENDED REPLACEMENT PARTS

STEROGLASS S.r.l. has its own spare parts warehouse which can guarantee the prompt replacement of every single **STRIKE 5000 ATEX** component. Thus customers have the choice of whether or not to stock parts for **STRIKE 5000 ATEX** apparatus at their own warehouse.

9 ACCESSORIES

STEROGLASS srl furnishes a universal antispark wrench with the machine as a standard accessory for fastening or removing the evaporation flask.

STEROGLASS srl furnishes as an optional accessory the trolley for emptying the evaporation flask.

STEROGLASS srl furnishes as an optional accessory e diathermic oil for the thermostatic bath.

10 TROUBLESHOOTING – MECHANICAL PROBLEMS

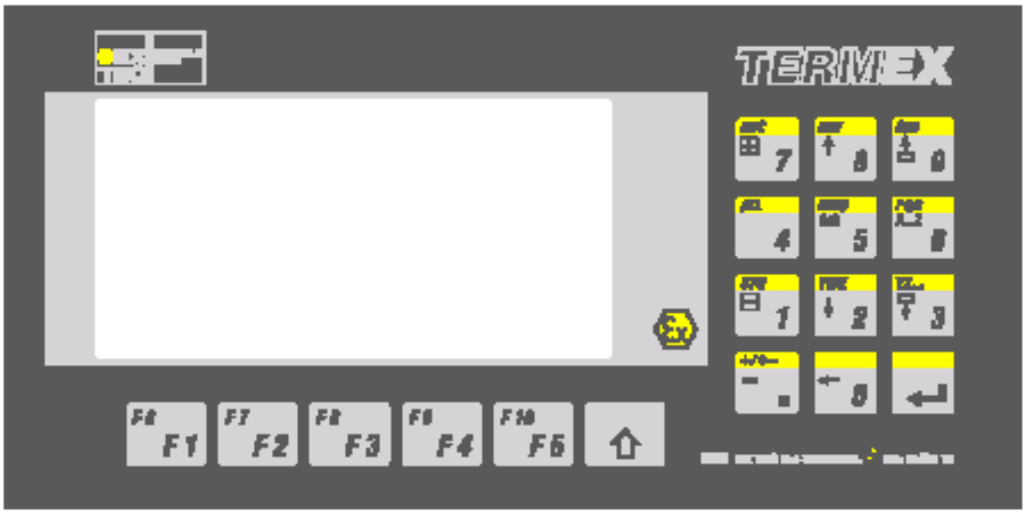
Foreseeable mechanical problem	Measures/Steps
Broken ring nut locking spring	The rotation locking pin prevents the flask from rotating. ⇒The rpm sensor warns the PLC of the problem and the machine goes into the protection mode.
Broken belt	Flask rotation stops. ⇒The magnetic rotation sensor no longer detects a rotation and puts the machine into the protection mode.
Rotating head seizes	Flask does not rotate easily and may go out of alignment. ⇒Bearing maintenance should be done within a period of half the life of the bearing. Also, the overheating of the motor and the subsequent increase in the force produces an increase in electrical power consumption. This increase in power consumption is detected by the motor circuit breaker, which is located upstream from the inverter and puts the machine into the protection mode.
Head rotation motor failure	See preceding point.
Oleodynamic unit motor failure	In this case there is no risk. The thermostatic bath does not rise.
Hydraulic circuit overpressure	An increase in pressure can be seen by a slower rising of the thermostatic bath. ⇒A timer is set at the normal rising time of the bath, and if it detects an increase in the time needed for the bath to rise, it disconnects the hydraulic unit and the lifting is stopped.
Overheating of the hydraulic fluid	⇒A bimetal is calibrated to 60°C; if it shows a temperature greater than 60°C it stops the lifting and brings the bath back into the resting position.
Lifting fluid valve failure	In this case there may be two different situations depending on whether the thermostatic bath tank is in the lowered or raised: - tank in the lowered position does not rise - tank in the raised-working position: the tank will lower but not abruptly, because the flowstat slows down the descent.
Lifting pantograph failure	Inside the hydraulic unit there is a valve calibrated to 50 bar (max working P for the lifting of the thermostatic bath in working conditions). ⇒P>50 bar, the greater pressure is released inside the fluid reservoir.
PLC failure during lifting	In this case the sensors send signals to the faulty PLC. ⇒The stroke of the piston is calculated so that when fully extended it will not cause the thermostatic bath tank to collide with glass or mechanical parts.

11 TROUBLESHOOTING – ELECTRIC/ELECTRONIC PROBLEMS

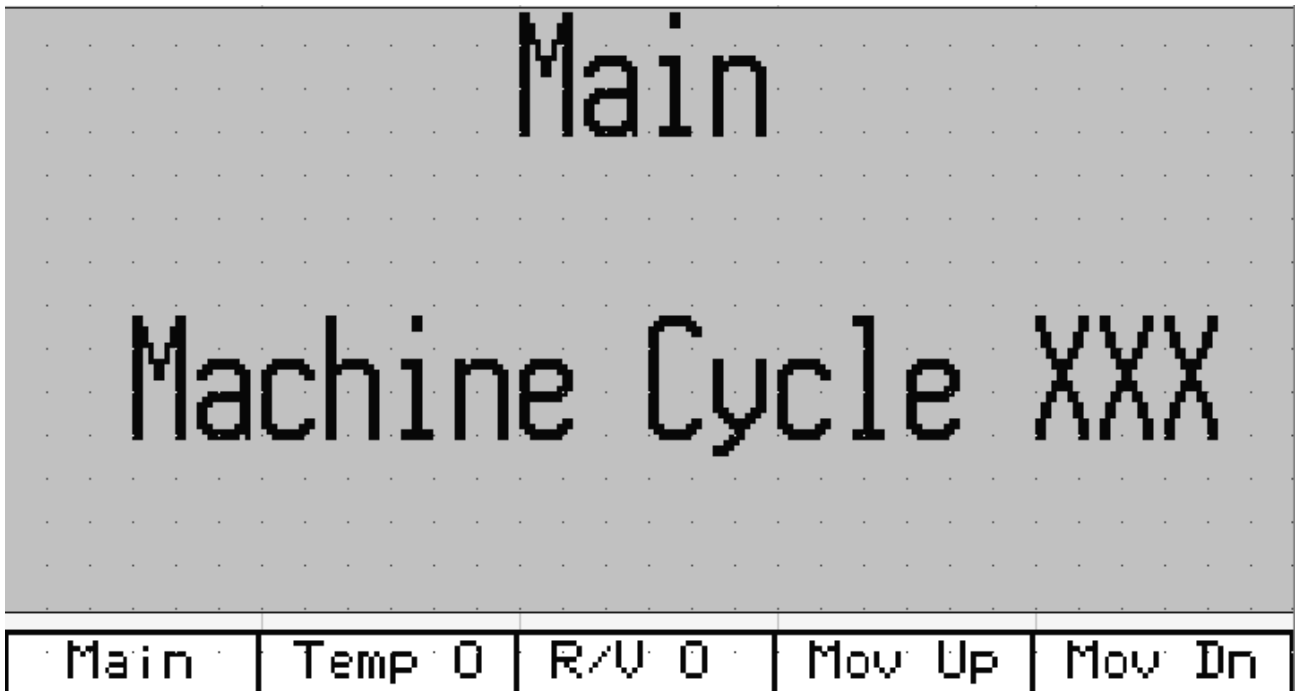
Foreseeable electric/electronic problem	Measures/Steps
Thermostatic bath PT100 faulty (open circuit) or not connected properly	In this case no protection is necessary, because with a maximum value temperature reading the heating element is kept turned off.
Thermostatic bath PT100 faulty (short circuit)	The heating element stays turned on constantly: if the temperature in the thermostatic bath tank exceeds the maximum allowable temperature, the bimetal locks out power to the entire machine. The red light flashes, signaling an alarm situation.
PT100 for reading vapor temperature faulty (open circuit) or not connected properly	The end of the cycle is never detected even if there is no water; however, the bath temperature is monitored by both the PT100 and the bimetal, thus no hazardous conditions are created.
PT100 for reading vapor temperature faulty	The end of the cycle is never detected even if there is no water; however, the bath temperature is monitored by both the PT100 and the bimetal, thus no hazardous conditions are created.
Heating element does not work	There are no risks connected with this malfunctioning. The PLC detects the lack of a rise in temperature, and sets off an alarm.
Maximum height is not read by inductive sensor	The maximum height that can be reached by the bath is limited by the height of the hydraulic piston, such as to not constitute a hazard. After 15 seconds the pump shuts off automatically by means of a contactor with timer; in addition, the temperature of the hydraulic fluid is monitored by a bimetal, which locks out the main power.
Pump failure	If the failure is due to a short circuit the power is interrupted immediately by the fuses or the circuit breaker. In the case of a breakdown that does not cause the absorption of electricity, there is no risk of danger. The PLC detects the failure of the thermostatic bath tank to move and sets off an alarm.
Failure in analogic command from PLC to inverter	The maximum rpm will not be exceeded, as the reduction ratio between the motor and the rotating head is set so that when the inverter emits the maximum frequency the rpm will be the same as the maximum which can be set with the keyboard.
Faulty inverter	The PLC immediately detects the discrepancy between the command value set and the rpm reading and sets off an alarm.
Fault in inductive sensor for reading the rpm	The PLC immediately detects the discrepancy between the command value set and the rpm reading and sets off an alarm.
PLC failure	All functional components are equipped with safety interlock devices that prevent functioning in the event of PLC failure: The heating element is monitored by a bimetal that locks out power to the machine if the thermostatic bath exceeds the maximum allowable temperature; The lifting pump is turned off by a contactor with timer and has a bimetal that monitors the fluid temperature; The rotation is mechanically limited so that it cannot possibly exceed the maximum allowable rpm The solenoid valve for regulating the vacuum level is not monitored, but it cannot cause foreseeable hazard conditions .

Vacuum solenoid valve failure	The vacuum can no longer be regulated, the PLC sets off an alarm.
Vacuum pump failure	The vacuum can no longer be regulated, the PLC sets off an alarm.

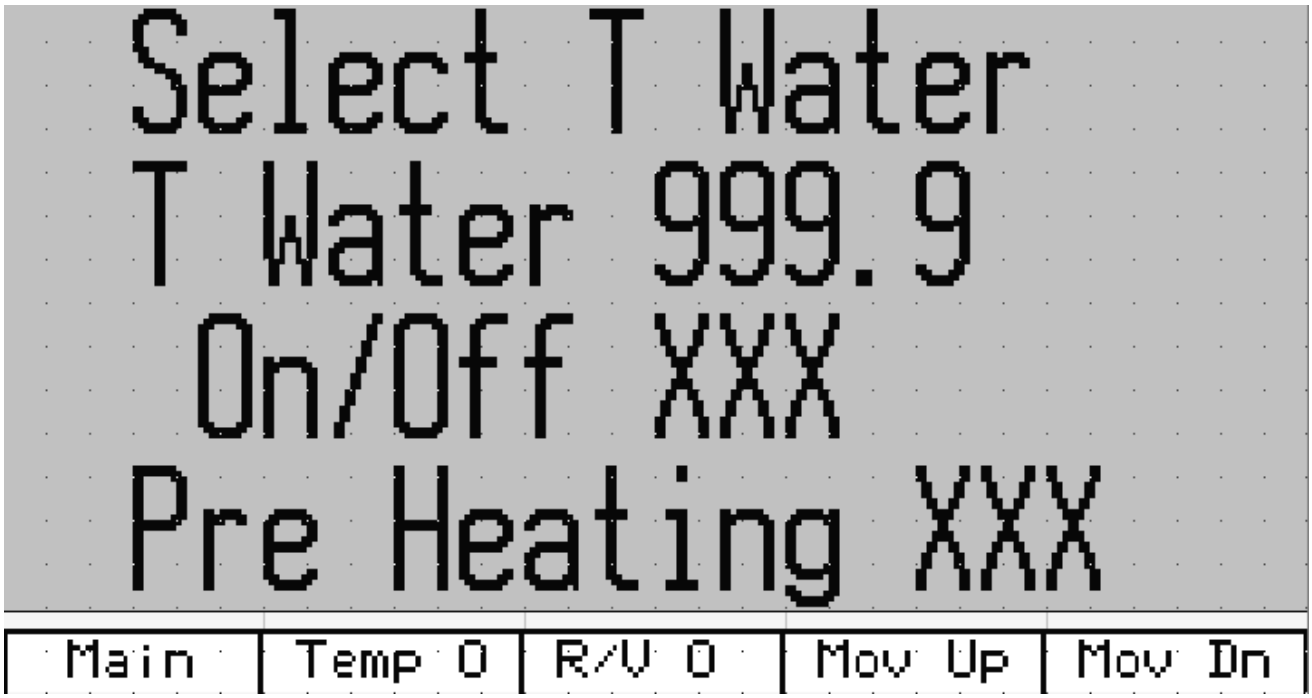
12 OPERATING PROCEDURES



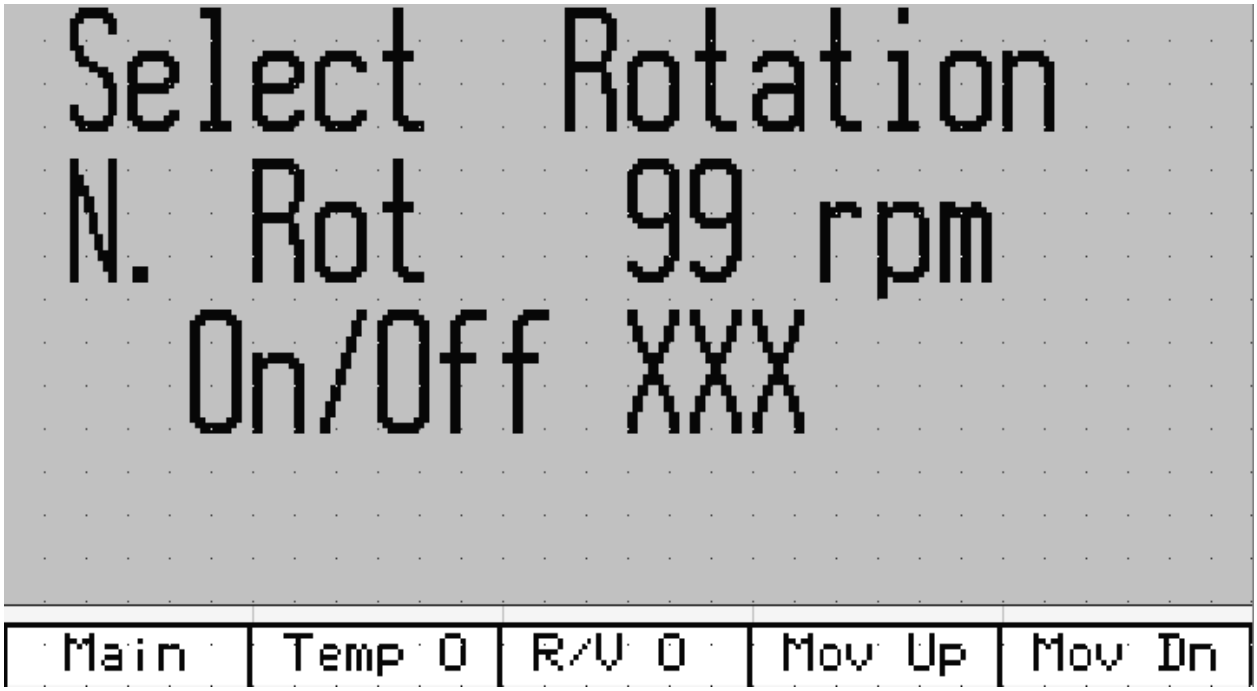
The keys located underneath the display are used to select the different screens in the user menu. The F1, F2 and F3 keys select the machine monitoring and operation windows, F4 and F5 give the windows for raising and lowering the thermostatic bath tank, and keys F6 to F10 select the screens for setting the machine operating parameters. To the right of the display are the number keys for entering and confirming the parameter values. These keys are also used for moving about within the screen.



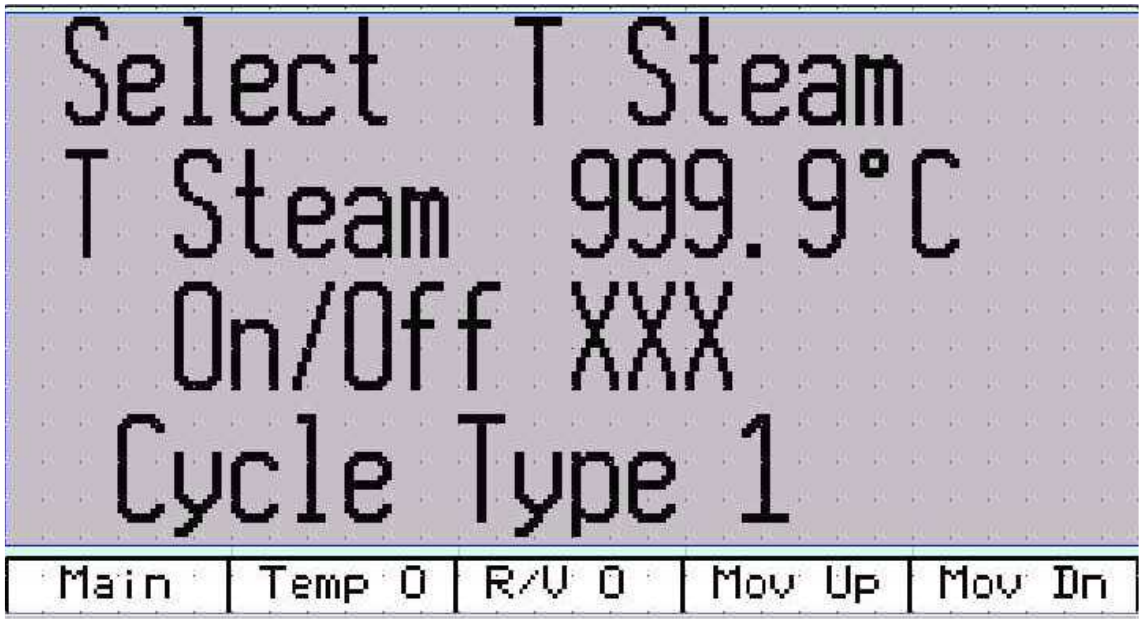
When the machine is turned on, the display shows the above window. This is the Main window, in which it is possible to start the working cycle by simply setting the Machine Cycle status to ON. To set this status to ON, hold down the shift key while pressing the + (7) key to the right of the display. To set this status to OFF, hold down the shift key while pressing the - (1) key to the right of the display.



In this window it is possible to set the water temperature in the tank in which the flask is immersed. To carry out this operation, first go to the parameter to be set by using arrow keys ↑ (9) and ↓ (3) together with the shift key ⇑ (symbol), set the parameter value using the 0 to 9 number keys to the right of the display, and then press "ENTER". The monitoring of the temperature and the preheating functions can also be set to ON or OFF.



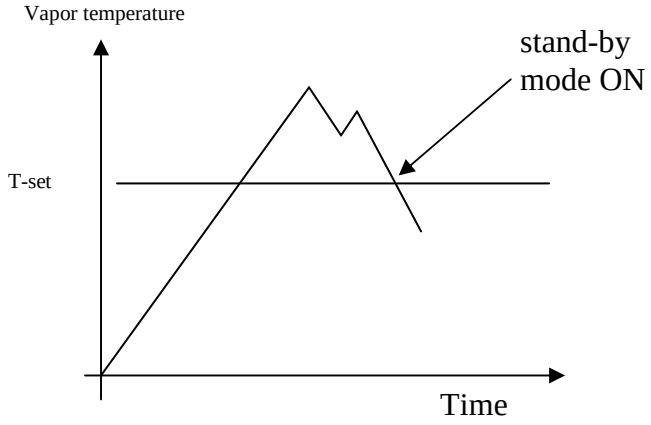
As in the preceding window, the flask rotation speed can be set, as well as the monitoring of the speed.



In this window it is possible to choose the vapor temperature value, whether or not to monitor this temperature, and the "cycle type". The procedures for selecting and setting these values are the same as those described in the previous windows.

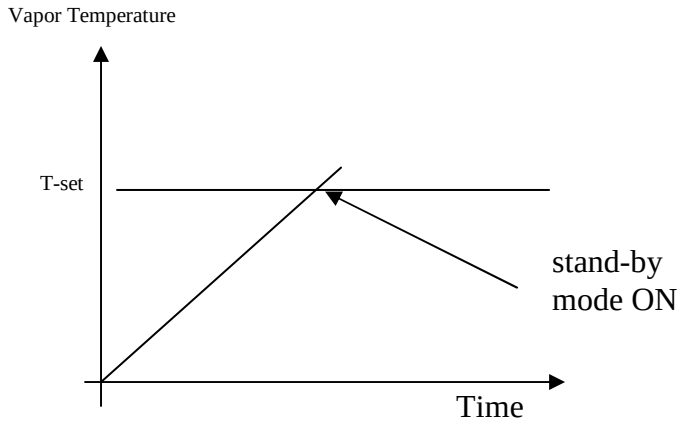
"cycle type 1"

In cycle type1 the control mode automatically activates when the vapor temperature exceeds T_set, and when the vapor temperature falls down below T_set the stand-by mode is automatically set to ON.



"cycle type 2"

In cycle type2 the stand-by mode automatically activates when the vapor temperature exceeds T_set.



"cycle type 3"

In cycle type3 T_set is manually saved when the control mode is set to ON *(confirm by pressing "ENTER").* The vapor set value displayed on the the second line *(see figure below)* refers to the maximum allowable temperature difference between T-set and the vapor temperature (Δ).

When the vapor temperature exceeds T-set+ Δ or falls below T-set - Δ , the stand-by mode automatically activates.

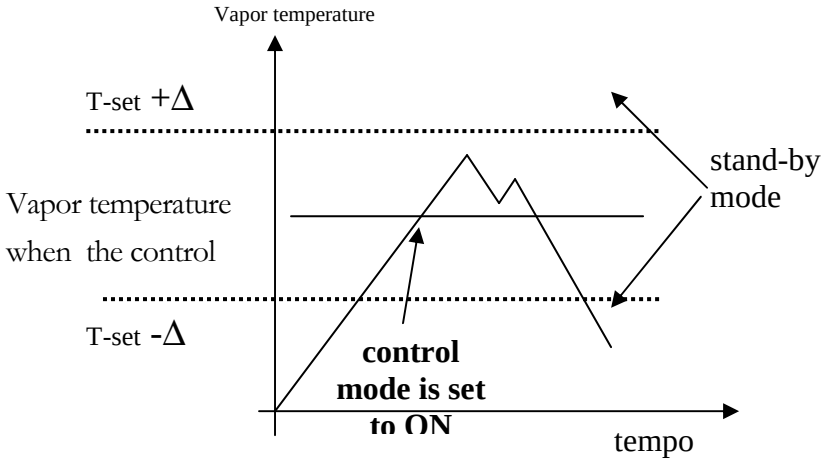
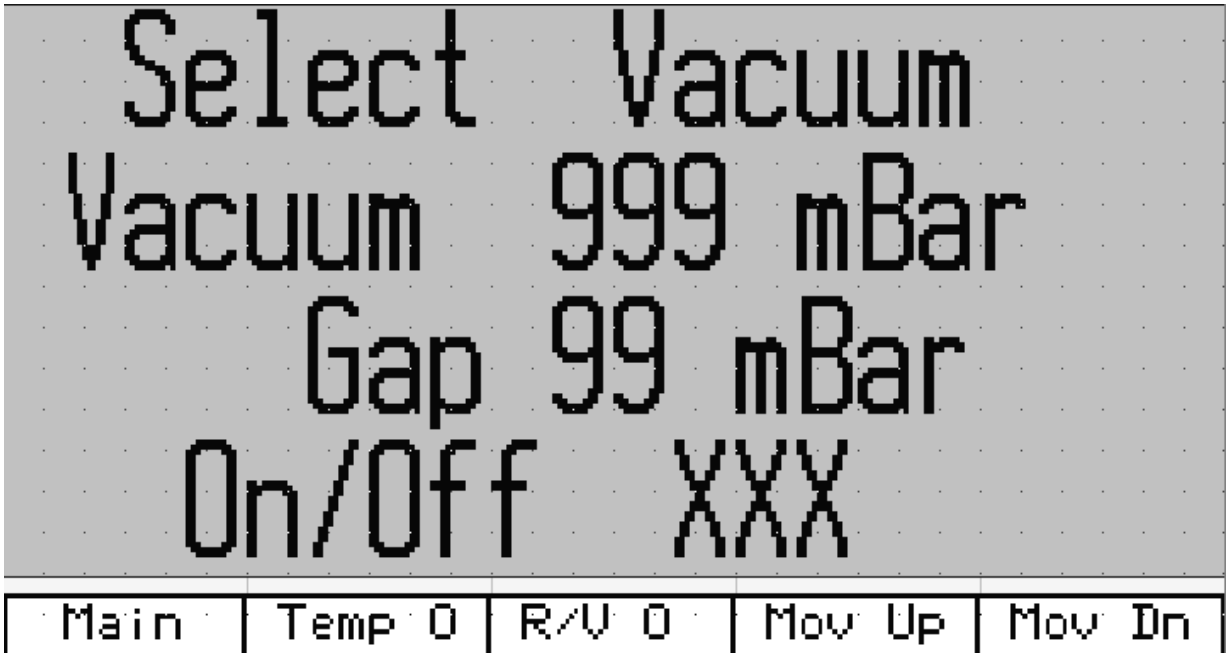
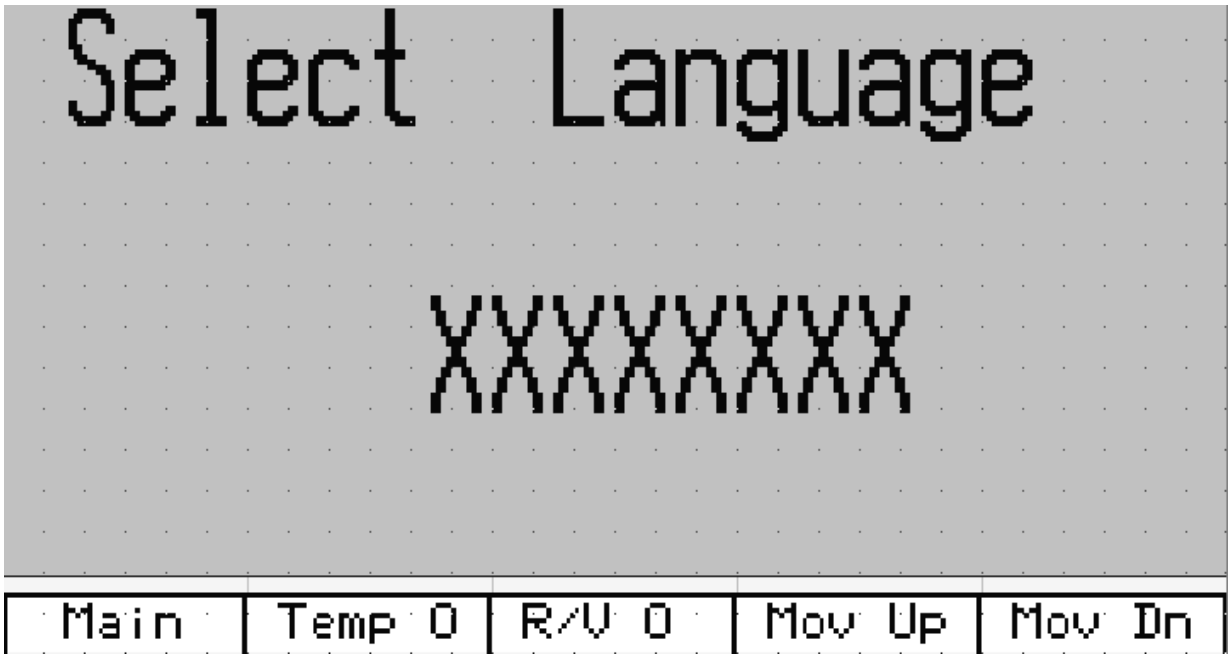


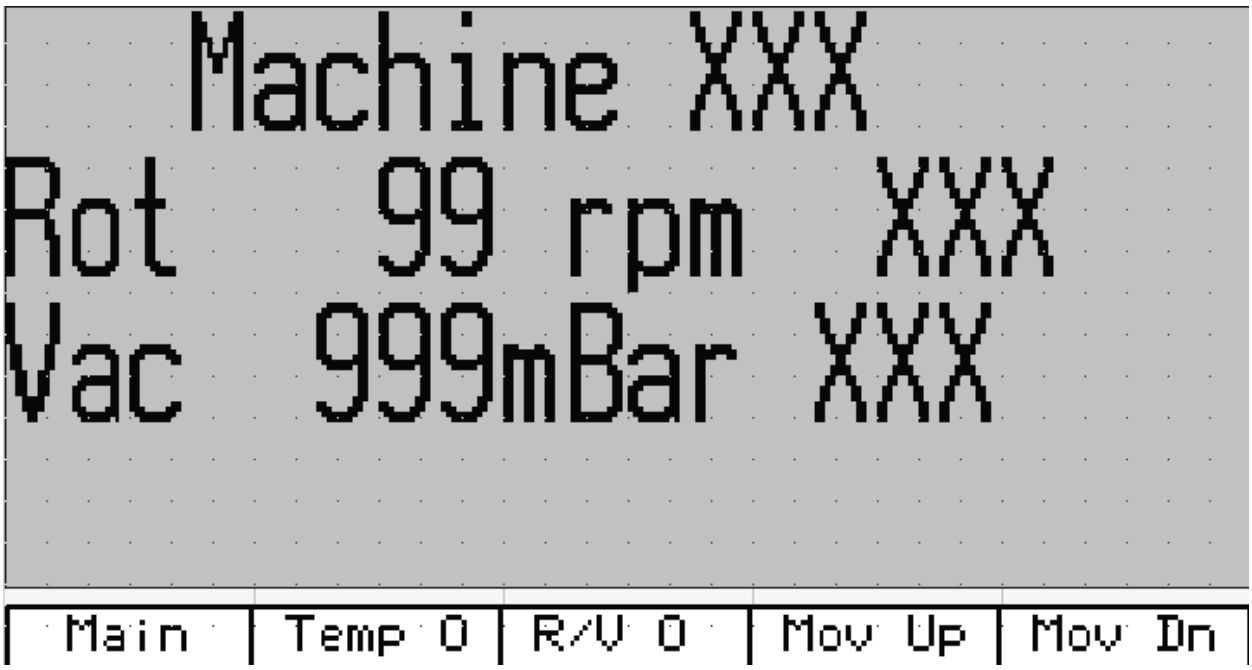
Figura 5



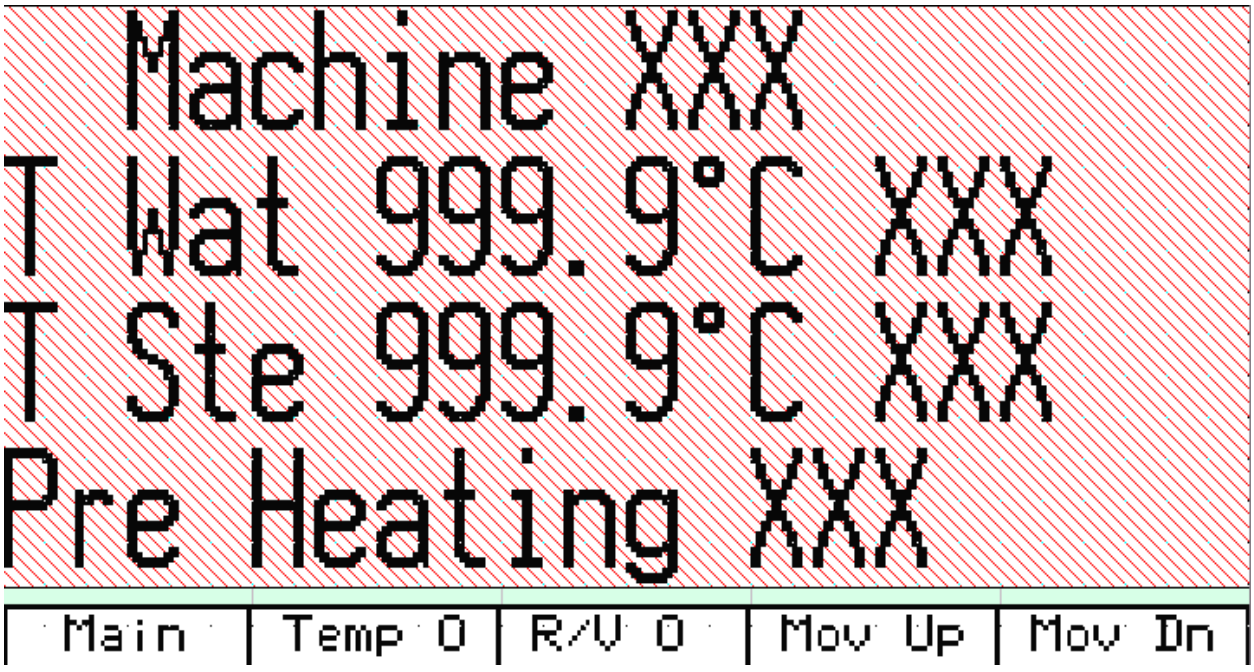
In this window the vacuum value and associated delta value are set. Here also the monitor can be set to ON or OFF.



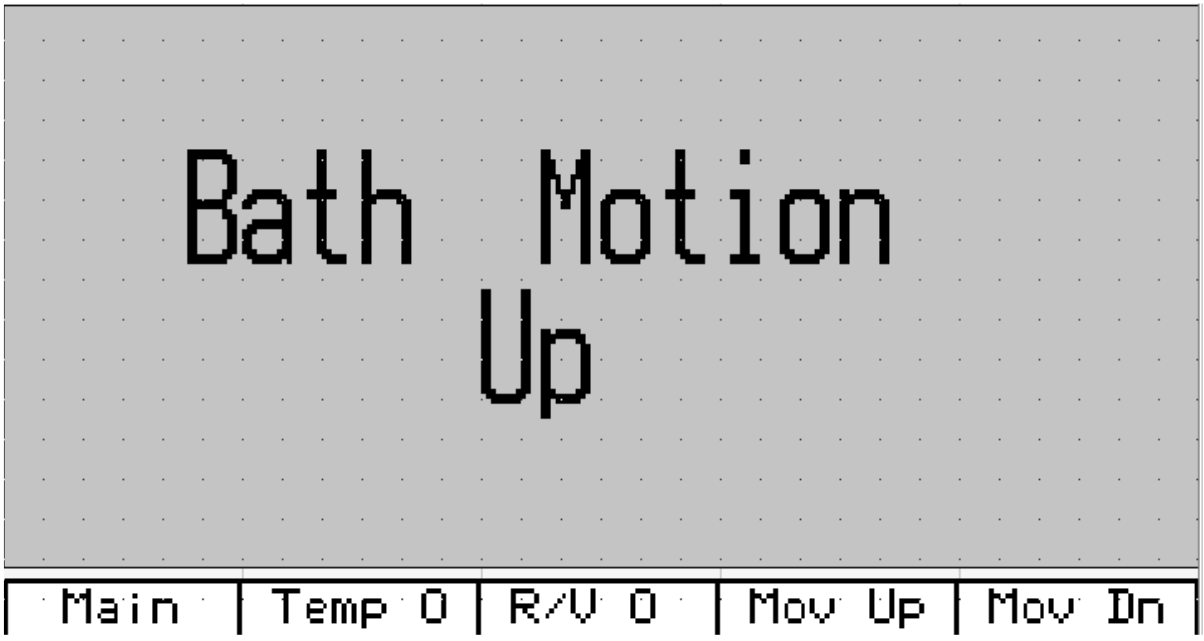
In this window it is possible to select the language of the menu shown on the display. To select the language, hold down the shift key and press the + (7) key for Italian or the – (1) key for English.



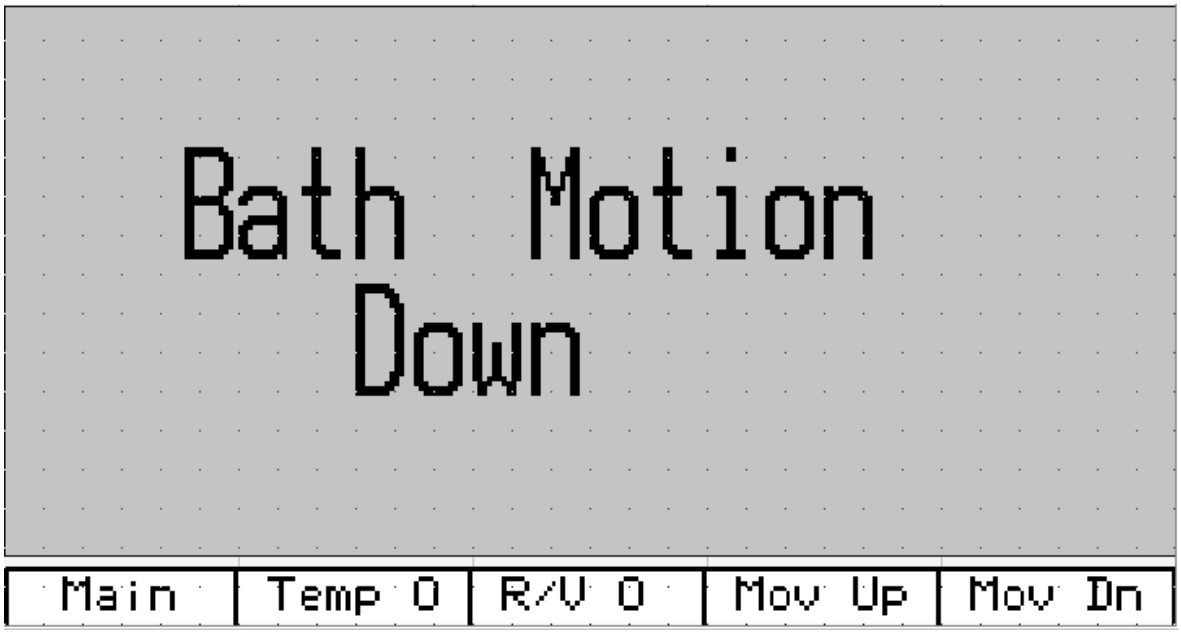
This screen serves only for monitoring in real time the rotation speed and vacuum level, as well as their monitoring status. No changes of any type can be made in this screen.



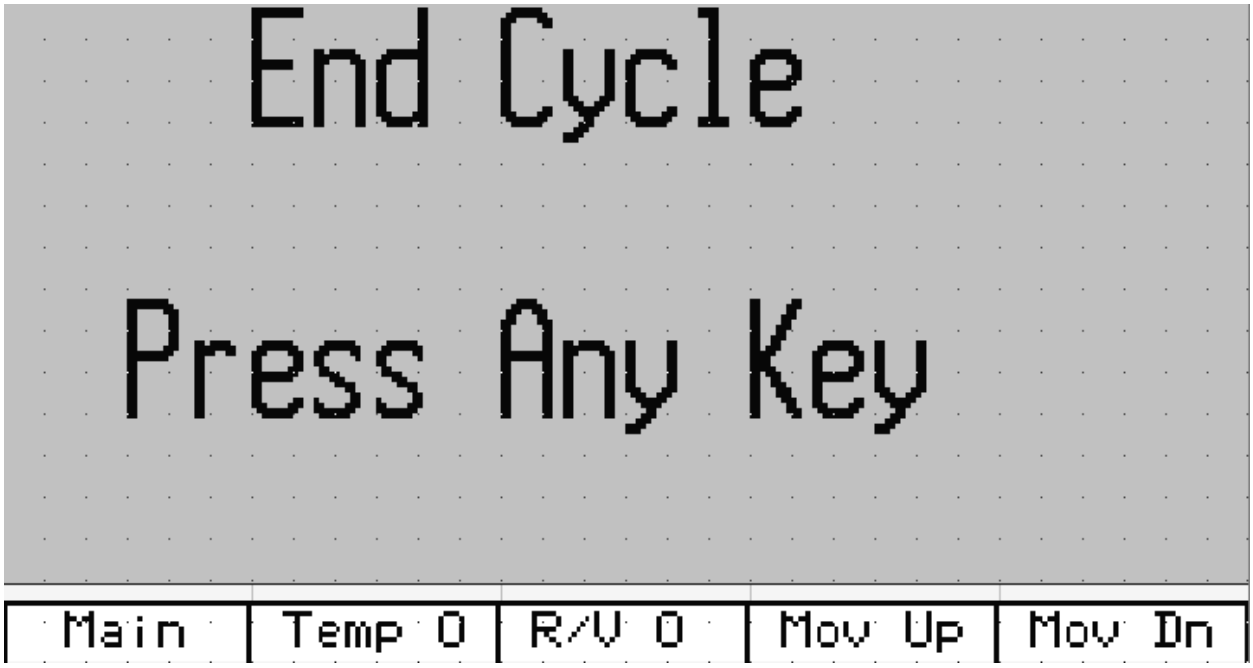
Like the preceding screen, this screen is purely informative. It indicates in real time the temperature of the water in the thermostatic bath tank, and the temperature of the vapor in the tube leading to the collection flask. It also indicates the temperature monitoring status and the preheating status.



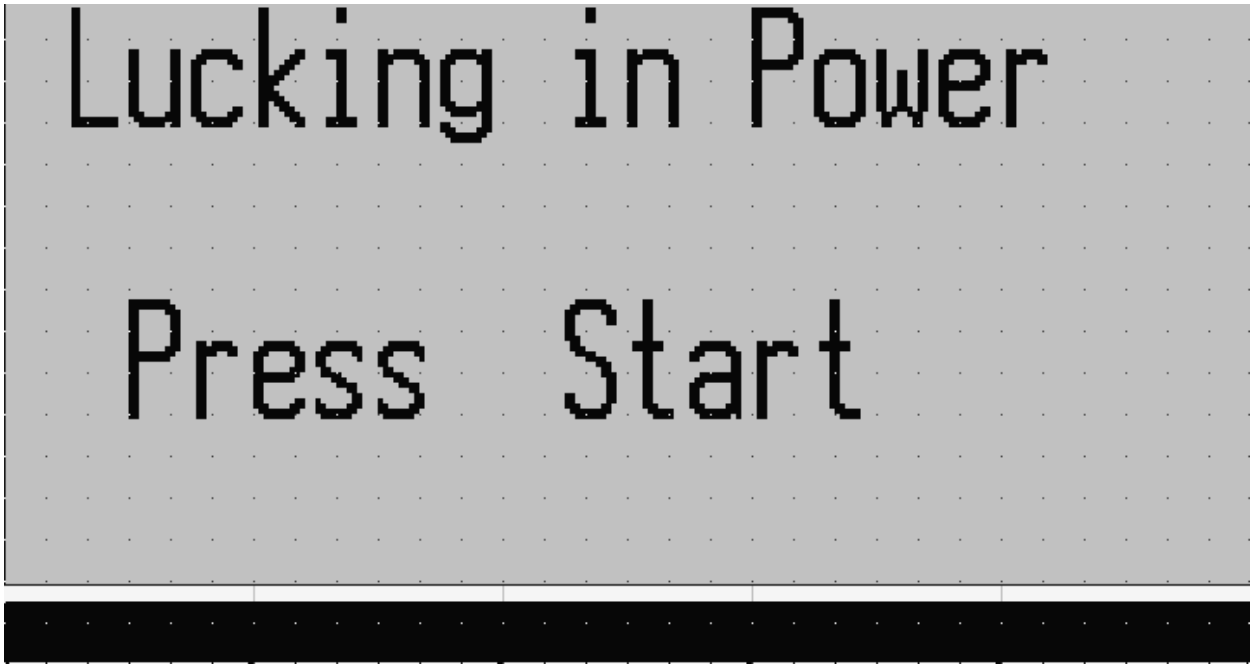
Press the F4 key to ability the upward movement of the thermostatic bath tank.



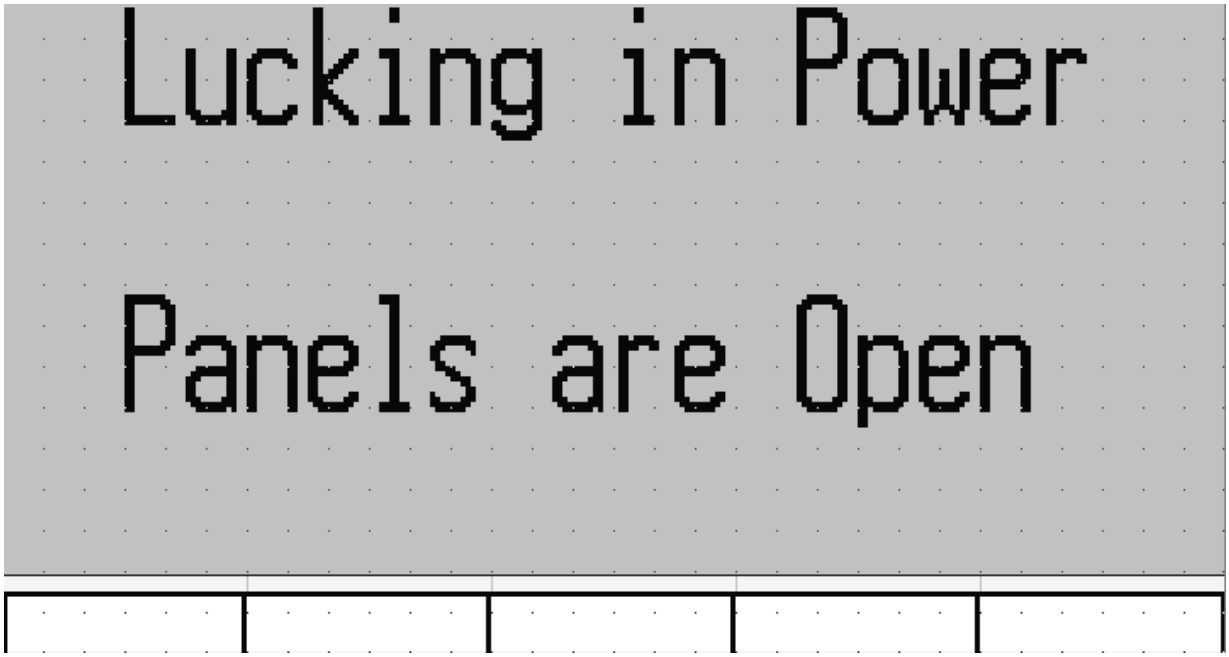
Press the F5 key to ability the downward movement of the thermostatic bath tank.



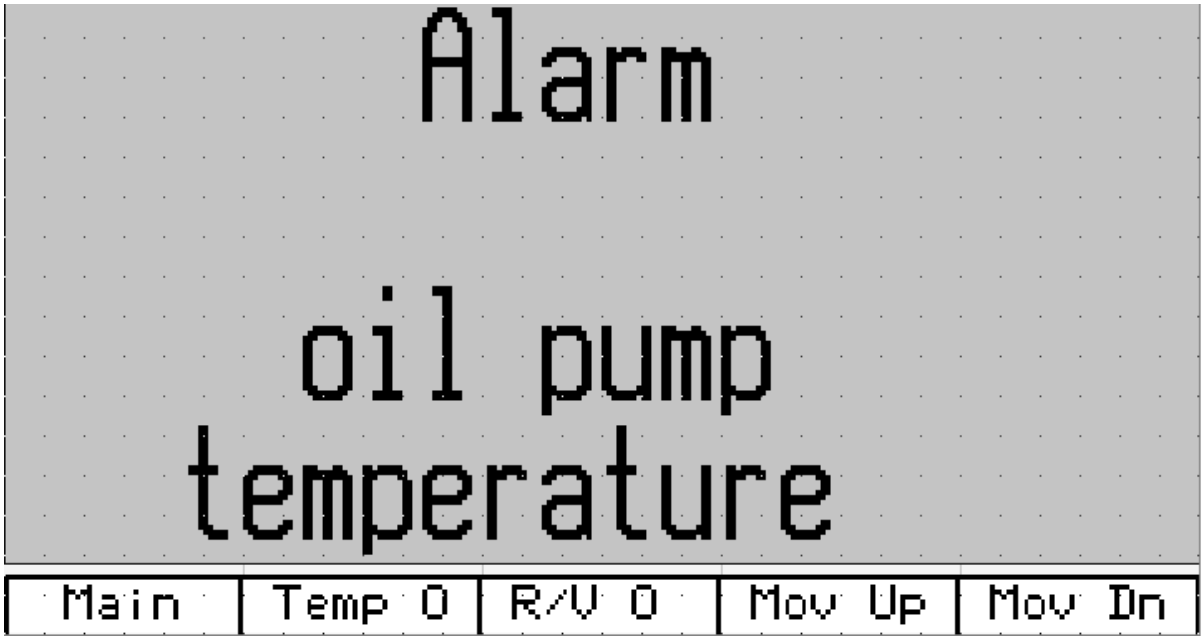
This screen appears when the machine has ended its working cycle.



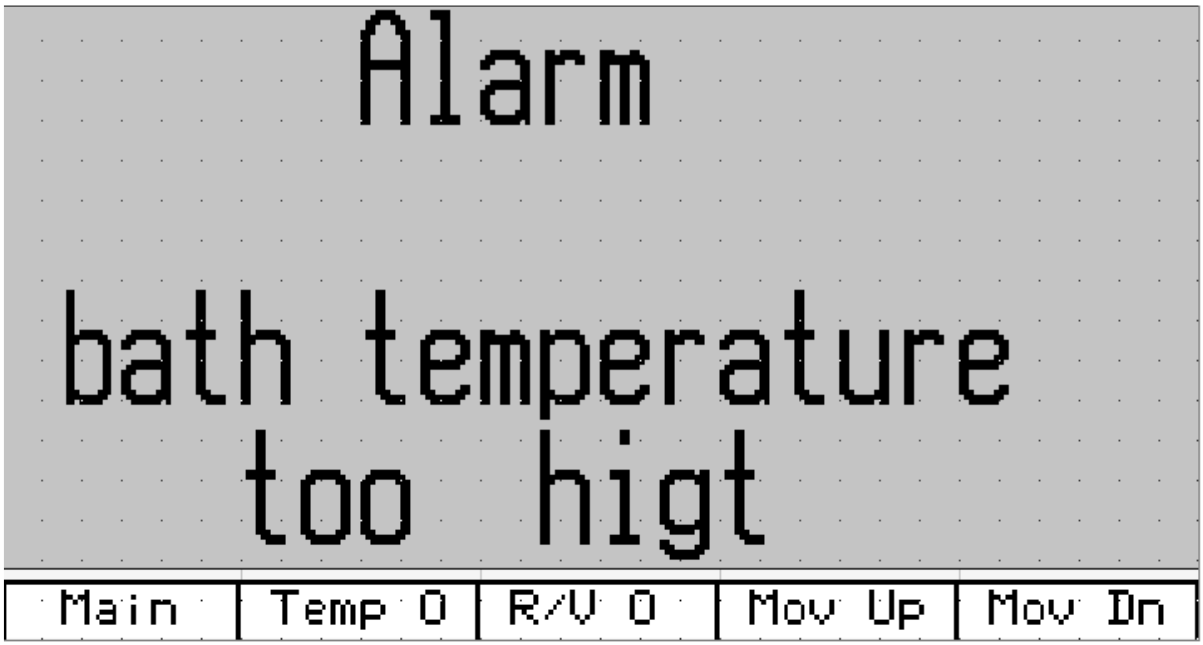
The above screen indicates that the machine is plugged in but power is not reaching the machine's functional components. Therefore, in order to begin a working cycle it is necessary to activate the power by pressing the start button on the lower part of the front panel.



The message on this screen warns that the shields protecting the glass components are open, and thus power cannot be supplied to the machine's functional components



This screen indicates that in checking the machine a problem in the normal machine operation was detected and thus the working cycle was stopped and the supply of power to the functional components was interrupted. This alarm regards the temperature of the fluid contained in the reservoir, which has risen beyond the safety limit.



This screen indicates that in checking the machine a problem in the normal machine operation was detected and thus the working cycle was stopped and the supply of power to the \s was interrupted. This alarm regards the temperature of the heating element immersed in the thermostatic bath tank, which has risen beyond the safety limit.

APPENDIX 1A - "Work Permit" form for jobs in areas with hazardous atmospheres

"WORK PERMIT" FORM for jobs in areas with hazardous atmospheres		
1	Job location	…… ……..… …… …… ……
2	Assignment/Position	…… …… …… …… ……
3	Job type	☐ Start ☐ other operations:_____ ☐ Stop ☐ …….. ☐ Load/Unload ☐ ……
4	Precautions taken before starting job ***BEFORE EVERY OPERATION PUT ON THE ANTISTATIC BRACELET AND CONNECT THE MACHINE TO THE GROUND OF THE STRUCTURE/BUILDING*** 	☐ Remove all combustible objects and substances including stored powders within a radius of …….meters and – where necessary – also from adjacent rooms ☐ Cover immovable combustible objects, e.g. wooden beams, plastic parts of flooring, with protective material ☐ Remove coverings and insulation materials ☐ Eliminate the danger of explosion in containers and tubing ☐ Close the openings of tubes, containers and accessories, etc. ☐ Assign a fire watchman with pails full of water, extinguishers, or fire hose connected (spray only for dusts and powders)
5	**Fire Watchman**	☐ During the job Name:……. ☐ After completion of job Name:……..Duration:……..hr
6	**Alarm**	***Address of nearest*** Fire Alarm ……. Telephone…… **Fire-fighting service, tel.** ……..
7	Fire-fighting/extinguisher equipment	☐ Extinguisher with ☐ Water ☐ CO^2 ☐ Powder ☐ Pails of water ☐ Fire hose connected
8	Authorization _____ Date	The safety measures listed must be followed. All accident prevention regulations established by law and all safety provisions established by the insurer must be observed. _____ _____ Signature of manager or of the person designated by the manager — Signature of the person doing the job

Appendix A2 –Steroglass Declaration of Conformity

EC Declaration of Conformity

This Declaration of Conformity is relevant to the following products

EVAPORATORE ROTANTE STRIKE 5000 ATEX

We,

Steroglass S.r.l.
Strada Romano di Sopra 2/c
06079 – S. Martino in Campo
Perugia – Italy

declare under our sole responsibility that the mentioned product is in accordance with the applicable european directive and to the listed harmonized standards or normative documents.

relevant european directive	**94/9/EC** **89/336/EC** **73/23/CEE** **98/37**
applied harmonized standards	**EN 1127-1** **EN 13463-1** **prEN 13463-5** **prEN 13463-6** **EN 60204-1**
Type Examination	CESI 03 ATEX 281 X
	⟨Ex⟩ II 2G c b IIB T4 o T3

Signature of manufacturer

function of the signer **Managing Director**

Date:

Appendix B1- Spare parts

Description	Code
Vacuum sensor	VAJS036380
Hydraulic piston	VAJS037757
Hydraulic power station	VAJS036392
Vacuum valve	VAJS036793
Antistatic bracelet	VAJS038985
Atex resistor T3	VAJS039371
Atex resistor T4	VAJS039370

Note: for other spare parts, please refer to the instrument drawings.

Appendix B2- Drawings

Attached drawings