RFX MACHINE OPERATOR'S MANUAL

PROPRIETARY & COPYRIGHTED MATERIAL

Ziel Equipment, Sales and Services, Inc.
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San Francisco, CA 94123

CONTRACT NO:

CUSTOMER:
General Operators Manual

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RFX MACHINE OPERATOR'S MANUAL

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Notice:

This General Operators Manual is provided as an example of what the final Operators Manual will include. The final manual will be assigned to the RFX unit serial number when Installation and Commissioning is completed. There may be updates or changes to HMI graphics, operational procedures, etc. between this General Manual and the final manual provided at the completion of commissioning.

VERSION RECORDS

Issue	Release Date	Amendment Details	Author
Original		**Initial Release**	**PY**

OPERATOR TRAINING COMPLETION RECORD

By my signature below, I hereby acknowledge and agree that (a) I have read and understand the contents of this Operator's Manual, that I have been afforded the opportunity to ask questions and seek clarifications with respect to such contents, and that such questions have been answered and clarifications have been provided to me by Ziel (the "Company"); (b) I agree to comply with, and understand it is my responsibility to abide by, the procedures and other terms contained in this Operator's Manual; (c) I have received adequate training provided by the Company in connection with this Operator's Manual in the use of RFX (the "Equipment"); and (d) I have the requisite qualifications, skills, ability and training necessary to properly and safely handle, operate and otherwise use the Equipment in accordance with such training and this Operator's Manual.

NAME OF OPERATOR	SIGNATURE	DATE

Ziel Equipment, Sales and Service, Inc. **Training Coordinator**	**Signature**	**Date**

Ziel Equipment, Sales and Service, Inc.
2269 Chestnut St. Suite 226
San Francisco, CA 94123

Tel: 1 (888) 612-9895
Website: ziel.com
E-mail: service@ziel.com

MACHINE TYPE **RFX**	SERIAL NO.
MODEL **4 kW**	YEAR **2023**
MODULE NO. **1/1**	MODULE WEIGHT **1250 kg**
INSTALLED POWER **16.8 kVA**	VOLTAGE SUPPLY **240 V +/- 5%**
MAXIMUM CURRENT **70 A**	PHASES **Single-Phase | 2 wire + Gnd**
SHORT CIRCUIT CURRENT **10 kA**	FREQUENCY **50/60 Hz +/- 2%**

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List of Contents

1. LEGAL

1.1 Copyright

1.2 Information and safety points

Personnel involved in the use, control, and maintenance of the RFX system must thoroughly read this manual, at least those parts of specific interest.

Throughout this manual, we will draw your attention to key information or safety points that the operator should be aware of when using or maintaining the machine. These safety points will be highlighted in a box, as the following:

TEXT in DOUBLE-FRAMED BOLD ITALICS indicates a PROHIBITION

1.3 Personnel operating RF devices safely

It is important to understand that radio frequency (RF) operates at a very low frequency (27.120 ± 0.163 MHz), which is similar to a mobile phone or a transistor radio (Figure 1.3). Ziel equipment, is designed to harness and control those gentle waves and apply them to a very specific and regulated cavity in the RF machine.

Additionally, safety measurements have been taken to enclose the process inside the machine. Switches, emergency push buttons, and a light tower notification system are some of the tools built into the RFX to guarantee the safety of the operator. These safety devices shall not be disabled at any time, as all have been thoroughly tested and implemented to ensure the safety.

At the time of manufacturing, an RF Leakage detector is run along all parts of the cavity of the machine to ensure the equipment is compliance with FCC and OSHA.

RFX Machines Comply with:

This RFX machine is in compliance with the following regulations:

- FCC (47 C.F.R. Subpart A §§ 18)
- OSHA (29 CFR § 1910.97) Guideline for Exposure to Non-ionizing Radiation in the Workplace.

What is emitted?

- All RFX equipment have a maximum emission of less than 1mW/ cm^2 at the tunnel apertures.
- This is lower than the 5 mW/cm^2 permissible on microwave units

  It also complies with the following limits, in its working frequency range:
  - **E (Electric field) < 61 V/m**
  - **H (Magnetic Field) < 0.16 A/m**

The Radio Frequency waves emanated by the RFX 7 are **NON-IONIZING** electromagnetic waves. Substances exposed to these waves are not subjected to irradiation. A comparison of RF waves to other waves and frequencies on the spectrum is illustrated in Figure 1.3.

Every equipment is tested at full power before delivery to the customer.

The equipment remains well below the stated limits in any working condition with the special shielding devices.

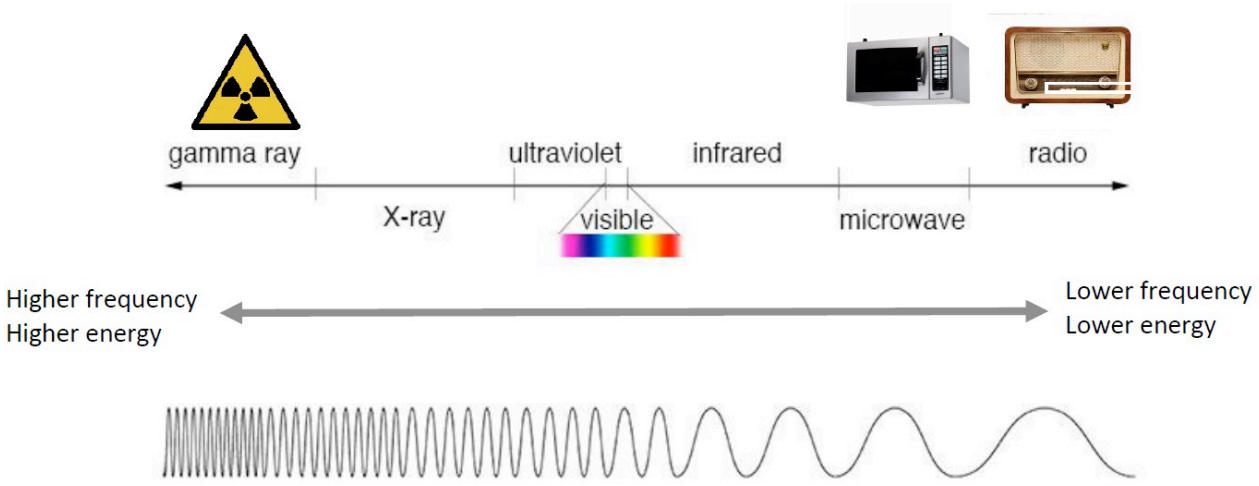

Figure 1.3

2. GENERAL REMARKS

2.1 Introduction

This manual refers to an RFX Radio Frequency system designed and manufactured in compliance with European Norms and Standards for systems constructions and safety (2006/42/CE, 2014/35/EU and 2014/30/EU, EN 12100, EN 60204, EN 61439).

The equipment must be stored and operated in an environment with the following ambient conditions:

Temperature: 15°C ~ 40°C
Relative Humidity: 10% ~ 90% (above dew point)

Personnel involved in installation, use, control, and maintenance of the system must duly read this manual; at least those parts of specific interest.

Keep this manual in a safe place and accessible to anyone operating the system, at any time. If lost or damaged, please contact Ziel Equipment, Sales and Service Inc. immediately in order to obtain a copy.

Ziel Equipment Sales and Services, Inc. and manufacturer decline any responsibility for events generated by failure to read this manual, or non-compliance with its contents.

2.2 Supply limits

Site preparation, and systems for carrying electrical energy or any other supplies (water or compressed air when applicable) to the equipment is not covered in this manual.

It is responsibility of the user to comply with any local regulations regarding safety standards and in this respect, local laws regarding safety standards of civil and industrial systems must be complied with.

Also excluded are works for carrying the air from the outlet mouths of the machines to the outside of the building.

2.3 Technical assistance

Ziel Equipment, Sales and Service, Inc. provides a specialized assistance service for extraordinary maintenance of the systems or their repair.

This service must be requested by email, after duly telephoning the Ziel Equipment, Sales and Service, Inc. Service Department, for each intervention included or excluded from the warranty terms.

Any service not covered by the warranty is completely at Customer's expense, as are any transport costs for the replacement parts, travel, room and board expenses for Ziel Equipment, Sales and Service, Inc. technicians, and will be billed at the foot of the list or personally borne by the same.

2.4 Order of Spare parts

Spare parts for the RFX machine can be ordered from our United States office:

Ziel Equipment, Sales and Service, Inc. **2269 Chestnut St. Suite 226**	**Telephone: +1 (888) 612 9895**

San Francisco, CA 94123 **United States of America**	**Website: www.ziel.com** **Email: service@ziel.com**

When ordering spare parts please make sure to have the following information available:

- Machine model
- Machine serial number
- Part number and description (If known)
- Quantity required
- Picture of the part

ALWAYS USE GENUINE SPARE PARTS

ALWAYS *use original spare parts supplied by* Ziel Equipment, Sales and Service, Inc. *– do not use parts supplied by any other company.*

Several of the parts listed in the spare parts list are safety related and it is very important that parts with the correct specification are used.

2.5 Glossary

LAYOUT = layout

RF = Radio Frequency

D	Information for the MANAGEMENT
I	Information for the INSTALLERS
M	Information for the MAINTENANCE TECHNICIANS
E	Information for the ELECTRICIANS
O	Information for the OPERATORS
S	Information for Ziel TECHNICIANS

TEXT IN BOLD FONT: indicates an important step

TEXT IN FRAMED BOLD ITALICS: indicates a WARNING

3. SAFETY AND ACCIDENT PREVENTION

O E M 3.1 Introduction

RFX machines are designed and built to offer the operators maximum safety. However, it is very important to correctly operate the equipment, to avoid the danger caused by mistakes. Anyone operating the equipment must carefully read and follow operator instruction manual.

> ***The operator of this machine must be in good physical and mental health.***

Ziel Equipment, Sales and Service, Inc. systems are manufactured to always meet current safety norms in the country where the machine is installed.

O 3.2 Foreseen use (2006/42/CE, EN 12100)

The Ziel Equipment, Sales and Service, Inc. system to which this manual refers to is designed and built for the Radio Frequency thermal treatment of dielectric products.

> ***USE OF THE SYSTEM FOR WORK OTHER THAN THAT STATED ABOVE WITHOUT HAVING CONTACTED* Ziel Equipment, Sales and Service, Inc. *AND HAVING OBTAINED PERMISSION, IS STRICTLY FORBIDDEN.***

Any use other than that contemplated by the manufacturer can cause damage to the system, and subsequently to the operator.

The same consequences can also derive from incorrect use of the system due to inadequate training or for other reasons.

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3.3 General safety warnings (EN 12100)

In order to operate in conditions of maximum safety, it is a very important to carefully follow the instructions and directions indicated in this manual.

During normal operations, follow the rules regarding work positions. In addition, constantly check the material being treated and the location of any tools that might be used for material preparation. Always use personal protective equipment while working with the equipment. Follow instructions carefully in the event of faults or malfunction of the equipment.

Ref. 89/656/EEC
The maintenance staff must be provided with the proper personal protection outfit, ladders and any other device required to work in safe conditions.
Clothing, gloves, and arm guards must be protecting against cuts in compliance with ISO 13999

Foundations are not required. Machine have to be placed on a flat, levelled but anti-slip floor with no obstacles.

THE USE OF THE MACHINE IS STRICTLY PROHIBITED, IF THE SAFETY DEVCIES HAVE BEEN REMOVED, ISOLATED, MODIFIED OR THEIR EFFICIENCY IS REDUCED.

Ziel Equipment, Sales and Service, Inc. maintenance personnel are authorized to check the functionality of the safety devices and to notify the Management (user) of any irregularity detected.

THE INTRODUCTION OF METAL OBJECTS INSIDE TREATMENT CHAMBER IS STRICTLY PROHIBITED.

DO NOT START RADIOFREQUENCY WITH CONDUCTIVE MATERIALS INSIDE TREATMENT CHAMBER.

DO NOT PLACE LIVE ANIMALS OR HUMAN INSIDE TREATMENT CHAMBER

3.4 Safety devices on machine

The machine is equipped with safety devices that safeguard the operator. Therefore, if the equipment is used in the conditions described in this chapter, the operator can work without having to use further individual protection systems.

The main **safety devices on the system includes**:

- Main switch circuit, which disconnects the power from mains to the equipment, when any of the doors on the generator cabinet or the electrode chamber are opened.
- Fully automatic protection circuits against overvoltage, discharges in chamber, excessive power output.
- Emergency stop buttons to shut down the entire equipment.
- Filtering and screening devices for reducing the emissions of electromagnetic waves.
- Thermal and magnetic protection on the feed line, the motors, and actuators.
- Designated key or tool required for opening any part of the machine.
- Arrangement for fire-extinguishing system. (optional)

3.5 Risk or remaining risk zones (2006/42/CE)

The operator must not to wear necklaces or bracelets, and to always close his/her lab coat or apparel when the RF generator is ON.

Note that electromagnetic field can disturb those who uses PACE-MAKER.

O 3.6 Control zones (2006/42/CE, EN 12100)

The designated work positions are shown in Figure 4.2 of Chap. 4, Session [4.2].

> ***Only operate in the designated work zones.***

The manufacturer is not responsible for any events caused by absence of the operator from the control panel or load/unload zones.

O 3.7 Periodical checks (2006/42/CE, EN 12100)

All the protection and emergency devices described in 3.4 must be controlled periodically, to ensure functioning correctly. **Every fault detected must be immediately corrected, or reported to** Ziel Equipment, Sales and Service, Inc**. technical assistance. For more information, see Chap.5.**

E M O 3.8 Noise (2006/42/CE)

The noise produced by the equipment is below acoustic pressure of 80 dB (Decible).

> ***Use of individual protection devices (ear protectors, plugs) is not deemed necessary during machine operation.***

To preserve their measured values, perform regular maintenance on moving parts (motors and fans) as these are the main sources of noise.

D 3.9 Reference regulations

For the protection, development, and realization of the machine and of this manual, the following regulations and norms were referred to:

3.9.1 *European regulations*

2006/42/CE of the European Parliament and of the Council of 17 May 2006 on machinery and amending Directive 95/16/EC.

2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to Electromagnetic Compatibility.

2014/35/EU of the European Parliament and of the Council of 12 February 2014 on the harmonization of the laws of Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.

3.9.2 *Harmonized norms*

EN 12100	EN 12198	EN 60204	EN 61439
EN 55011	EN 60519	EN 1672-2	EN 13849-1

D 3.10 Electromagnetic radiation safety notes

The RF equipment can process the designated product using the electromagnetic field created inside its chamber at the I.S.M. frequency of 27.12 MHz. The heat is generated by interaction between the product and electromagnetic field.

The mechanical and electric safety aspects of the equipment are in compliance with the European regulations and the equipment is the CE marked.

The safety of the operators working around the machine is according to the European norm No EN 12198.

The equipment object of this manual, in its working frequency range, complies with the following limits

E (Electric field) < 61 V/m
H (Magnetic Field) < 0.16 A/m

The use of special shielding built-in devices keeps the equipment within limits in any working condition.

According to EN 12198, the equipment is classified as category 1. An equipment in category 1, do not require any additional personal protective equipment to be operated.

Every equipment is fully tested before delivery to the customer.

3.11 Fire accident prevention

Radio Frequency is safe for approved products, however precautions must be taken to prevent damage to the RFX or product.

1) RF waves generate heat directly inside the materials through oscillation of polar molecules. Different molecules behave differently when exposed to RF waves, i.e. some molecules can be heated easily even by very weak RF fields, while other molecules heat up very slowly, in the same RF field. If not properly used, or if foreign materials are placed inside the RFX, damage to the product or RFX could occur in the following sample situations.

- the product is exposed to RF field for too long, so that the product is reaching to very high temperatures;
- two or more products with very different heating properties are inside the RF chamber, so that one of the products could reach high temperatures, while the rest have not been fully processed;
- a piece of conductive metal is inside the product, which can cause local concentration of RF waves, and thus overheating and even arcing;
- a piece of ferrous material is inside the product, which can cause localized heating, and thus overheating and burning;

If a situation occurs in which a fire or burning is observed, keep a minimum 10 lb Co2 fire extinguisher in the area where the RFX is installed.

E M O 3.12 Metal detector

It is necessary to ensure the product entering RF chamber is free of any conductive and ferrous material. A metal detector with the following detection limit should be utilized right before the product enters the RF processing chamber.

Required detection limit for metal detector:

Non-Ferrous material 5mm

Ferrous material 1mm

Note: To choose the suitable metal detector for your product, always discuss the product presentation with the metal detector manufacturer.

E M O 3.13 Warning Signs

SIGN	DESCRIPTION
Voltage Warning Sign 	This warning sign indicates the presence of dangerous electrical voltage. Do not attempt to gain access to any area where this sign is displayed while the main power switch is ON.

Arc Flash Warning Sign 	This warning sign indicates presence of an arc flash and shock hazard. Personal Protective Equipment (PPE) should always be worn when operating controls or opening covers of anywhere this sign is displayed.
Hot Surface Warning Sign 	This warning sign indicates the presence of a Hot Surface nearby. Any contact may cause severe burns.
Pacemaker Warning Sign 	This warning indicates that any person who has a heart pacemaker should be warned that the machine generates high levels of RF energy.
RF Warning Sign 	This warning sign indicates the presence of Radio Frequency (RF) energy.

4. RFX OPERATION MANUAL

M O 4.1 Introduction

Below is a simple explanation of the basics of RF processing: the functional principles of the RF equipment:

– RF Thermal treatment of dielectric products (poor electric conductor) by applying an electromagnetic field generated between the electrodes in the process chamber. Therefore, the RF generator must be ON to obtain the heating.

– Equipment output power depends on the **product quantity under the electrodes: Any variations in the product quantity and nature, can cause rises or falls in the power output, for that reason the generator does not always deliver maximum power, and the power level is not constant. Therefore,** it is very important to minimize the product variation as much as possible and to always follow the same loading procedures.

– Treatment time must be calibrated according to application and product specification during process setting.

– It is always **risky to leave the machine unsupervised when the product is inside the process chamber and RF generator running. Unsupervised equipment always increases the chance** of overheating and or partially or completely burning of the product.

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4.2 Work position

***During machine operation, work only in the zones indicated in THE WORK POSITIONS* (2006/42/CE, EN 12100)**

During normal operations, follow the rules regarding work position (See Figure 4.2). In addition, constantly check the material being treated and the location of any tools that might be used for material preparation. Always use personal protective equipment while working with the equipment. Follow instructions carefully in the event of faults or malfunction of the equipment.

Always keep the machine and surrounding work area clean and free of objects or materials that may hinder the movement of personnel in operations of normal use and maintenance, or emergency conditions.

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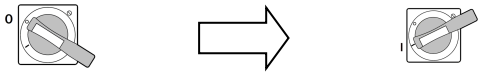
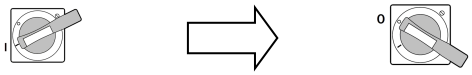
4.3 Control Panel (SIMATIC S7-1200)

4.3.1 ***Power main switch***

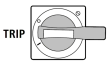
ON position

TRIP position

OFF position

From OFF to ON	***From ON to OFF***
	

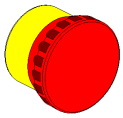
DO NOT TURN ON FROM TRIP POSITION



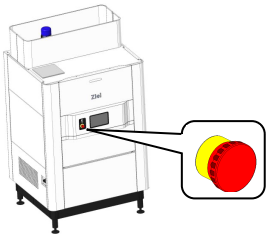
TRIP position

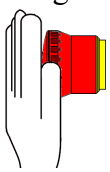
RESET

ON position

Cycle start and stop pushbuttons are touch button located on HMI.	
EMERGENCY RESET 	Emergency reset push button to restart machine after an emergency system activation
	Emergency pushbutton
DATA LOGGER  USB FLASH DRIVE 	USB socket is installed. USB flash drive can be inserted to store data using data-logger function on HMI.

4.3.2 Emergency pushbutton





After EMERGENCY MODE ACTIVATION, it is necessary to CLOSE all the doors before push **EMERGENCY RESET** button. The positions of emergency stop pushbuttons were presented in Enclosure 8.2.

4.3.3 Emergency reset pushbutton

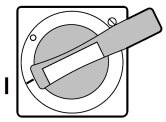
EMERGENCY RESET 	If blue light is ON machine is in EMERGENCY mode Push button to reset EMERGENCY MODE. If blue light is OFF you can turn ON switches.

After EMERGENCY MODE ACTIVATION, it is necessary to CLOSE all the doors before push emergency reset button.

M O **4.4 Work Cycle** (2006/42/CE, EN 12100)

4.4.1 Turning on the equipment

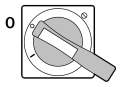
The sequence to turn on the equipment is as following:

Turn "I" main switch 	Turn on machine main supply
	Log in using your credential. Select the “Processing Page” (see chapter 4.5)
Check and clear alarms. Once the product is inside the chamber (see chapter for detail information). Close the chamber door. Push the green “Start cycle” button on HMI.	

4.4.2 Turning off the equipment

The sequence to turn off the equipment is as following:

The process will stop automatically when the treatment cycle is completed, or the process time expires. If necessary, the process can be manually stopped by pressing the “Stop Cycle” on HMI.
Empty the process chamber of all the product.
Wait about 10 minutes for the fans to cool down the RF tube.

Turn "O" main switch 	Turn off machine main supply

THE INTRODUCTION OF METAL OBJECTS INSIDE TREATMENT CHAMBER IS STRICTLY PROHIBITED.

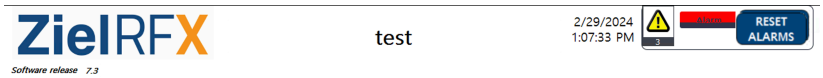
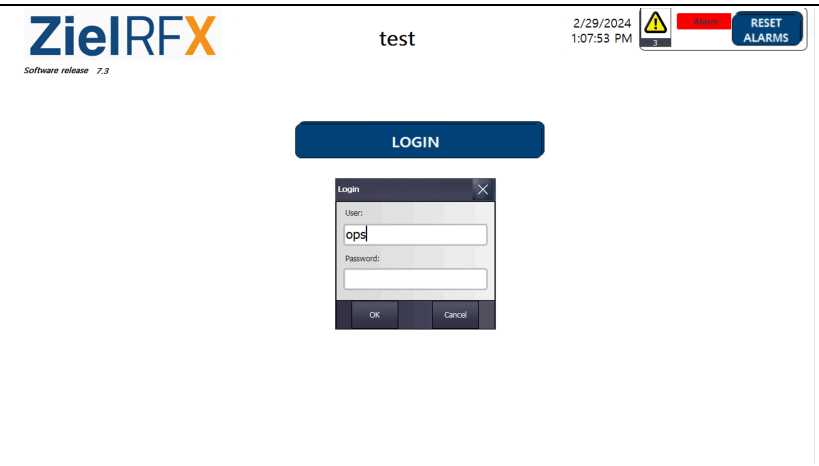
DO NOT START RADIOFREQUENCY WITH CONDUCTIVE MATERIALS INSIDE TREATMENT CHAMBER

DO NOT INTRODUCE LIVE ANIMALS OR HUMAN INSIDE TREATMENT CHAMBER

4.5 PLC Operations (2006/42/CE, EN 12100)

4.5.1 Login

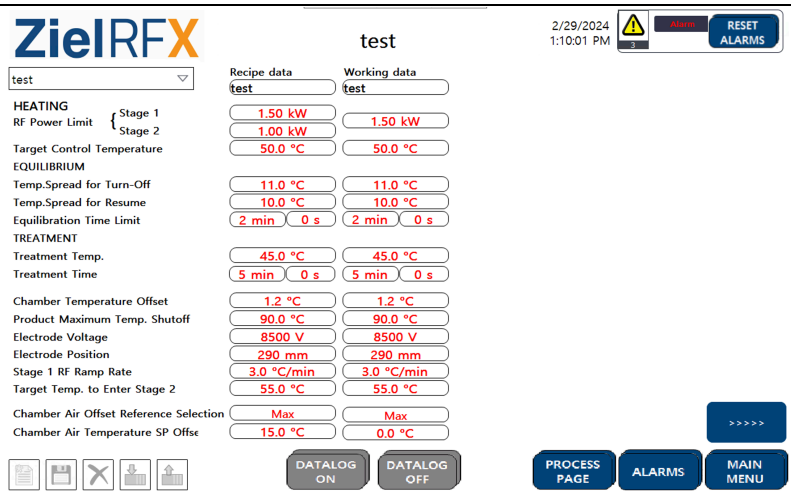
When powered up, the HMI will load the **User Login** screen.

 	Press **LOGIN** to enter user credentials. (Credentials will be provided by Ziel during installation)
	Enter credentials based on the user of the machine. (Operator or Supervisor)

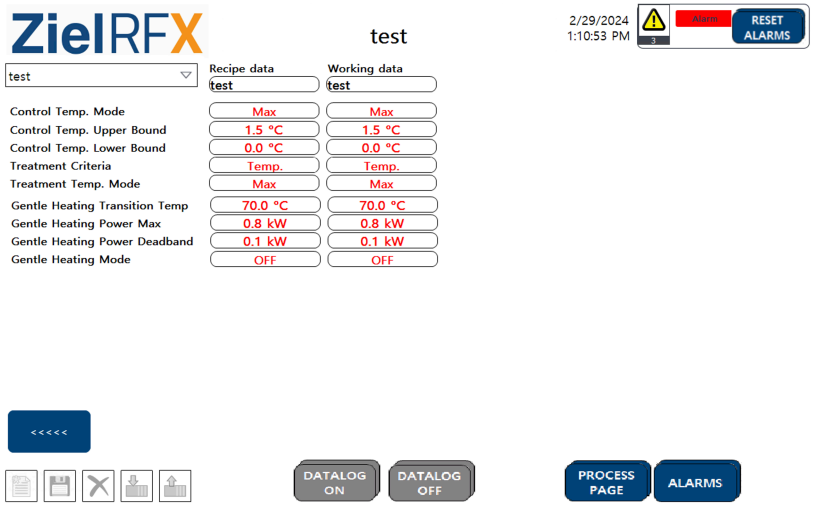
4.5.2 ***Recipe Management***

User can operate using saved recipes only. Creating recipes is restricted to Supervisor level access.

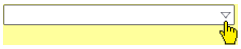
Page 1



Page 2



Saved recipes can be selected from the drop-down box.



To use the selected recipe, press the **Download Recipe Data** button.

Enter the parameters under the **Recipe Data** column.
Enter the name of the new recipe on the top row.
Save the changes in the first page before going to the next page.

To delete a selected recipe, press the **Delete Recipe** button.

New Recipe

- Save New Recipe 
- Delete Selected Recipe 
- Download Selected Recipe Data 
- Upload Working Data to New Recipe 

4.5.3 Recipe/Processing Page Glossary

Chamber Pre-heat Temp – The RF chamber can be pre-heated to a desired air temperature. At the start of the cycle, the air is pre-heated to the chamber temperature set value in the recipe prior to starting the treatment. The RF chamber temp is maintained throughout the process.

Max RF Power Limit Stage 1 – Maximum RF power during Stage 1 (ramp-up).

Max RF Power Limit Stage 2 – Maximum RF power during Stage 2 (holding)

Electrode Voltage – Voltage applied to the Electrode.

Electrode Position – The Electrode height (distance from chamber floor to electrode plate) is adjustable and is predetermined for each recipe and typically depends on the product height and moisture content.

Target Control Temperature – The temperature that control the RF cycle, based on temperature readings of the 6 RFTEs.

Temp. Control Mode – The Target Control Temperature can be based off the MIN, AVG or MAX temperature.

Product Maximum Temp. Shutoff – The maximum allowed temperature, if any of the 6 RFTEs reaches this limit, the process will shut down

Target Temp. to Enter Stage 2 – The temperature at which the process will transition into Stage 2. Stage 2 will complete when all bags have been treated according to all recipe parameters, or if the equilibration timer times out.

Temp. Spread for Turn-off – If the delta between the min and max is greater than the setting for the turn off spread, the RF will shut down until the spread reaches the "Temp Spread for Resume" setting.

Temp. Spread for Resume – Once the delta between the highest and lowest RFTEs reaches the set value for "Temp. Spread for Resume, the treatment will resume.

Maximum Equilibration Time – The Equilibration Time is the time during Stage 2 that the Temp. Spread is above the "Temp. Spread for Turn-off" setting. During the equilibration time, the RF is off allowing the temperatures to equilibrate. The "Maximum Equilibration Time" is the maximum allowable time for an equilibration period, if reached, the process will terminate.

Control Temp. Upper Bound – The upper allowed limit for Control Temperature, during stage 2. Once the control temperature reaches the upper limit, the RF will stop.

Control Temp. Lower Bound – The lower allowed limit for Control Temperature, during state 2. Once the control temperature reaches the lower limit, the RF will start.

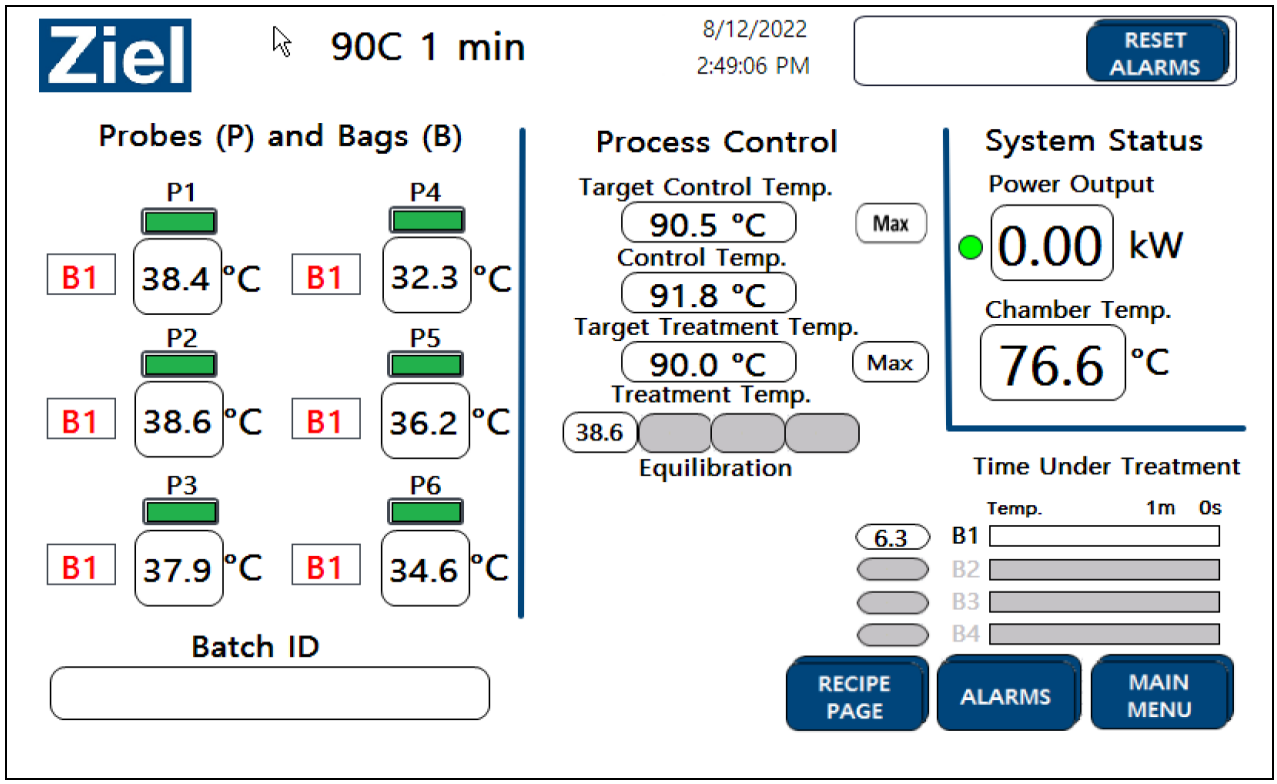
Treatment Criteria – There are three “Treatment Criteria” that can start the “Treatment Timer”. The three criteria are, “Temp”, “Temp & RF” and “RF”.

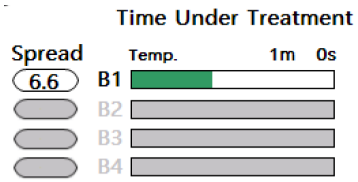
Treatment Temp. – Target treatment temperature that will start the “Treatment Timer”, when treatment criteria is Temp.

Treatment Temp. Mode – There are three “Treatment Temp. Modes. MIN, MAX & AVERAGE. These refer to the product temp readings. E.g. When set for MIN, the treatment timer will start when the lowest (MIN) temp reaches the “Treatment Temp.” setting.

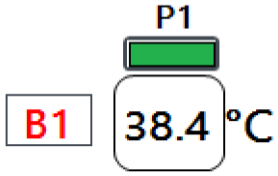
Treatment Time – The time required for the treatment to be completed. The treatment time for each bag is shown as progressive bar under “Time Under Treatment” on the process page. When the “Treatment Time” for a bag is completed, a notification will display on the HMI indicating that the treatment for that bag is completed. If the treatment time for two or more bags completed at the same time, two or more notifications will appear notifying the operator that the treatment time for the related bags are completed.

4.5.4 ***Processing Page***



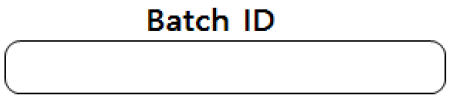


The bag (if selected) has a treatment status bar on the process page. This bar reflects the Treatment Time set in the recipe, e.g. 1 minutes & 0 seconds as shown here. As treatment progresses, the bar, will fill left to right. Once a bag reaches full treatment a banner will display on the HMI indicating which bag's treatment is completed.



Each probe displays the live temperature reading, in degrees Celsius. Next to each Probe reading is the bag selection box. Pressing on the B#, opens a drop-down list of B1- B4. All probes must be assigned to B1, corresponding the bag being treated. If a probe is broken or malfunctioning, pressing the green bar (changing it to red) will temporarily by-pass the probe for that treatment

cycle. A probe automatically re-enables when a new batch starts and must be by-passed for each cycle until it is replaced.



The user can enter the Batch ID that matches the batch/lot code associated with the product being treated. This ID will line up with the data from the treatment batch, in the data stored on the USB. The ID must be entered for each batch, following Ziel' SOP (Attachement II)

4.5.6 Operating Procedure

Material Requirements

Bags:

- FDA approved,
- BPA free,
- 100% Food Grade,
- Material (nylon, poly-nylon); must be approved by Ziel.

Trays:

- Ziel provided trays

Follow Ziel's SOP: "APEX7 operating procedure" Attachment II

4.5.7 *Instruction to Save Process Data*

1. Insert a flash drive (memory stick) in the DATA LOGGER port (USB) located on the RFX unit.
2. Before starting the cycle, enter the lot number of the product to be processed on HMI using alphabetic and numerical character.
   Example: 12345 or Lot 25.
3. Start the process by pressing start cycle button on HMI.

Note: As soon as cycle starts, the data will be captured directly on the flash drive. Once the cycle is ended the data log automatically will stop.

4. Enter the lot number for the next batch of product to be processed and start the cycle. The process data will be saved automatically on the flash drive.

5. At the end of the day/shift remove the flash drive from DATA LOGGER port and download the data.

Note: Data is saved on "CSV" format which can be opened on excel file.

The csv file is automatically named by real date and time of the day that the data log has ended.

Example: DATALOG20231112140434

The data log has stopped on November 12, 2023, at 14:04:34 PM.

4.5.8 ***Instruction to Download Data***

1. Open a new workbook on Excel.
2. On data page choose "from text".
3. Select the file you are planning to download on the flash drive.
4. Text import wizard window will pop up.
5. Make sure the file origin shows: Windows (ANSI). Adjust if needed.
6. Choose "Delimited", then press "Next".
7. Choose "semi colon" then press "next", "next" and "finish".
8. Import the data in a "new worksheet".
9. Save the file as excel file on your computer.

4.5.9 ***Trend Page***

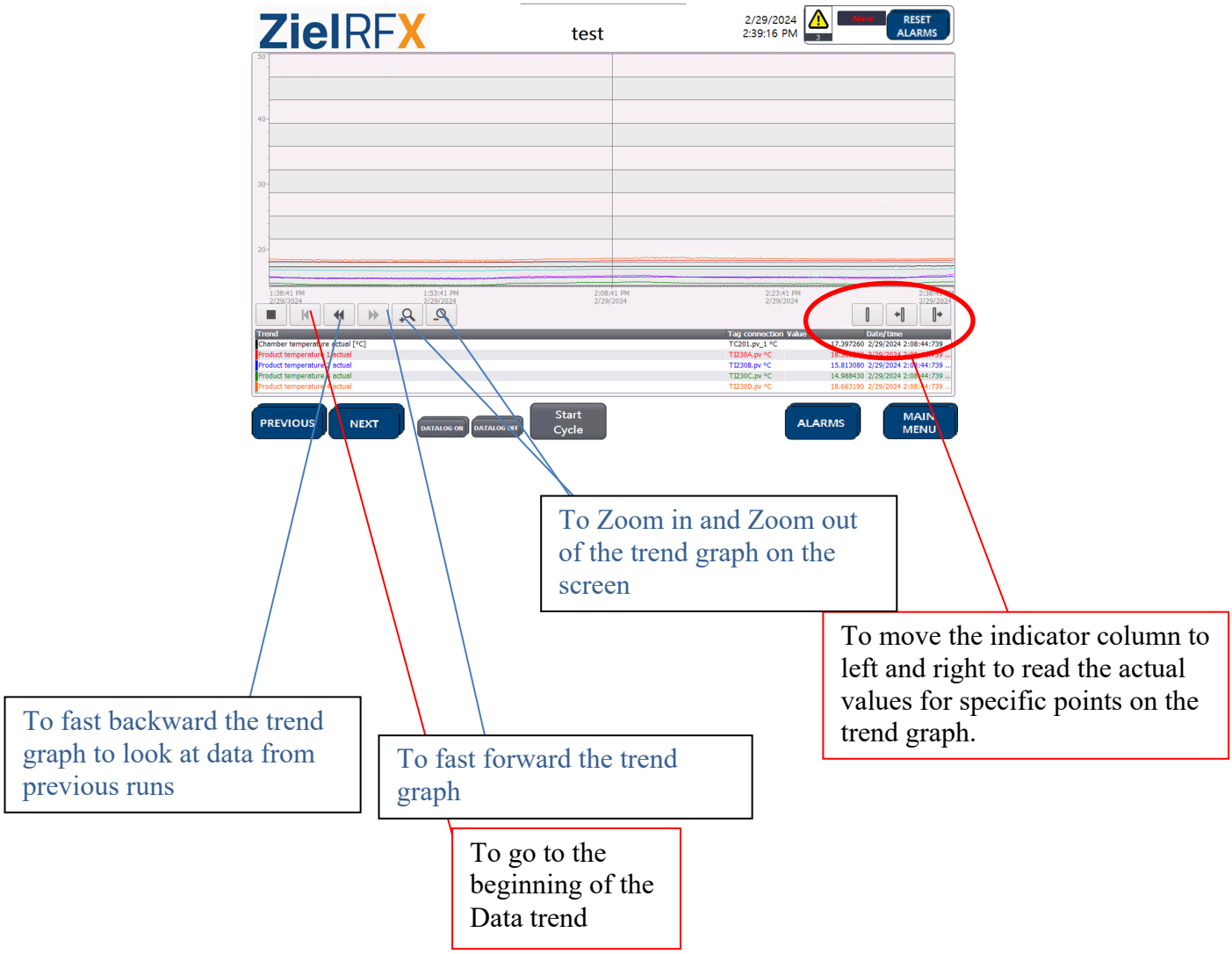
Trend Page has three screens:

Page 1: shows the trends for product temperatures from six fiber optic probes, chamber actual temperature.

Page 2: shows the trends for Process cycle status, Chamber heating status, RF generator status.

Page 3: shows the trends for actual RF power, Actual electrode voltage and variable capacitor position.

The description of soft buttons on Trend page is shown below.



If "DATALOG ON" is pressed the equipment will save the data on the flash drive continuously. Independent of cycle being ON or OFF.

For example, if you require the data between two cycles.

Press "DATALOG Off" to stop recording.

M O **4.6 Controls and inspections** (2006/42/CE, EN 12100)

During machine operation, the introduction of different type of product will cause variation on the power delivered.

It is advisable to always place two CO_2 fire-extinguishers near the equipment as a precaution.

M O **4.7 Cleaning** (2006/42/CE, EN 12100)

Cleaning of the machine and keeping it clean is the first requirement for a safe use.

During machine operation, the operator must take care to keep the work and control positions clean. Ensure there are no points of contacts between electrodes and the product by checking inside the RF chamber through window from designated working position.

5. MAINTENANCE

M E I

5.1 Introduction

The information contained in this chapter is fundamental to the correct and safe maintenance of RFXRF Machine.

The maintenance technician must duly read all the contents of this chapter

Ref. 89/656/EEC

The maintenance staff must use personal protection equipment, ladders or any other device to work in acceptable safe conditions.

Clothing, gloves and arm guards must be protecting against cuts in compliance with ISO 13999

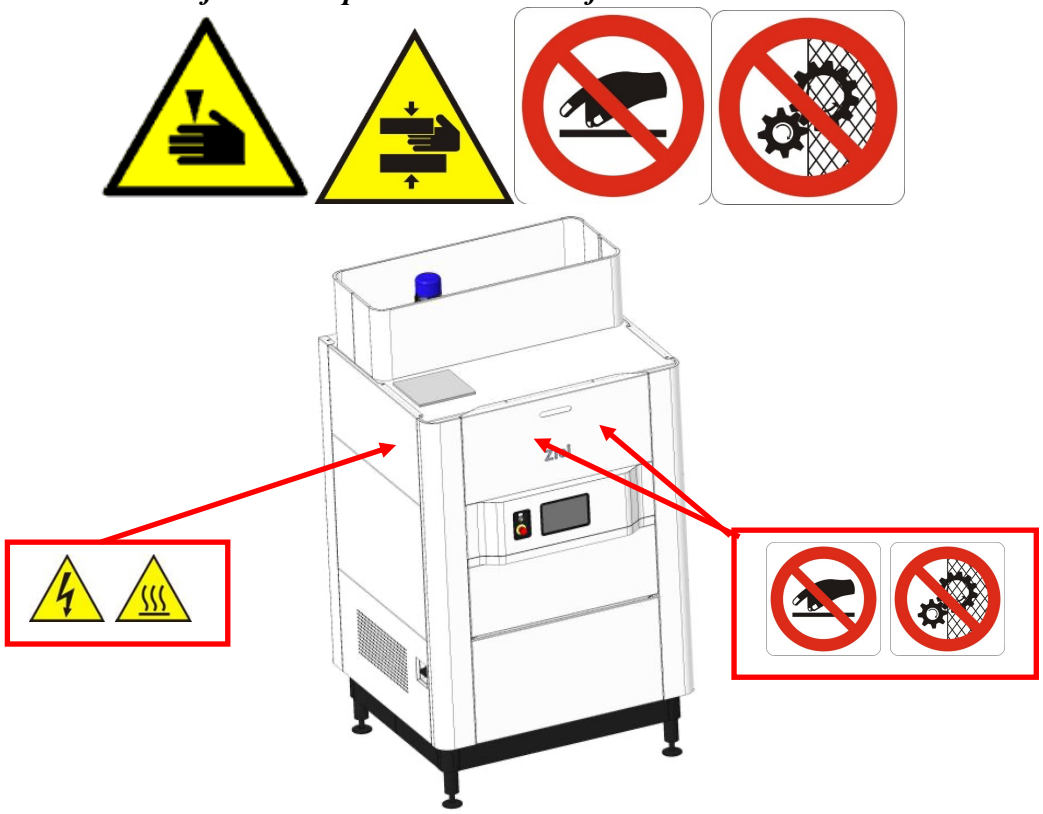
DON'T WALK ON THE TOP

FALL DANGER

FALL DANGER

THE USE OF THE MACHINE IS STRICTLY PROHIBITED, IF THE SAFETY DEVCIES HAVE BEEN REMOVED, ISOLATED, MODIFIED OR THEIR EFFICIENCY IS REDUCED.

DANGER ZONES
if machine parts are removed for maintenance

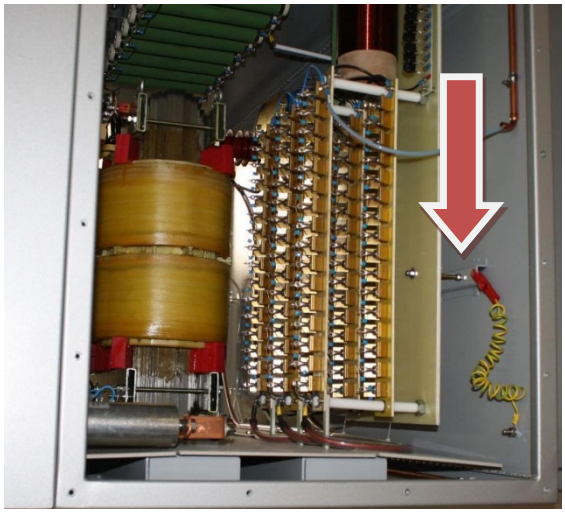


Inside the main transformer cabinet and the generator cabinet, even after having cut off the power, RF filters and capacitors can stay electrically charged for a long time.

DANGER
ELECTRIC SHOCK

Before touching any of the parts in the high voltage cabinet, it is mandatory to attach the prearranged earth connection clip to each of them

CLIPS EXAMPLE IMAGE



The following explanations refer to operations and steps to be carried out for routine, preventive and extraordinary maintenance of the system based on indicated time cycles. Routine and preventive maintenance of the system is done to ensure the equipment is operating in optimal conditions. The extraordinary maintenance is for replacement of broken or worn-out parts.

M E I 5.2 Routine Maintenance (2006/42/CE, EN 12100)

Routine maintenances are very simple, but extremely important for correct functioning of the system. They must not be neglected and must be carried out carefully and regularly.

M E I 5.2.1 *Maintenance of the Mechanical Parts*

Routine mechanical maintenance must be carried out by specialised mechanical personnel.

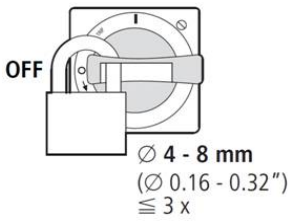
The carrying out of mechanical maintenance with main switches ON is strictly prohibited.


Inside the cabins of transformers, panels, oscillating circuits and the processing cabinet marked by special signs, indicating there are parts, which reach high temperatures during machine operation.

Do not perform any work near these parts until several hours after the machine has been turned off.

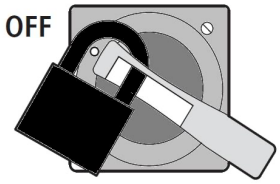
Use heat resistant gloves for all operations carried out inside the processing cabinets, generators and transformer cabins.

During maintenance operations lock in the main switch on off position to prevent unexpected dangerous activations



Even when the main switch is off, voltage is still present on some wires and devices.

EXTERNAL MACHINE SUPPLY LINE SWITCH



locked

To isolate machine from external electrical supply, turn off and lock the external supply main switch

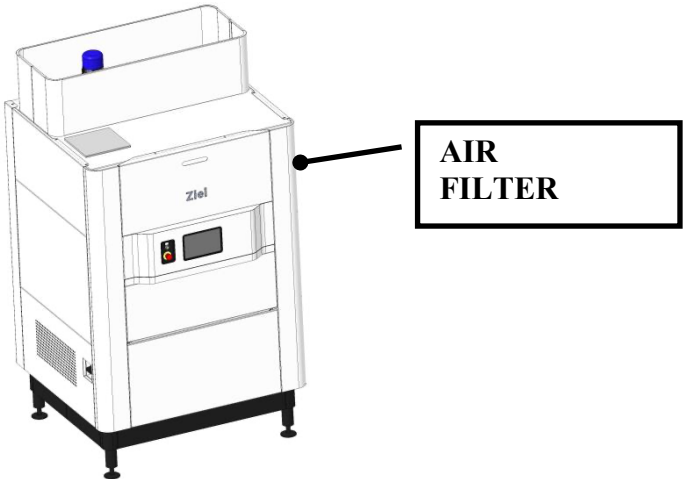
5.2.1.1 ***Daily Maintenance***

- check the process chamber to remove parts of products and evaluate the need of a complete machine cleaning

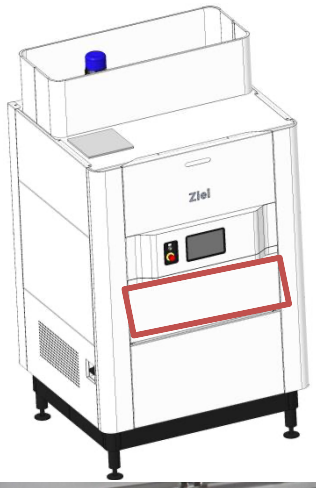
Pay particular attention to the inductances and other details of the material inside the chamber, because they can become very hot after a few minutes running the machine.

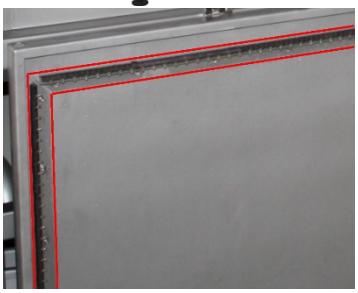
5.2.1.2 ***Weekly Maintenance***

- Clean and replace (if necessary) the FILTERS of fan/aspirators air intakes; use compressed air and/or specific detergents for surfaces of the filters and their stainless steel bases



- Check the condition and the proper electrical contact between the door frames and the copper finger strips installed on the respective doors.





Strips mounted on door frame

Spare part roll of strip

Conductive gasket
Code A22D0050

Code A3100004  ***Box of Rivets*** ***Code A01EJ003***	

Such devices are very important for the stable working of the RF generator and for the shielding action against the electromagnetic waves generated in the machine. If necessary, change the copper finger strips and polish the contact parts of the door frames.

5.2.1.3 ***Maintenance to be carried out every four months***

- Clean off dust and any other impurities, foreign materials from the rotating unit of the product chamber exhausters.

M E I

5.2.2 Maintenance of the Electrical Parts

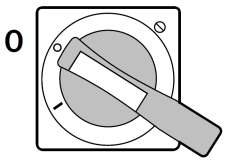
Operations of regular electrical maintenance must be carried out by specialized electrical personnel.

The carrying out of electrical maintenance operations with main switches ON is strictly prohibited.


The parts inside the transformers, panels, oscillating circuits, and processing cabinets reach high temperatures during machine operation and marked by caution signs.

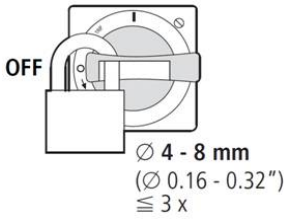
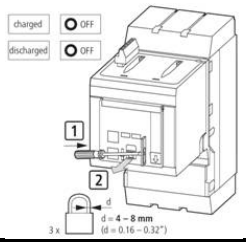
Do not perform any work near the marked parts until several hours after the machine has been turned off.

Use heat resistant gloves for all operations carried out inside the processing cabinets, generators and transformer cabinets.



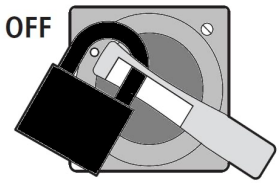
Before carrying out any type of operation disconnect all main switches, and block them in position **O**. This is to prevent other operators from turning ON the power to the generator during maintenance.

During maintenance operations lock in the main switch on off position to prevent unexpected dangerous activations.

manual command on machine (if remote command not mounted)	***remote operator on machine (if remote command mounted)***
	

Even when the main switch is off, voltage is still present on some wires and devices

EXTERNAL MACHINE SUPPLY LINE SWITCH



locked

To insulate machine from external electrical supply, turn off and lock the external supply main switch

5.2.2.1 ***Maintenance to be carried out every two months***

- Check the efficiency of electrical contacts inside the panels. Also check the cleanliness of parts under voltage, the fixing of nuts and bolts tightening the contacts, the good state of power and signal wires, general cleanliness inside the panel.
- Check and, if necessary, tighten the nuts and bolts clamping the ends of all wires and electrical components inside the transformer cabinets and oscillating circuits, the state of power wires, the fixing of bolts clamping the inductances and the laminated brass strips. Check and eventually clean where necessary, inside the mentioned cabinets.
- Check, and if necessary, fix the bolts clamping the inductances and those clamping the laminated strips inside the processing cabinet.

M E I **5.3 Extraordinary Maintenance** (2006/42/CE, EN 12100)

The most important part of the equipment is the triode.

The triode's life dependents on how hard (hours and power) the equipment is used.

M E I **5.4 Lubricants** (2006/42/CE, EN 12100)

All lubricants used in the moving parts should be food grade and complied with the user's SOP.

M E I **5.5 Fiber Optic Temperature Sensor Verification of Accuracy Procedure**

Fiber optic probes come with certificate of calibration from the probe manufacturer. Once the probes are connected to the equipment, the accuracy of their reading must be verified and adjusted. In addition, the probe calibration must be verified annually or according to customer requirement.

5.5.1. Required tools:

- Certified reference thermometer (THS-222-555, Thermoworks.com) with temperature range of 0-100°C and increment of ≤0.2°C.
  Note: Any other certified thermometer with a valid calibration certificate can be also used.
- Water bath or dry well temperature calibrator.
- Water at room temperature.
- Fiber Optic Calibration Test Report Form.

5.5.2. Procedure:

1. Turn on the main power switch. On the main screen select "PROCESS PAGE".
2. Take one of the six fiber optic temperature sensors and record the serial number and HMI probe number in the Fiber Optic Calibration Test Report Form.
3. Place the certified calibrated thermometer and the fiber optic temperature sensor to be calibrated side by side, in a clean container with boiling water and make sure the tips of certified thermometer and fiber optic sensor are not touching each other or the container walls.

Note: A dry well temperature calibrator can be used alternatively if available. Set the dry well temperature to desired temperature (100 °C for high temperature calibration and 20°C for room temperature calibration) and wait for the well to reach the set temperature before inserting the temperature probes.

4. Wait for the temperature readings of certified thermometer and fiber optic probe to be stable, then record the temperatures in Table 1 in Fiber Optic Calibration Test Report Form.
5. Do not remove the certified thermometer and fiber optic from the water (or dry well), wait for 20 seconds and record the temperatures in Table 1.
6. Repeat the above step.
7. Remove the fiber optic sensor.
8. Calculate the average temperature for each column.
9. Calculate the correction factor using the following formula:
   (average of fiber optic reading minus average of standard reading = correction factor).

   If the correction factor is +/-1°C, no action is required.

   If the correction factor is between +/- (1- 4)°C go to step 5 for offset adjustment.

   If the correction factor is greater than +/- 4°C, replace the fiber optic temperature sensor.

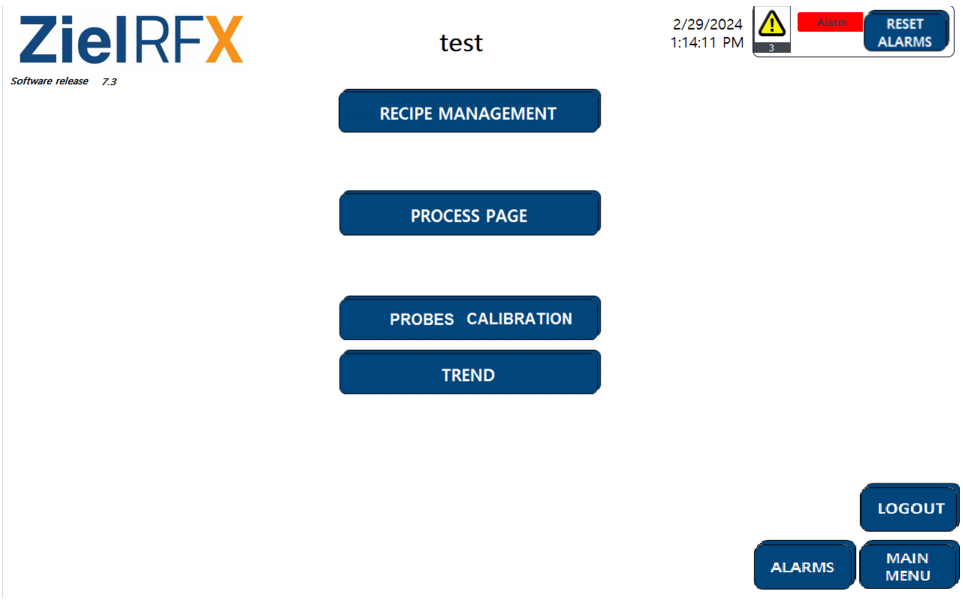


Figure 1. Main page

10. On the main screen select the “PROBES CALIBRATION” (Figure 1).
11. On the PROBES CALIBRATION page, enter the correction factor value in the right hand box corresponding to the probe number. (Figure 2).

    For example:

    If probe 6: correction factor is 2.1, enter 2.1 on the corresponding box.

    If probe 3: correction factor is -0.9, enter -0.9 on the corresponding box.

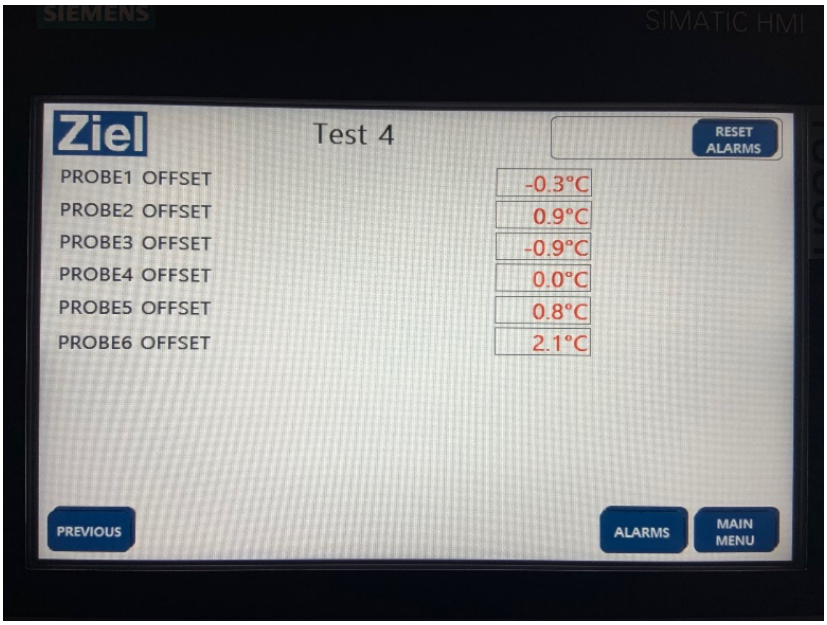


Figure 2. Probes calibration page.

12. Once all the values are entered, repeat the steps 2 - 7 and record the temperature readings in Fiber Optic Calibration Test Report Form **Table 2**.

    The acceptable accuracy deviation is +/-1°C. Any temperature probes that does not meet the criteria after offset adjustment, should be replaced.
13. Repeat step 2-8 with room temperature water or drywell set at 20°C.
14. Calculate the correction factor.

    The acceptable accuracy deviation is +/-1°C.

5.6 Fiber Optic Calibration Test Report Form

Test Date: _____

Equipment model and serial number:

Certified standard thermometer description: _____
Certified standard thermometer calibration due date: _____

Fiber optic temperature sensor serial number: _____
Fiber optic temperature sensor # on HMI: _____

Table 1.

Standard Thermometer (°C)	Fiber Optic (°C)	Correction factor (average 2- average 1)	Offset required Y/N
average1:	average2:		

1 average of three temperature readings for Standard Thermometer.
2 average of three temperature readings for Fiber Optic

If Offset required:
Off set value: _____
Date applied: _____
Verification after Offset date: _____

Table 2.

Standard Thermometer (°C)	Fiber Optic (°C)	Correction Factor (average FO- average ST)	Pass/Fail
average1:	average2:		

Table 3.

Calibration Summary:	
As Found (Check One):	**As Left (Check One):**
☐ Found In Tolerance (Pass)	☐ Left In Tolerance
☐ Found Out of Tolerance (Fail)	☐ Left Out of Tolerance
☐ Found Broken	☐ Left Broken
☐ Could Not Locate	☐ Removed from Service
☐ As Found Data Not Required	

Table 4.

Approval:	
Instrument/System ID/ serial number	
Technician's Signature/Date:	
Engineering / Maintenance Management (or Designee) Signature/Date:	

5.7 Probe Clip Installation Procedure

Probe clips are designed to fit on the existing fiber optic probes. Installation should be done by a qualified maintenance engineer. The clips will eliminate the need to measure the probe depth manually, by providing a repeatable and visible depth marker. The probes remain fragile and should be handled carefully when installing the clips.

1. Make a mark on the probe at (desired depth) (4-7 cm)
2. Place the bottom of the clip on the mark.
3. Using a blunt ended tool, such as a #4 flat blade screwdriver, or plastic putty knife, carefully press the probe into the clip.
4. Do not press in the center of the clip, start on one side, then move down as the probe snaps into place.

Do not use a sharp device as it could cut and damage the probe casing.

Do not attempt to snap the clip on by hand, if the probe is kinked the internal fiber will snap and the probe will need to be replaced.

5. Double check the distance between the tip and the bottom of the clip for the accuracy.
6. Using a permanent marker, writer the probe number (matching HMI reading) on the clip.

6. DIAGNOSTICS

6.1 **Control panel alarms** (2006/42/CE, EN 12100)

Every alarm has a simple description to help with troubleshooting from the HMI.

> ***Carry out any maintenance operations following an alarm with machine completely off.***

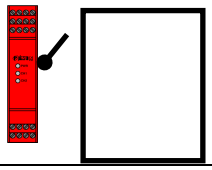
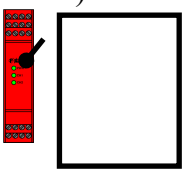
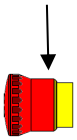
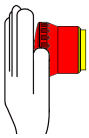
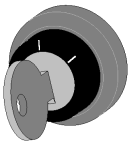
6.2 Troubleshooting main alarms

Alarm	Help
O/L Cabin Exhauster Switch (O/L = Over Load)	The magnetic thermal switch of the cabin exhauster is open. Check the running of the motor and its current absorption.
O/L Filament Switch	The magnetic thermal switch of the triode filament supply is open. Verify the continuity between the triode filament connections and the condition of the filament transformer located in the generator box.
O/L Main Transformer Exhauster Or Main Transformer High Temperature	The magnetic thermal switch of the transformer exhauster is open. Check the running of the motor and its current absorption. - The temperature into the main transformer box is too high. Eventually check the running of the transformer exhauster on the top of the machine and the side transformer box air filters.
O/L Triode Exhauster	The magnetic thermal switch of the triode exhauster is open. Check the running of the motor and its current absorption.
Triode Pressure Low	The differential pressure sensor has detected a too low triode air cooling flow. Check the proper running of the triode exhauster motor and its current absorption. Check the condition of the air filters located on the machine. If needed, clean the filters with compressed air.
High RF Power Alarm	The power delivered has exceeded the machine maximum power or an electric arc has happened inside the machine. Activate “kW-“ for a few seconds and start RF again. If the generator stops suddenly, check inside the generator box and look for any black marks on the components caused from high voltage sparks.
High Grid Current	The triode grid current is too high. Activate “kW+” button for a few seconds and start the RF generator. If the alarm is activated again and again, the grid inductor bridge must be moved by 1 cm away from the inductance connection points, then the machine restarted.
Low Grid Current	The triode grid current is too low. Try to activate “kW-“ button for a few seconds and start the RF generator. If alarm is activated again and again, the grid inductor bridge must be moved by 1 cm closer from the inductance connection points, then the machine restarted.

Alarm	Help
Low Electrode Voltage	The machine has detected a too low electrode voltage. Check if the electrode voltage probe is OK. To know if the machine is working OK, check for the neon tubes located inside the RF chamber, are properly lighting when RF is on.
Mob. Elect. limit switch Alarm	The machine has detected both the mobile electrode limit switches pressed. Check the proper working of the mentioned switches and their connection to the electric panel.
Var. Cap. Scan in progress (Notification)	This is just a warning to advise the Variable Capacitor scan is in progress
O/L Variable. Capacitor. Motor Switch	The magnetic thermal switch of the variable capacitor motor is open. Check the running of the motor and its current absorption.
O/L Mobile Electric Motor Switch	The magnetic thermal switch of the mobile electrode motor is open. Check that no obstacles are stopping the movement of the electrode. Check the running of the motor and its current absorption.
Mobile Electrode moving (Notification)	This is just a warning to advise the Mobile Electrode is moving
O/L Low Exhaust. /Blowers switch. O/L Final Exhauster Switch.	The magnetic thermal switches of the low exhausters/blowers are open. Check the running of the motors and their current absorption. The magnetic thermal switch of the final exhauster is open. Check the running of the motor and its current absorption.
Air Triode Temperature High	The triode air cooling temperature is too high. Check the proper working of the triode exhauster and filament blower. Check the condition of the air filters located on the machine. If they are dirty, clean the filters with compressed air.

6.3 Emergency stop and safety control relay

6.3.1 *Emergency stop and reset button*

Safety relay 	Safety relay after emergency stop with lights off (machine is **NOT enable** to be turned on) 		Safety relay is NOT in emergency stop with lights on (machine is **enable** to be turned on) 
Emergency stop pushbutton 	Emergency stop Command is not activated in the below position 	**Press** button to active 	**Pull** button to enable 
Emergency reset 	Blue light ON Safety relay is on emergency stop mode 	**Push** button to reset emergency 	Blue light off means safety relay is reset and machine can be turned on 

6.3.2 *Minimum voltage coil inside main switch*

If the safety relay is active, the lights on it are on and a minimum voltage coil inside main switch is supplied.

If the minimum voltage coil is supplied the switch can be turned ON.

On every emergency stop event, the safety relay goes OFF and cuts off the supply to the minimum voltage coil inside main switch. The main switch cuts off the power supply and goes in to a TRIP position.

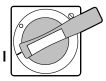
Tampering or removing minimum voltage coil from the main switch It is strictly prohibited.
Wrong installation or wrong connection may compromise the safety of the machine.

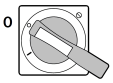
AFTER EMERGENCY STOP MACHINE MAIN SWITCH GOES TO TRIP POSITION.

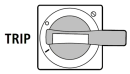
MAIN SWITCH CANNOT MOVE FROM TRIP TO ON POSITION

IT IS NECESSARY TO MOVE SWITCH FROM "TRIP-POSITION" TO "OFF-POSITION" BEFORE TRY TO TURN IT ON AGAIN.

ON POWERED ***OFF*** ***Trip***

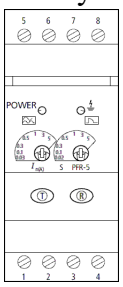


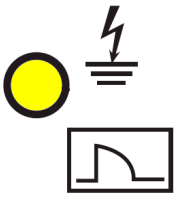




6.3.4 ***Electric differential protection switch***

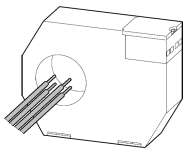
Differential relay





LED blinking = current value lower than set point
– Blinking frequency 2 s = 25 % – 50 %
– Blinking frequency 1 s = 50 % – 75 %
– Blinking frequency 0.5 s = 75 % – < 100 %

Toroid sensor



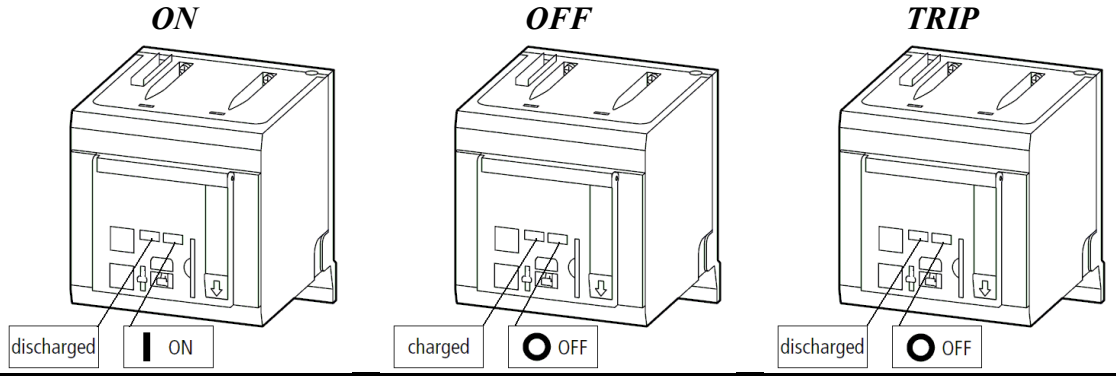
LED on = activated

When the differential relay switches, minimum voltage coil inside main switch is out of voltage (not energized) and main switch goes OFF on TRIP position.

After differential switch activation it is necessary to turn off differential switch to restore a normal working condition. After that the machine can be turned on again.

AFTER EMERGENCY STOP MAIN SWITCH GOES ON TRIP POSITION.

AFTER THE TRIP IT IS NECESSARY TO GO TO THE OFF POSITION BEFORE TURNNING THE MACHINE ON AGAIN.



7. TECHNICAL DATA (2006/42/CE, EN 12100-2)

7.1 Introduction

The principle of the RFXRF machine is based on the transmission of energy to the molecules of the product being processed under an electromagnetic field. This happens by making the product transit between two electrodes subjected to a voltage of about 5000 Volts, which oscillates at a frequency of 27.120 ± 0.163 Mhz. The electromagnetic field mainly effects on the water, but is also partially absorbed by the product; **therefore, treatment times must be controlled to prevent the overheating the product.**

The values given in section 7.2 & 7.3 are only refer to the RF system which this manual is referred to (Page 4), and cannot be assigned to other systems of the same or other manufacturers.

- Maximum overall dimensions and layout of system;
- Values of power used, evaporative efficiency, maximum dimensions of product be worked;
- Appraisal of environmental impact of system;

A detailed drawing of the layout of the system, with maximum overall dimensions, is given in **Enclosure (8.1)**

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7.2 Specifications

7.2.1 *Electrical Specs*

Feed voltage	240 V ± 5%
Phases	1
Nominal power	4 kW
Installed power for every module	16.8 kVA
Nominal frequency	50/60 Hz ± 2 %
N° generators	1
International Protection (IP) for control panel	IP 20
International Protection (IP) for machine	IP 40

7.2.2 *Mechanical Specs*

Electrode height	From 200 to 350 mm
Electrode dimension	1200 x 700 mm

7.2.3 *Load Specs*

Distance from electrode	60 mm

D 7.3 Environmental impact (2006/42/CE)

7.3.1 *Emissions in the atmosphere*

During RF processing, vapors will be produced and released inside the processing chamber. These vapors will be released to outside environment if an exhaust ducting is connected to the unit.

The content of the vapors can vary depending on the treated product, which for the most part are made up of moist air (water vapor mixed with air).

Therefore we recommend that user carefully review and follow the local laws on emissions, to avoid penalties and production delays.

7.3.2 *Waste*

In normal operation the machine does not produce industrial wastes of any kind. During maintenance there may be waste lubricants and replaced mechanical parts.

The elimination of these materials is subject to local regulations on the elimination of special, toxic and harmful wastes.

7.3.3 *Noise*

According to measurements carried out during machine testing at Ziel Equipment, Sales and Service, Inc., a continuous acoustical pressure level was determined in the workplaces foreseen by the manufacturer. The data are given in the following table:

POSITION	Leq. dB(A)	Lpeak dB
Work position (Chap. 4.2)	< 80	

According to the values obtained, use of individual protection devices (ear protectors, plugs) during machine operation is not deemed necessary

8. ENCLOSURES

8.1 Layout

8.2 Utilities

Utilities connections to be provided by the customer

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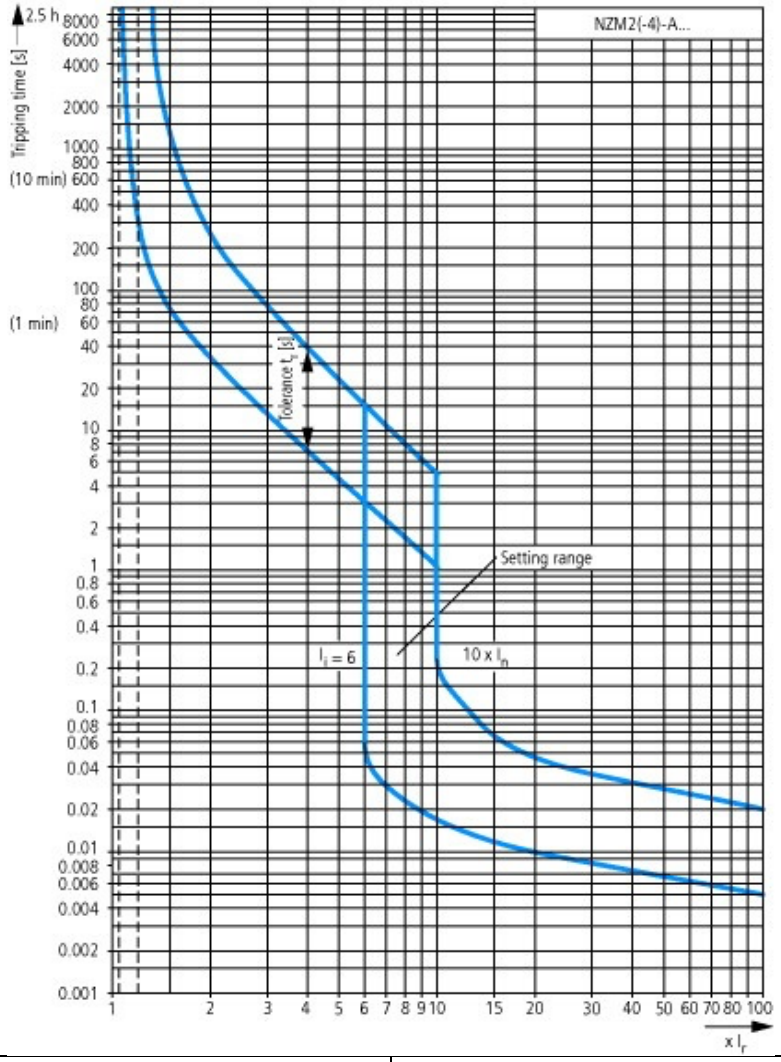
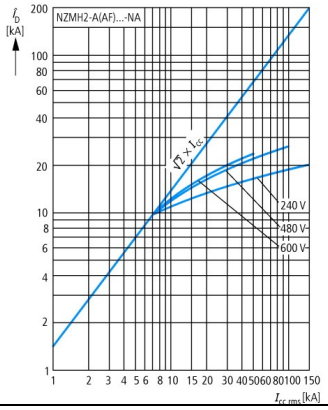
MAIN SWITCH EXAMPLE IMAGES

8.3 Main switch intervention graphs

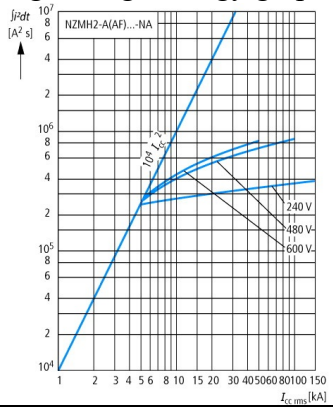
NZMH2-A40 NA	
In= rated current;	**Ir**= thermal protection setting;
Ii= magnetic protection setting;	**Icc**= short circuit current;
Id= passing through current	



Passing through current graph



Passing through energy graph (I^2t)

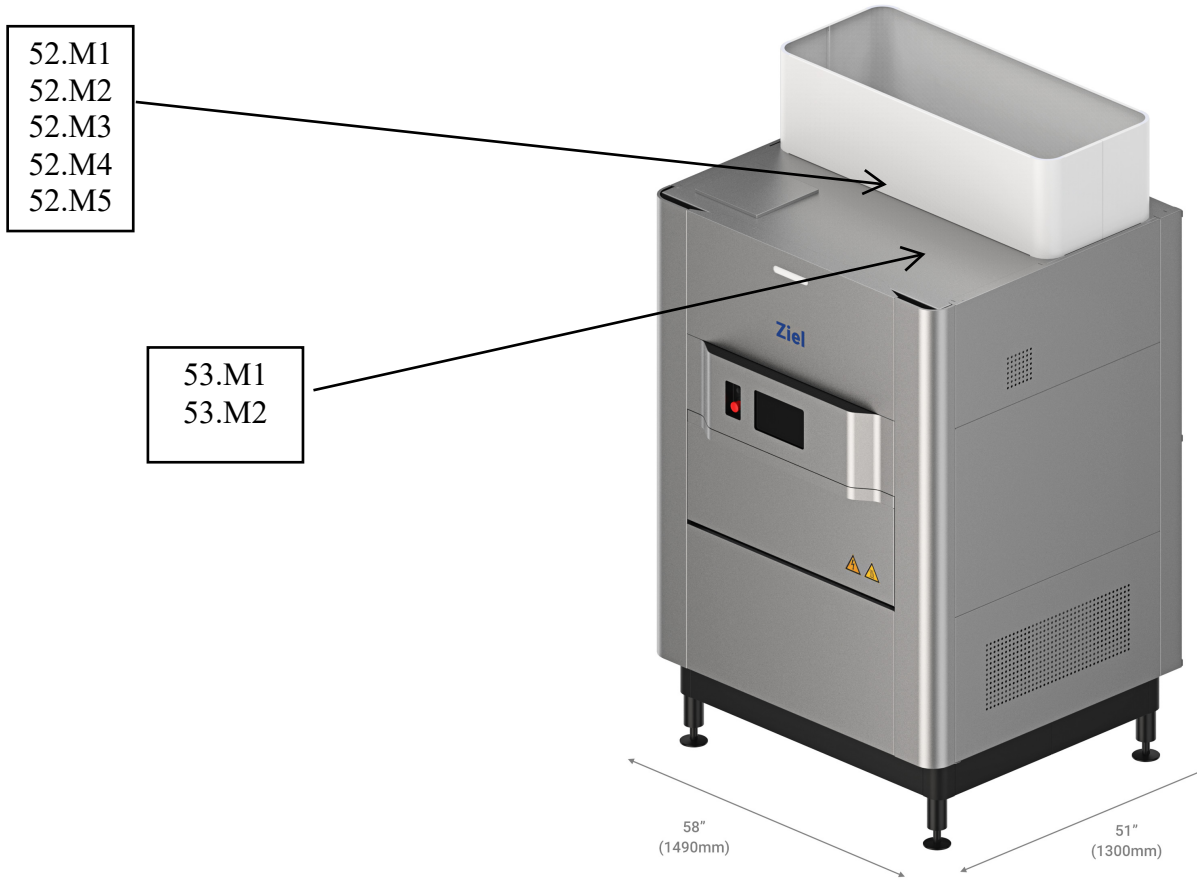


8.5 Electrical voltage supply stabilizer

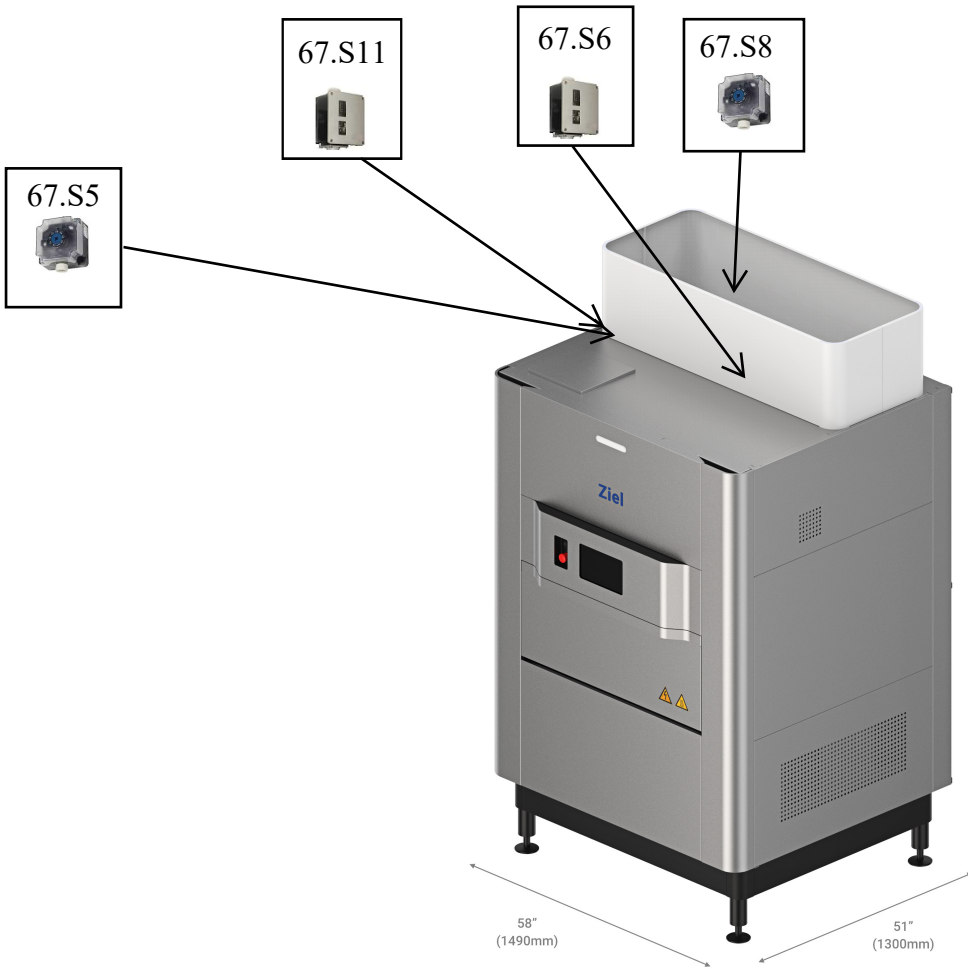
In case the electrical voltage supplied cannot stay within the range of +/- 5%, an electromechanical voltage stabilizer device is needed. The following table will help to choose the suitable voltage stabilizer.

GENERATOR RF POWER	INSTALLED POWER	STABILIZER CAPACITY	OUTPUT VOLTAGE TOLERANCE
4 kW	16.8 kVA	~20 kVA	+/- 3%

8.6 Motors

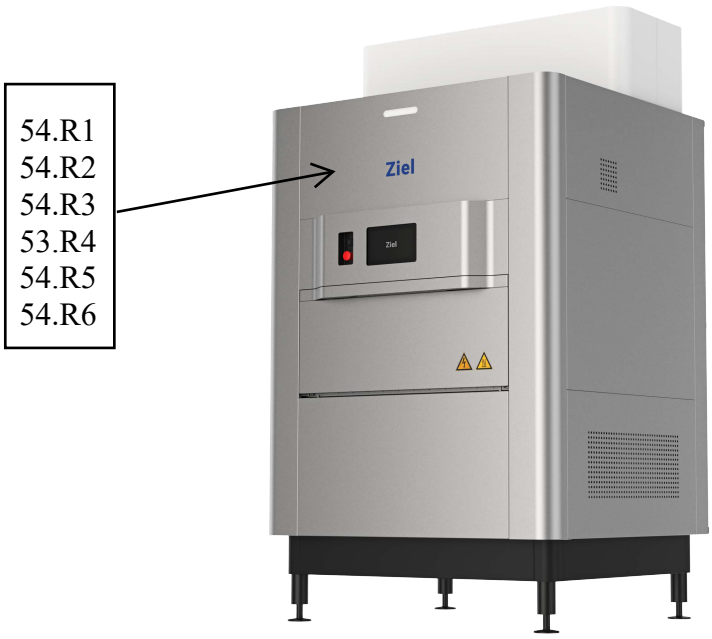


8.8 Pressure switches and temperature switches

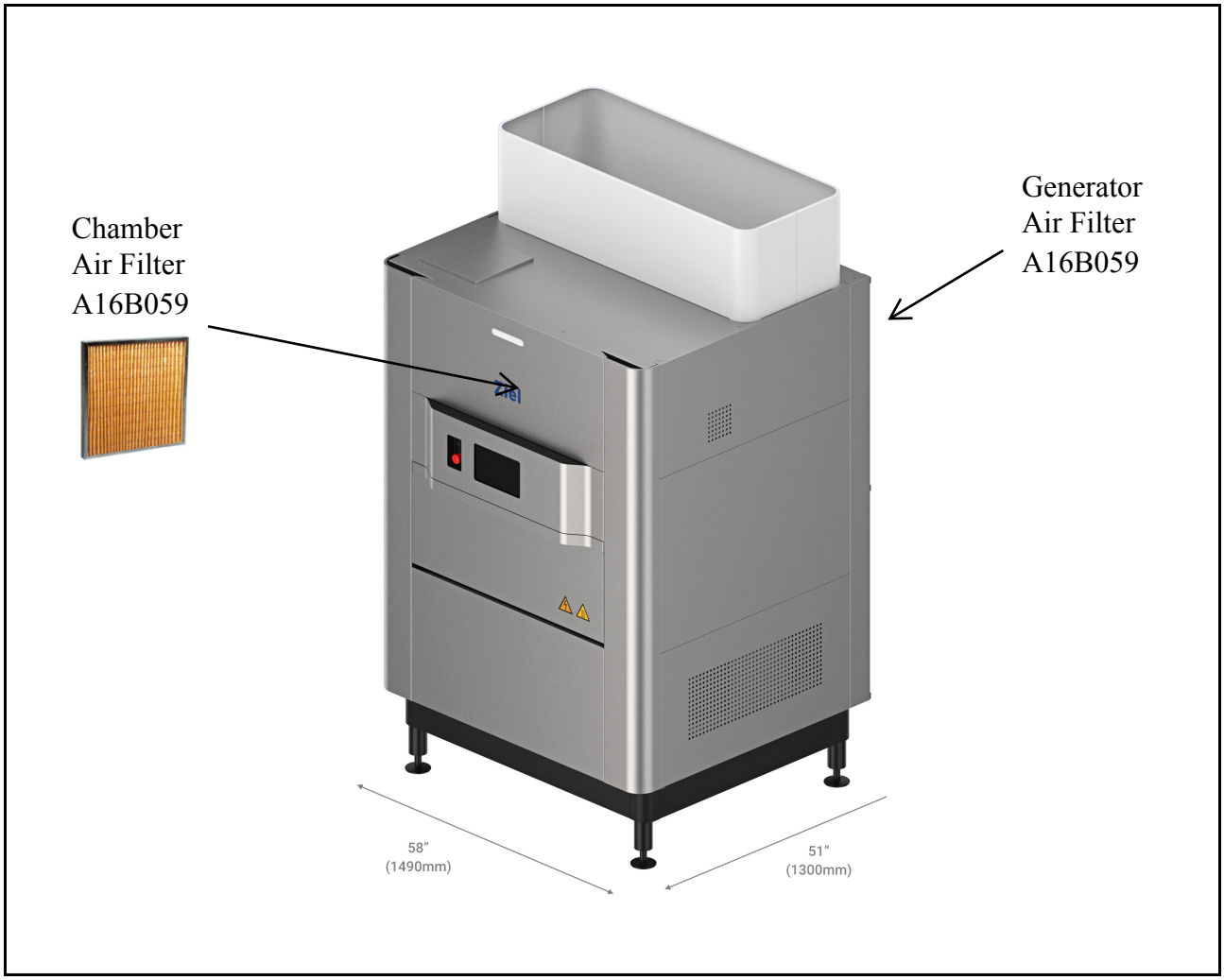


8.9 Encoder

8.10 Heating resistors



8.11 Air Filters



9. NOTES

You can use these pages to write your own notes about the RFX machine.

10. APPIDENIX

APPIDENX I-OPERATOR TRAINING RECORD

This is to certify that “The Customer” Operator(s) were trained per this Operator’s Manual on all aspects of safety, operation and maintenance of this RFX system.

Name of Operator	Signature	Date
Name of Operator	Signature	Date
Name of Operator	Signature	Date
Name of Operator	Signature	Date
Ziel Training Coordinator	Signature	Date

