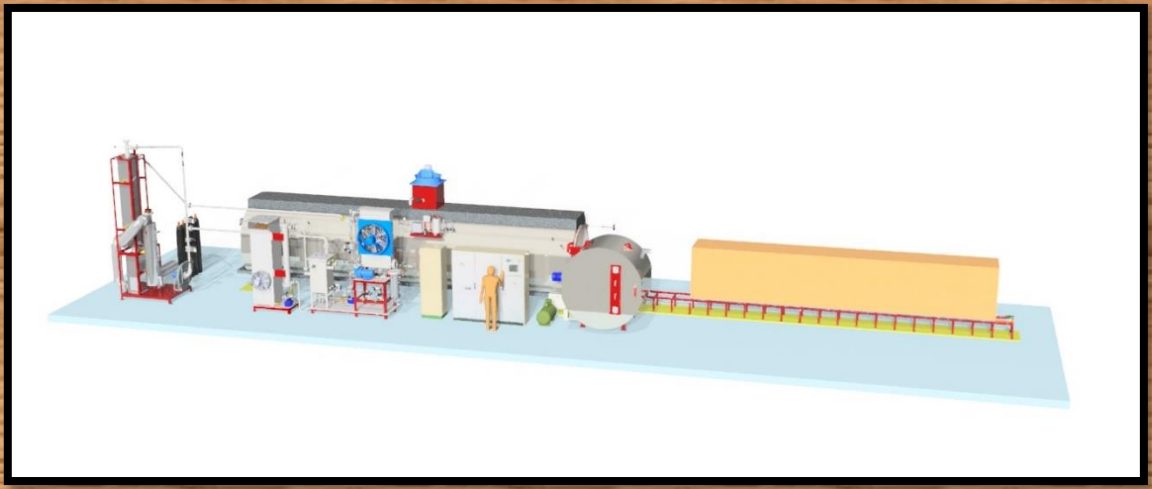
USE AND MAINTENANCE MANUAL FOR THERMOVACUUM TYPE:

CRTC - TVS ROLL 1800 E L 8000 MATR. 536-22



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Keep on drying

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EC DECLARATION OF CONFORMITY
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FASCICOLO TECNICO AUTORIZZATO A COSTITUIRE DA
TECHNICAL DOSSIER AUTHORIZED BY

Ernesto Pagnozzi
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DICHIARA CHE LA / E MACCHINA / E — DECLARES THAT THE MACHINE(S)

VACUUM DRYER FOR HIGH-TEMPERATURE TREATMENT
Descrizione/Description

TVS ROLL 1800 E L 8000
Serie/Modollo – Series/Model

Serial No. 536/22
Serie – Matricola / Series – Serial No.

2022
Anno costr./ Year of manufacture

Drying of wood for treatment at high temperature
Uso previsto / Intended use

È / SONO CONFORME ALLE DIRETTIVE
COMPLY(IES) WITH THE FOLLOWING DIRECTIVES
IL FABBRICANTE / MANUFACTURER

Direttiva 2004/108/CE Direttiva 2006/42/CE Direttiva 2006/95/CE Dichiariamo inoltre che sono conformi a tutte o altre normative ad esse applicabili.	Directive 2004/108/EC Directive 2006/42/EC Directive 2006/95/EC We further declare that they also comply with all other applicable regulations.
Norme Armonizzate ISO 12100-1; 12100-2 — UNI EN 294 — CEI EN 60204-1 (CEI 44/5)	Harmonised Standards UNI EN ISO 12100-1; 12100-2 — UNI EN 294 — IEC EN 60204-1 (IEC 44/5)

Data/Date: 02/08/2023

Il Legale Rappresentante
Legal representative

WDE MASPELL SRL
Dott. Ing. ERNESTO PAGNOZZI
TERNI - ITALIA

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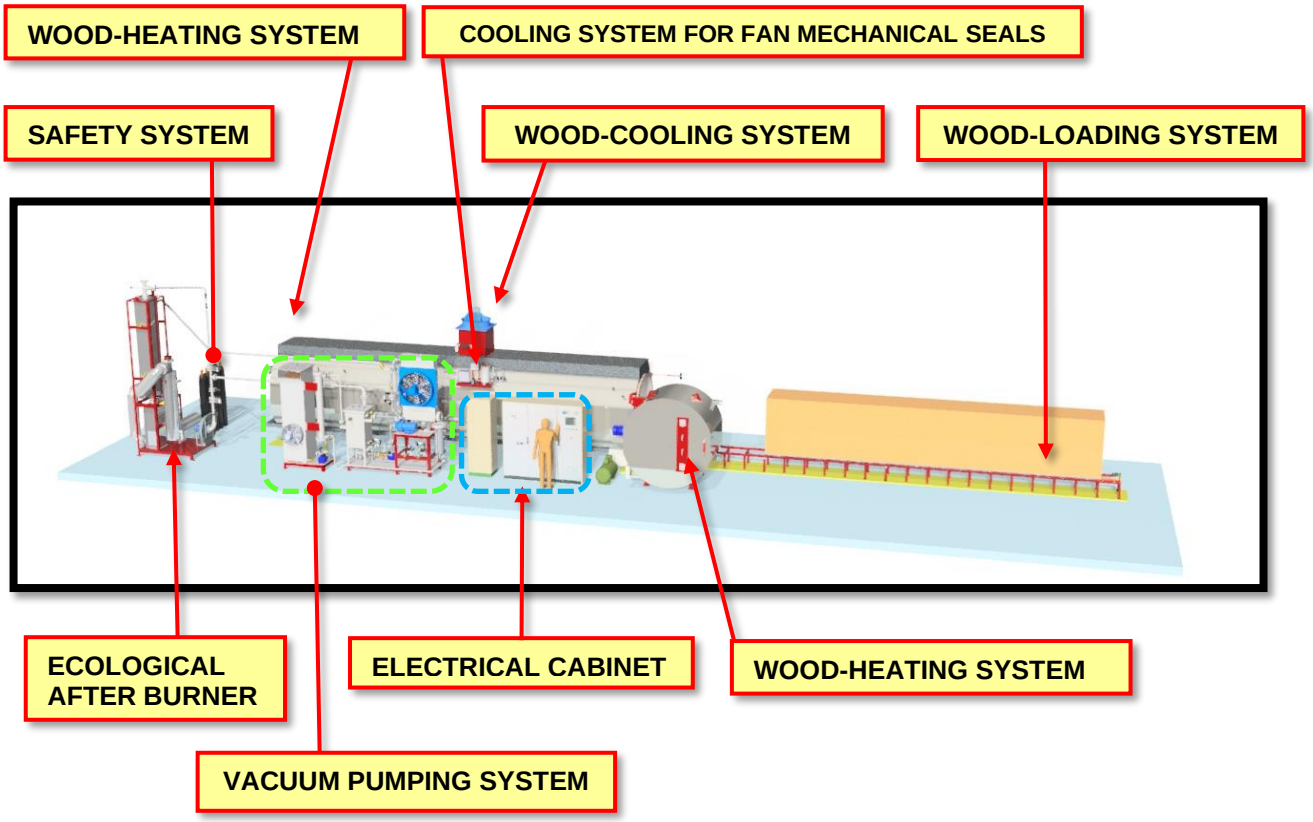
CHAPTER 1 OVERVIEW OF THE SYSTEM AND ITS PRINCIPLES OF OPERATION.

1.1 OVERVIEW

The THERMOVACUUM type TVS ROLL 1800 E L 8000 vacuum kiln principally consists of the following elements:

- DRYING AND THERMOVACUUM CELL
- WOOD-LOADING SYSTEM
- WOOD-HEATING SYSTEM
- WOOD-COOLING SYSTEM
- COOLING SYSTEM FOR FAN MECHANICAL SEALS
- VACUUM-PUMPING SYSTEM
- ELECTRICAL CABINET
- SAFETY SYSTEM
- ECOLOGICAL AFTER BURNER



1.1.1 DRYING AND THERMOVACUUM CELL.

The cell consists of a cylinder of AISI 304 stainless steel with a fixed base, a central body and a door through which the wood-charging car can pass.

1.1.2 WOOD-LOADING SYSTEM.

This system consists of a car that slides on internal rails (fixed to the stainless-steel tank) and external rails (removable or set in concrete as necessary). By means of a forklift truck, the operator can load piles of wood directly onto the car and then push them into the tank. (See cap.: INSTRUCTIONS FOR USING THE DRYER)

1.1.3 WOOD-HEATING SYSTEM.

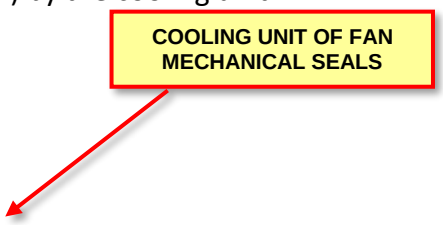
The thermal energy for drying is supplied by two electrical heaters located inside the door and the back of the dryer. The heat is transferred to the wood by the hot-air circulation forced by six fans mounted on the door and the back of the dryer.

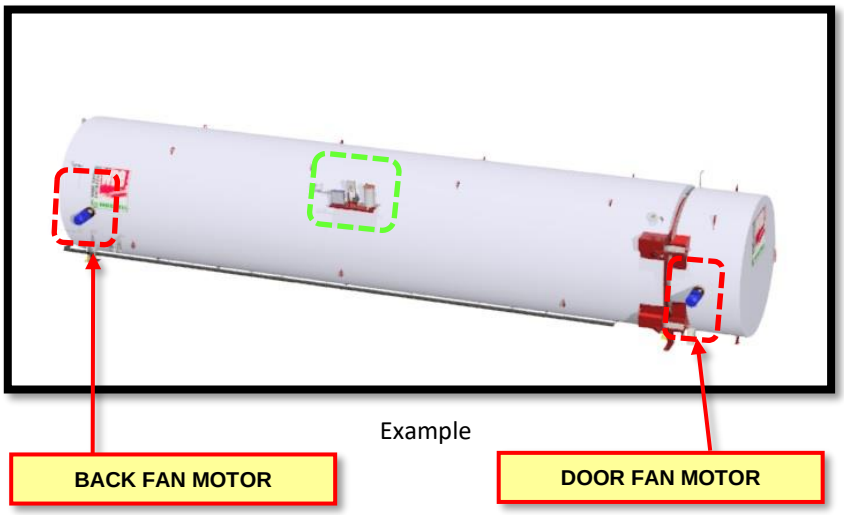
1.1.4 WOOD-COOLING SYSTEM.

The cooling system comprises a double wall around the treatment cell, in which, during the cooling phase, the fans induces a forced circulation of cold air suched by a bottom hole in order to cool the cell surface and thus the treated wood.

1.1.5 COOLING SYSTEM FOR MECHANICAL SEALS.

The transmission shafts of the fans are equipped with a system of mechanical seals that close the external air input during the vacuum drying. These mechanical seals are lubricated and cooled with a mixture of glycol (50%) and water (50%) by the cooling unit.





Example

1.1.6 VACUUM-PUMPING SYSTEM.

The vacuum pumping system comprises a vacuum pump with liquid ring, a condenser, a cooling tower, and an automatic system of water condensate unloading.

1.1.7 STEAMING SYSTEM.

The steaming system is composed from a steam generator and a nozzles freshwater pump. For the steaming phase the user can choice the steam generator or the nozzles fresh water pump.

1.1.8 ELECTRICAL CABINET.

Given the simplicity of the machine, it is clear that the control is simple and safe.

It essentially consists of the regulation of the temperature of the heating air and the vacuum in the cell.

1.1.9 SAFETY SYSTEM.

The only real risk during the heating of the wood to temperatures above 160°C is the risk of combustion of the wood due to an external air accidentally input into the cell during the ThermoVacuum process.

The cause of such an event may be external to the equipment (stoppage due to a failure of the electricity supply and/or compressed air supply and/or fresh water supply), or it may be caused by the breakdown of malfunction of one or more components of the dryer.

1.1.10 ECOLOGICAL AFTER BURNER

The ecological after burner system to reduce and/or transform the incondensable gases coming out from our equipment ThermoVacuum in other non-irritating and acceptable human sense of smell substances.

1.2 GENERAL OPERATING PRINCIPLES.

The machine can operate as a Vacuum Dryer or as a ThermoVacuum system for the modification of wood at high temperature.

1.2.1 DRYING FUNCTION.

After the loading of the wood pile onto the cart, connect the humidity probes and insert the woodcore temperature probe in a hole done in one of the tables: now the cart can be pushed into the dryer then the rail bridge can be removed and the door closed using the two small handwheels.

When this has been done, the operator has to select the drying program on the HMI touch screen, which depends on the type of wood, its thickness and its initial and final moisture (see Section 14), and then the drying cycle can start
The DRYING CYCLE is composed from the phases below:

- PHASE 0: Preheating to the wood core
- PHASE 1-8: Drying
- PHASE 9: Cooling of the wood.

PREHEATING: During this phase, which can be done under partial vacuum, fans circulate the air through the heaters and the woodpile so that the wood is heated following an incremental ramp until the set temperature.
When the set temperature is achieved the pre-heating timer starts.
When the pre-heating time finishes the PLC passes to the drying phases.

DRYING: After the preheating phase, the vacuum pump withdraws air from the cell until the vacuum value set for the drying process is reached, while heating system (consisting of the fans and the electrical heaters) continues to supply the wood with thermal energy needed to reach

and maintain the required temperature: vacuum and temperature cause the evaporation of water from the wood.

The combination of vacuum and temperature greatly stimulates the flow of water from the centre to the surface of the wood such that the water, converted in steam, is withdrawn by the vacuum pump and evacuated to the outside of the drying cell.

During drying, the PLC performs all necessary changes in temperature and pressure inside the cell, depending on the wood moisture content measured by the humidity probes.

After the moisture content of the wood has reached the desired final value, the dryer passes to the cooling phase.

COOLING: During this phase, the supply of heat is inhibited, but the fans continue to rotate so as to even out the moisture of the various wood planks and to cool them.

At the same time, the dryer cooling fan circulates cold air inside the dryer wall to cool the inner wall of the cell and hence the wood contained within it.

When the temperature inside the cell reaches the value programmed into the PLC, the dryer switches off all components, waiting for the operator to open the door and unload the dry wood.

1.2.2 THERMOVACUUM FUNCTION.

The wood can be treated with the ThermoVacuum function only if his initial humidity is lower 12%.
After the loading of the wood pile onto the cart, connect the humidity probes (optional) and insert the woodcore temperature probe in a hole done in one of the tables: now the cart can be pushed into the dryer then the rail bridge can be removed and the door closed using the two small handwheels.

When this has been done, the operator has to set the most suitable THERMOVACUUM program on the HMI touch screen, taking into account the type of wood and its thickness and its initial moisture, and then the Thermovacuum cycle can start.
The Thermovacuum heat treatment is composed from the phases below:

- PREHEATING: Preheating to the wood core
- PHASE 1-3: THERMOVACUUM heat treatment
- STEAMING: Optional steaming of wood after the heat treatment
- COOLING: Cooling of the wood.

PREHEATING: During this phase, the vacuum pump suchs the air contained in the dryer until to achieve the vacuum set value and the fans circulate the hot air through the woodpile so that the wood is heated following an incremental ramp until to the set temperature.
When the set temeperature is achieved the pre-heating timer starts: at the end of this time the PLC passes to Phase 1 of ThermoVacuum

PHASE 1-3 THERMOVACUUM: After the preheating phase, the vacuum pump withdraws air from the cell until the target vacuum value for the drying process is reached, while heating system continues to supply the wood with thermal energy needed to reach and maintain the set temperature.

The combination of vacuum and temperature causes a thermochemical modification of the woody matter, while any residual vapour and/or gas sucked out by the vacuum pump is condensed and returned to liquid state by the effect of the condenser.

During the treatment, the PLC performs all necessary changes in temperature and pressure inside the cell, depending on the desired end result.

After the time indicated in the program, the system automatically switches to the steaming phase if set or directly to the cooling phase.

STEAMING: During this phase a preset quantity of steam for a preset time is put in the dryer for give to the wood more plasticity. After the quantity of set water is reached or the preset time has passed, the program passes to the cooling phase.

COOLING: During this phase, the supply of heat is inhibited, but the fans continue to rotate so as to cool all the wood. At the same time, the dryer cooling fan circulates cold air trhough the dual wall of the dryer so as to cool the inner wall of the cell and hence the air contained within it.

When the temperature of the dryer reaches the set value and the cooling phase time (300 min.), the PLC switches off all the components and the dryer can be opened and unloaded.

CHAPTER 2 **SAFETY.**

2.1 DEFINITIONS.

In order to indicate important information and risks, the following signal words and symbols are used in these operating instructions.

2.1.1 WARNING SIGN.

The warning sign is found in the safety warnings at the bottom left of the title field alongside the signal word (DANGER, WARNING, CAUTION).

Safety notices with this warning sign indicate a risk of physical injury. Respect safety notices in order to protect yourself against injuries that can be fatal!

Safety notices without this warning sign indicate a risk of material damage.

2.1.2 SIGNAL WORDS.

The following signal words are found in the title fields of safety notices:

- DANGER
- WARNING
- CAUTION
- ATTENTION
- NOTE

They follow a certain hierarchy and indicate (in relation to warning sign) the degree of danger and/or the nature of the alert.

See the explanations below:

DANGER

Risk of physical injury.
Indication of an imminent danger that will result in death or serious injury if proper precautions are not taken.

WARNING

Risk of physical injury.
Indication of a possible danger that will result in death or serious injury if proper precautions are not taken.

CAUTION

Risk of physical injury.
Indication of a possible danger that may result in minor or moderate injury if proper precautions are not taken.

CAUTION

Risk of material damage.
Indication of a possible danger that may result in material damage if proper precautions are not taken.

ATTENTION

Indication of a possible problem, i.e., some statuses or consequences may result if proper precautions are not taken.

NOTE

Indication of a possible benefit, if appropriate measures are taken – a tip.

2.2 GENERAL SAFETY MESSAGES.

WARNING

Improper use of the machine can result in serious injury or death!

The operating instructions:

- Must have been read and understood before performing any work with or on the machine.
- Must be respected.
- Must be available at the workplace.

WARNING

Improper use of the machine can result in serious injury or death!

Functioning of the machine:

- According to the use described in “Intended use” Section 3.
- According to the use described in “Technical Data”, Section 4

WARNING

Improper use of the machine can result in serious injury or death!

Only reliable and qualified personnel are authorized to work on and with the dryer (transport, installation, decommissioning, maintenance, waste treatment)!

WARNING

Work on the dryer can cause risks of injury by cutting, crushing and burning, among others!

- First, put on personal protective equipment (helmet and gloves, safety shoes).
- Then work on the system.

WARNING

Hair and clothes can be drawn into the machine or moving parts and may become caught or entangled!

- Do not wear large or loose clothing!
- If you have long, loose hair, wear a cap.

DANGER

Risk of electrocution!

Before starting work on the machine or installation, the following measures should be implemented:

- Turn power off at the switch.
- Set to the opening position.
- Turn power off at the regulator.
- Connect to earth and short circuit.
- Cover or cordon off adjacent live parts.

DANGER

Risk of electrocution!

Work on electrical installations should be done by qualified electricians!

DANGER

Risk of electrocution!

In case of intervention and/or inspections on the dryer and components, first switch the power off.
Then open the junction box of the equipment and/or motors.

WARNING

Risk of high pressure or partial vacuum!
Danger from escaping fluids (cold or hot water)!

Before starting work on the machine or installation:

- Disconnect the supply of industrial fluid.
- Bled pipes and devices (relieve pressure)

WARNING

Danger due to external fans of electric motors of the vacuum pump and water pump!
Operation of the devices only with the air deflector installed!

DANGER

Danger from loads that may fall or tip over!
When transporting with lifting equipment, consider the following basic rules:

- The operations of transporting, handling and installing equipment should be performed by personnel trained in the use of transport and lifting equipment (cranes, forklifts, etc.).
- The load capacity of lifting equipment and accessories must correspond to the weight of the material (see the mass/weight table)
- The machine must be secured so that it cannot fall or tip over.
- Do not stand under suspended loads!

WARNING

Tipping or falling objects can cause, among other things, wounds and fractures!
Sharp edges can cause cuts!

When transporting, first put on personal protective equipment (helmet and gloves, safety shoes).

CAUTION

Risk of freezing!

Install the dryer in an environment where the temperature is always higher than 5°C to prevent freezing damage the hydraulic heating circuit and/or vacuum pump.

DANGER

Inappropriate behavior may cause serious physical injury and material damage.

Before working on components and/or devices installed on the dryer (e.g., vacuum pump, fans, etc.), you must read and understand the manuals of devices and follow the instructions.

CHAPTER 3 **INTENDED USE.**

3.1 USE AND MAINTENANCE MANUAL.

The instructions in this manual:

- are valid for the THERMOVACUUM vacuum kiln
- contain information relating to transport, installation, commissioning, operation, servicing, maintenance and waste treatment for the machine;
- must have been read and understood before the operator and maintenance personnel perform any work in or with the dryer;
- must be respected;
- must be available at the place where the dryer is used.

3.2 OPERATING AND MAINTENANCE PERSONNEL.

The operating and maintenance personnel for the dryer must be trained and authorized to perform the work.

Only qualified electricians are allowed to perform work on electrical installations.

A qualified electrician is one who, due to professional training, knowledge and experience, as well as knowledge of the relevant specifications, is able to assess the tasks assigned and identify potential hazards.

3.3 INTENDED USE.

The THERMOVACUUM vacuum kiln**:**

- is used for the drying and/or heat treatment of solid wood in the form of planks or pre-cut parts
- is intended to be used with the following liquid: cold water for the vacuum tank filling.
- is intended for industrial installations
- is designed for continuous operation.

3.4 FORESEEABLE MISUSE

The following is prohibited:

- use of the dryer to dry materials other than wood
- use of the dryer in non-industrial facilities, in the event that appropriate precautions and/or safety measures have not been taken (for example: protection for children)
- making changes to the machine

The operator is only authorized to perform maintenance and repair as described in this instruction manual.

Maintenance and repair work beyond the scope of this manual may only be performed by companies authorized by the manufacturer (contact the after-sales service).

CHAPTER 4 **TRANSPORT.**

4.1 GENERAL INFORMATION ON DANGERS AND WARNINGS.

WARNING

Improper use of the machine can result in serious injury or death!

Have you read the safety instructions in Section 2, Security?

If not, you are not permitted to work with or on the machine.

WARNING

Improper use of the machine can result in serious injury or death!

Only reliable and qualified personnel are authorized to work on and with the dryer (transport, installation, decommissioning, maintenance, waste treatment)!

DANGER

Danger from loads that may fall or tip over!
When transporting with lifting equipment, consider the following basic rules:

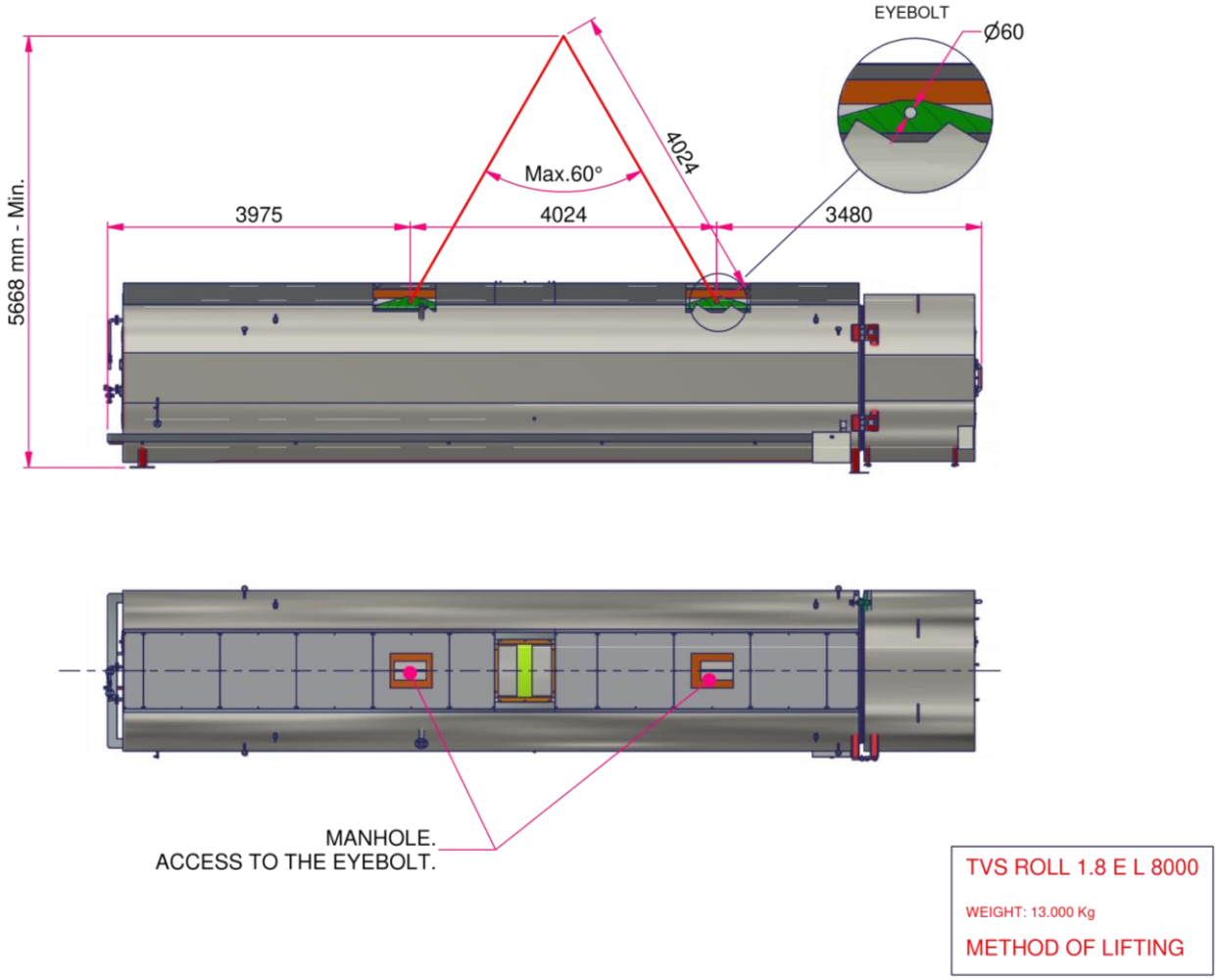
- The operations of transporting, handling and installing equipment should be performed by personnel trained in the use of transport and lifting equipment (cranes, forklifts, etc.).
- The load capacity of lifting equipment and accessories must correspond to the weight of the material (see the mass/weight table)
- The machine must be secured so that it cannot fall or tip over.
- Do not stand under suspended loads!

WARNING

Tipping or falling objects can cause, among other things, wounds and fractures!
Sharp edges can cause cuts!

When transporting, first put on personal protective equipment (helmet and gloves, safety shoes).

4.2 TRANSPORT AND LIFTING.



DANGER

Danger from loads that may fall or tip over!

When transporting with lifting equipment, consider the following basic rules:

- The operations of transporting, handling and installing equipment should be performed by personnel trained in the use of transport and lifting equipment (cranes, forklifts, etc.).
- The load capacity of lifting equipment and accessories must correspond to the weight of the material (see the mass/weight table)
- The machine must be secured so that it cannot fall or tip over.
- Do not stand under suspended loads!

When lifting the material, use the two securing points.

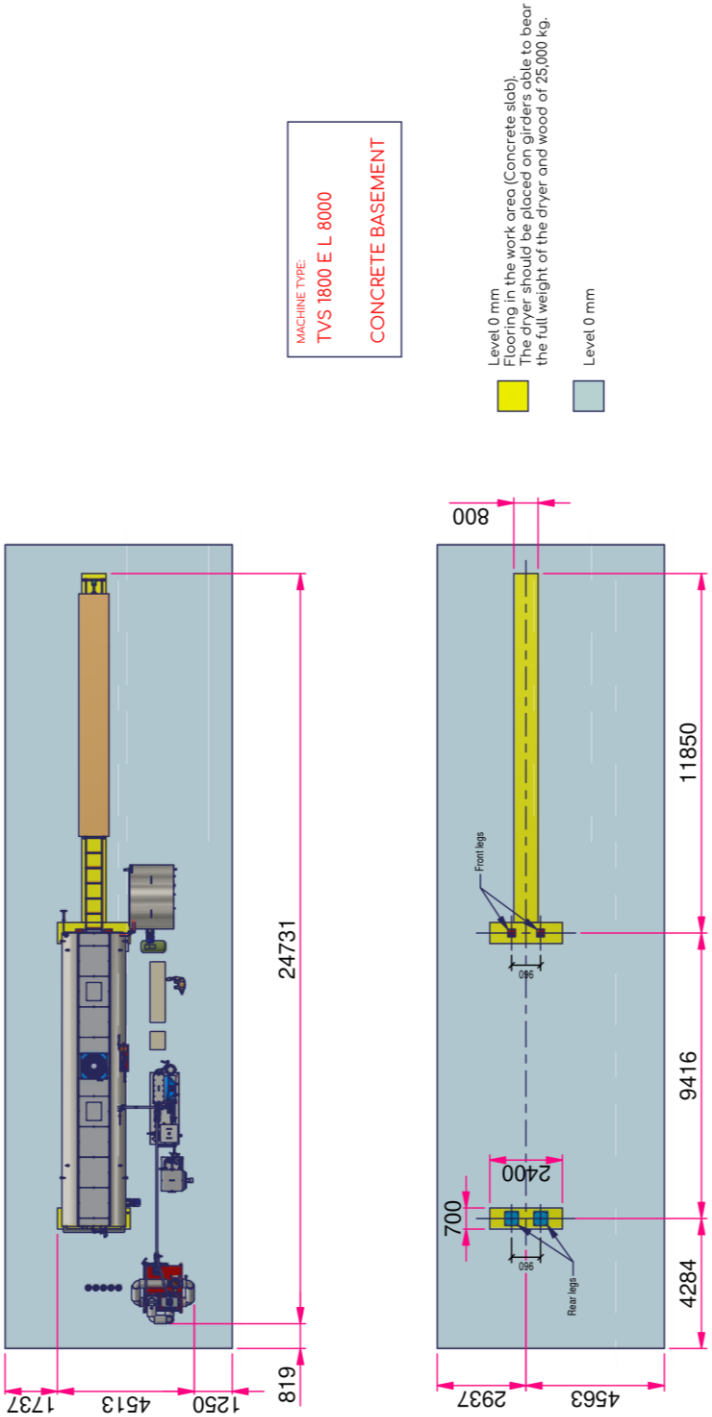
Make sure that the load capacity of the lifting equipment and accessories correspond to the weight of the material.

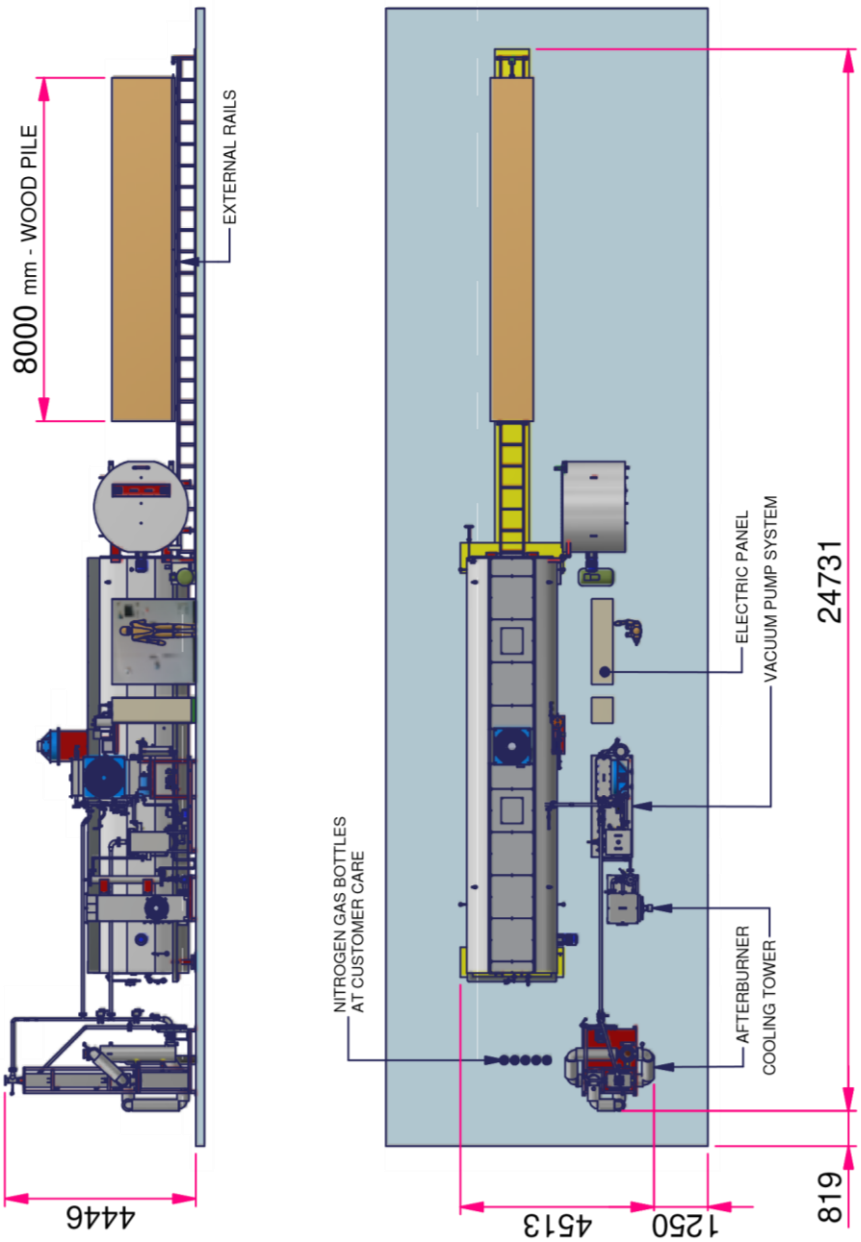
CHAPTER 5 **INSTALLATION.**

5.1 POSITIONING.

The dryer and its accessories must be positioned according to the diagrams below.

As provided in the communications prior to delivery of the material, the dryer should be placed on girders able to bear the full weight of the dryer and wood of 25.000 kg.




8000 mm - WOOD PILE
EXTERNAL RAILS
4446
NITROGEN GAS BOTTLES
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VACUUM PUMP SYSTEM
AFTERBURNER
COOLING TOWER
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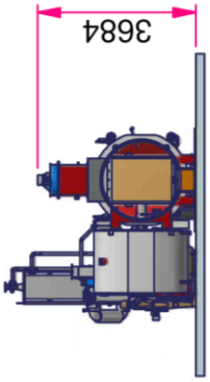
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WARNING

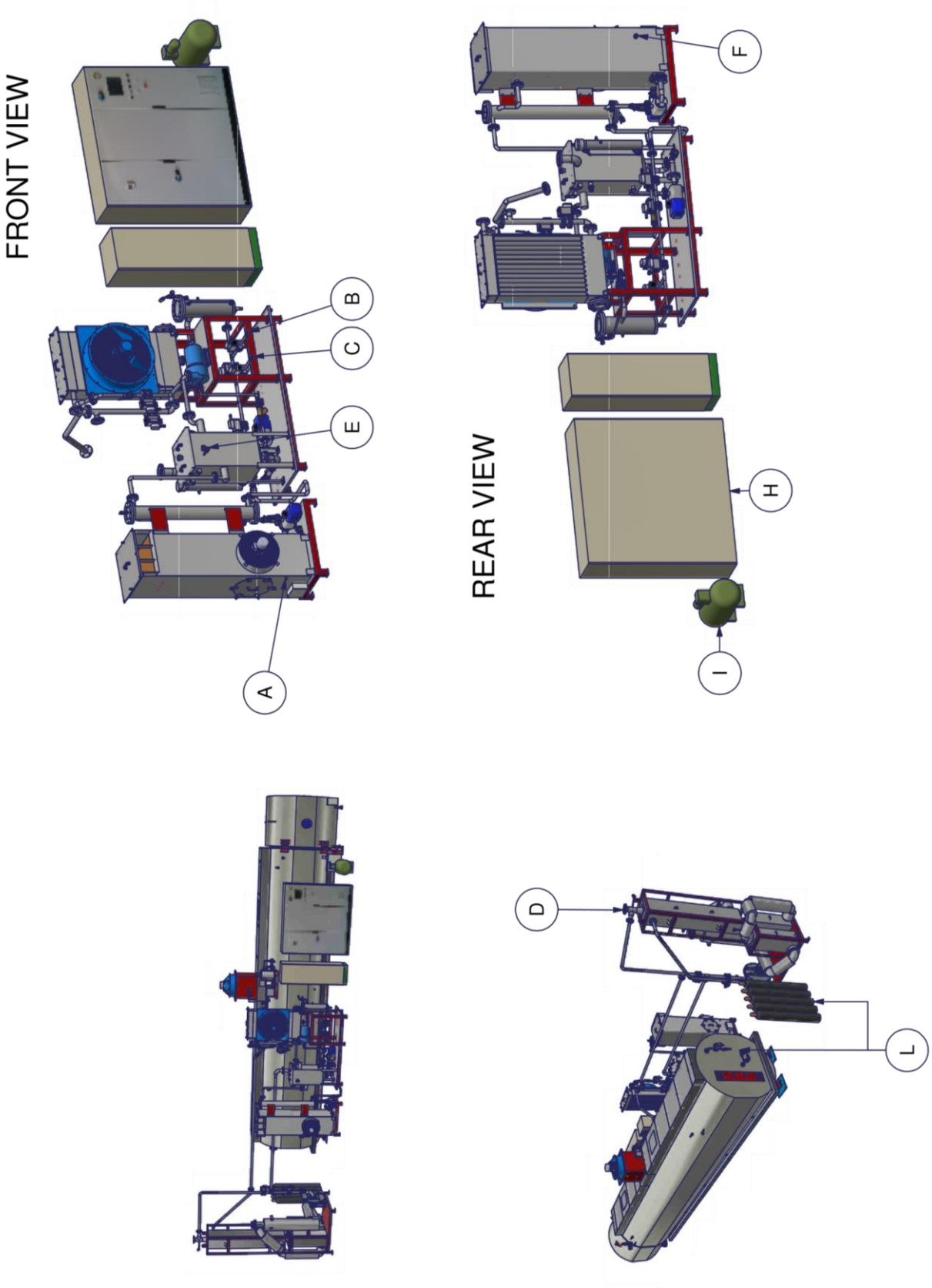
Improper use of the machine can result in serious injury or death!

Have you read the safety instructions in Section 2, Security?
If not, you are not permitted to work with or on the machine.

DANGER

Risk of electrocution!
Work on electrical installations should be done by qualified electricians!

5.2 HYDRAULIC AND ELECTRICAL CONNECTIONS



	English
A	1/2" WATER INPUT from general net (Female) Minimum pressure 1 bar (14.5 psi) - maximum 3 bar (43.5 psi) Minimum water flow 10 l/min. (2.27 gal/min)
B	1" barb - hose FOR THE RECOVERY OF AQUEOUS LIQUID WASTES EWC Code 16 10 02
C	1" barb - hose FOR THE RECOVERY OF AQUEOUS LIQUID WASTES EWC Code 16 10 02
D	4" OUTPUT FOR GAS EXHAUSTING PURPOUSE TO CONNECT WITH OUTSIDE BUILDING CHIMNEY
E	1/2" WATER IN (Female) Minimum pressure 1 bar (14.5 psi) - Max pressure 3 bar (43.5 psi) Minimum water flow 10 l / min. (2.27 gal/min)
F	1" 1/2 OVERFLOW PIPE TO CONNECT WITH DRAIN (Male)
G	ELECTRONIC STEAM GENERATOR WATER INPUT FROM GENERAL NET 1/2" barb - hose
H	Electric panel: Connection 1: single-phase 110v-60Hz-3Kw Connection 2: three-phase+PE 480V-60Hz-115Kw Internet connection: 30 megabits/sec. in download, 3 megabits/sec. in upload. SIM card for safeties. Pneumatic system: Rilsan pipe cable gland for pipe Ø est. 10 mm (0.393 in) Pressure min. 7bar (101.5 psi) - max 10bar (145 psi)/60°C (140°F)
I	Compressor min. 50 liters (11.35 gal) Airflow min. 200 l/min (44 gal/min) Supply and installation by customer.
L	CONNECTION TO NITROGEN GAS BOTTLES PIPE ¾" male Maximum pressure: 1,5 Bar (21.75 psi)

5.2.1 NOISE LEVEL.

The noise level of the machine is equal to the sum of the individual components:

a) Vacuum pump:
the sound pressure level at the measurement surface for 1 mL [dB(A)] = 70 dB

b) Condenser fan = 36 dB

c) Cell-cooling fan = 74 dB

5.2.2 ELECTRICAL DATA.

WARNING

Risk of pollution.
Depending on the type of wood to be dried, the condensates may contain chemicals that must be treated before being sent to industrial drains: check with the competent authorities.

WARNING

Improper use of the machine can result in serious injury or death!

Have you read the safety instructions in Section 2, Security?
If not, you are not permitted to work with or on the machine.

DANGER

Risk of electrocution!

The electrical connection of the dryer to the utility network should be performed only by qualified electricians!

DANGER

Risk of electrocution!

Work on electrical installations should be done by qualified electricians!

DANGER

Risk of electrocution!

Before starting the machine, the dryer must be earthed by a connection made in accordance with safety standards.

CAUTION

Incorrect connection of the dryer can cause serious damage to the machine.

DANGER

Risk of electrocution!

Before starting work on the machine or installation, the following measures should be implemented:

- Turn power off at the switch.
- Set to the opening position.
- Turn power off at the regulator.
- Connect to earth and short circuit.
- Cover or cordon off adjacent live parts.

The electrical connection of the dryer to the utility network should be performed only by qualified electricians, taking the electrical data of the dryer into account.

The electricians must be able to connect the main switch of the dryer's electrical cabinet to the utility network using appropriately sized cables in accordance with the following figures:

5.3 INTERNET CONNECTION FOR REMOTE CONTROL.

5.3.1 GENERAL INFORMATION OF THE CONTROL SYSTEM

The full-automatic control of the machine is composed by the following elements:

A. a PLC module, in which drying and thermal-treatment schedules are stored.

B. a touch-screen, which allows the operator to communicate with the control panel, to monitor temperatures, pressure and other parameters, to see drying diagrams and to edit and save, when necessary, new programs.

C. electronic components to connect the equipment to the INTERNET, to enable remote control by the operator and by WDE Maspell engineers.

5.3.2 GUARANTEE AND INTERNET CONNECTION FOR REMOTE CONTROL

The remote control is a fundamental and necessary part of the TVS, and the customer must provide a good and safe connection to the INTERNET.
A good and safe connection to the INTERNET allows WDE MASPELL engineers to provide remote assistance (free of charge during the warranty period of validity) by monitoring, analysing and possibly solving inconveniences and/or malfunctioning, as well as by assisting the operator during his work.
Moreover, the operator can monitor and control the TVS from any distance via PC, tablet and/or smart-phone.

WARNING:
INTERNET AND GUARANTEE.

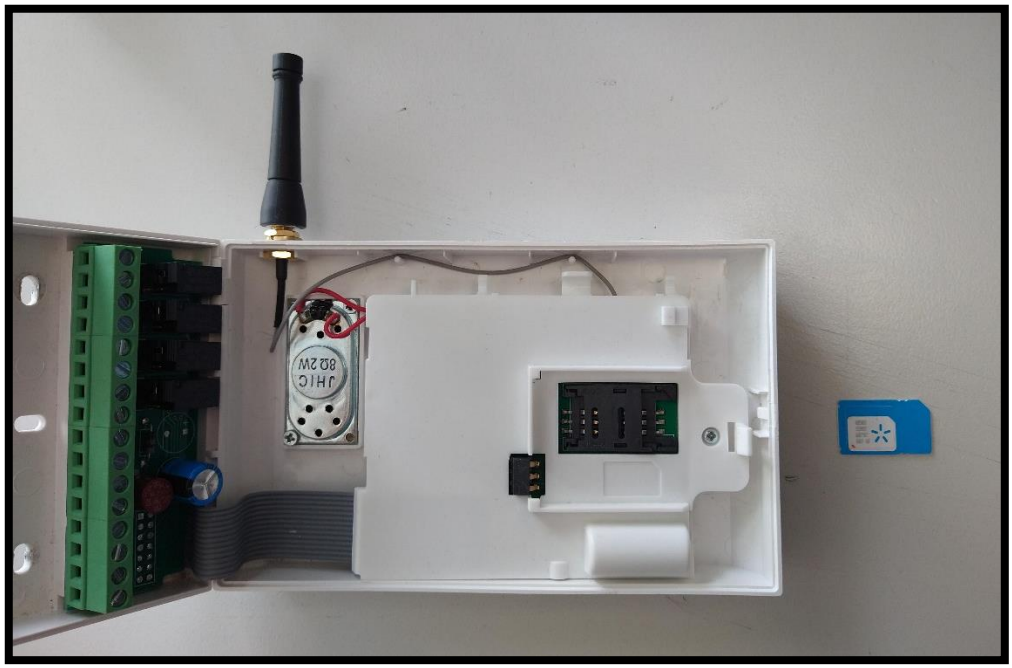
User's interest is that the equipment is constantly and permanently connected to the network INTERNET.

In any case, the manufacturer's warranty expires if the customer, for any reason, fails to provide the machine with the connection to INTERNET.

5.3.3 GSM SIM-CARD FOR ALARM CALL DIALER

The system is equipped with a call-dialler that immediately informs the persons on duty about an alarm.
The call dialler has to be provided at customer charge with a phone GSM sim-card.

The GSM sim-card has to be without pin-code and must have credit to call.



The image's indicative.

5.4 INSTRUCTIONS FOR NITROGEN CONNECTION

For safety reasons, in order to avoid combustion of the wood, the TVS cell must be connected to a reserve of nitrogen as the table below. The reserve of nitrogen consist in a set of bottles at a nominal pressure of 200 Bar (2900 psi).

SIZING OF NITROGEN VOLUME TVS

CELL DIMENTIONS		
Inside diameter	mm	1800
Body usefull lenght	mm	8000
door and back lenght	mm	1250
INSIDE VOLUME OF THE CELL	m3	26,72
WOOD STACK SIZE		
Wood stack heigh	mm	1400
Wood stack width	mm	1000
Wood stack lenght	mm	8000
Wood thickness	mm	25
steakers thickness	mm	8
GROSS WOOD STACK VOLUME	m3	11,20
NET WOOD STACK VOLUME	m3	8,48
NET FREE VOLUME OF THE CELL	m3	18,23
NITROGEN GAS PRESSURE	Bar	200
NITROGEN MINIMUM VOLUME	litri	91,17
SAFETY	*25%*	*22,79*
MINIMUM VOLUME OF GAS BOTTLES		
	Litres	114

Therefore, user should connect the Thermo Vacuum system with an adequate number of bottles of nitrogen, ensuring at least the liters indicated by red arrow, corresponding to **114 LITERS.**

5.4.1 WARNINGS SUMMARY

1) The choice, the supply and the installation of the adequate components have to be executed by specialized and qualified technical personnel, according to the rules locally in force.

2) The system must be provided with a gas bottle package having a total minimum capacity of 114 liters (30 gal), at a 200 Bar (2900 psi) pressure.

3) The connection between the nitrogen bottles and the machine must be done with an adequate pressure reducer system:
   a. The maximum gas pressure at the connection point of the machine must be 1.5 Bar (21.75 psi).
   b. Quantity of flow of nitrogen through the reducer = 46 m^3/h (60 yd^3/h)

4) A special attention to the pipe's size is warmly recommended, in order to ensure the required gas flow rate.

5.4.2 EXAMPLE OF CONNECTION BETWEEN NITROGEN BOTTLES.

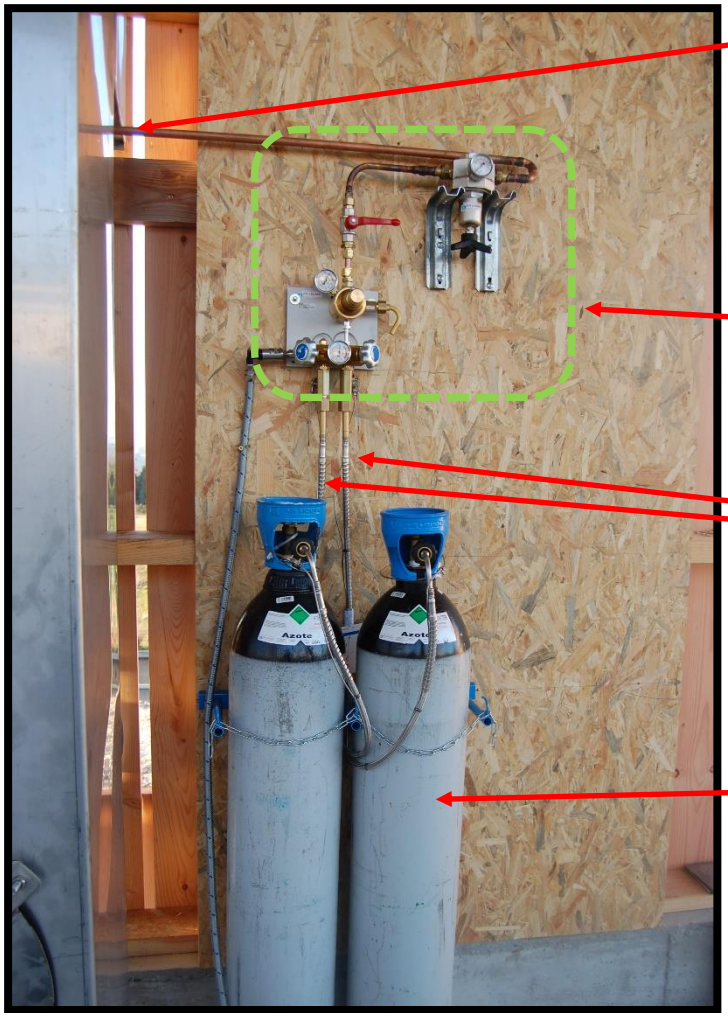
The nitrogen bottles cannot be connected directly to the equipment, instead it must be connected by a manifold able to resist the pressure of 200 Bar.

The complete pressure reduction station must be equipped with two special pressure reducers, able to reduce the nitrogen pressure from 200 bar to 1.5 bar, that is the maximum working input pressure of the TVS.

A specialized company must take care of the connections.

Enclosed, two pictures showing what is described above.

Please note that the manifold is equipped with a pressure transducer for the check of the nitrogen pressure by the PLC.



Connection pipe between reduction station and TVS nitrogen input (supply and installation by customer).

Nitrogen pressure reduction station (supply and installation by customer).

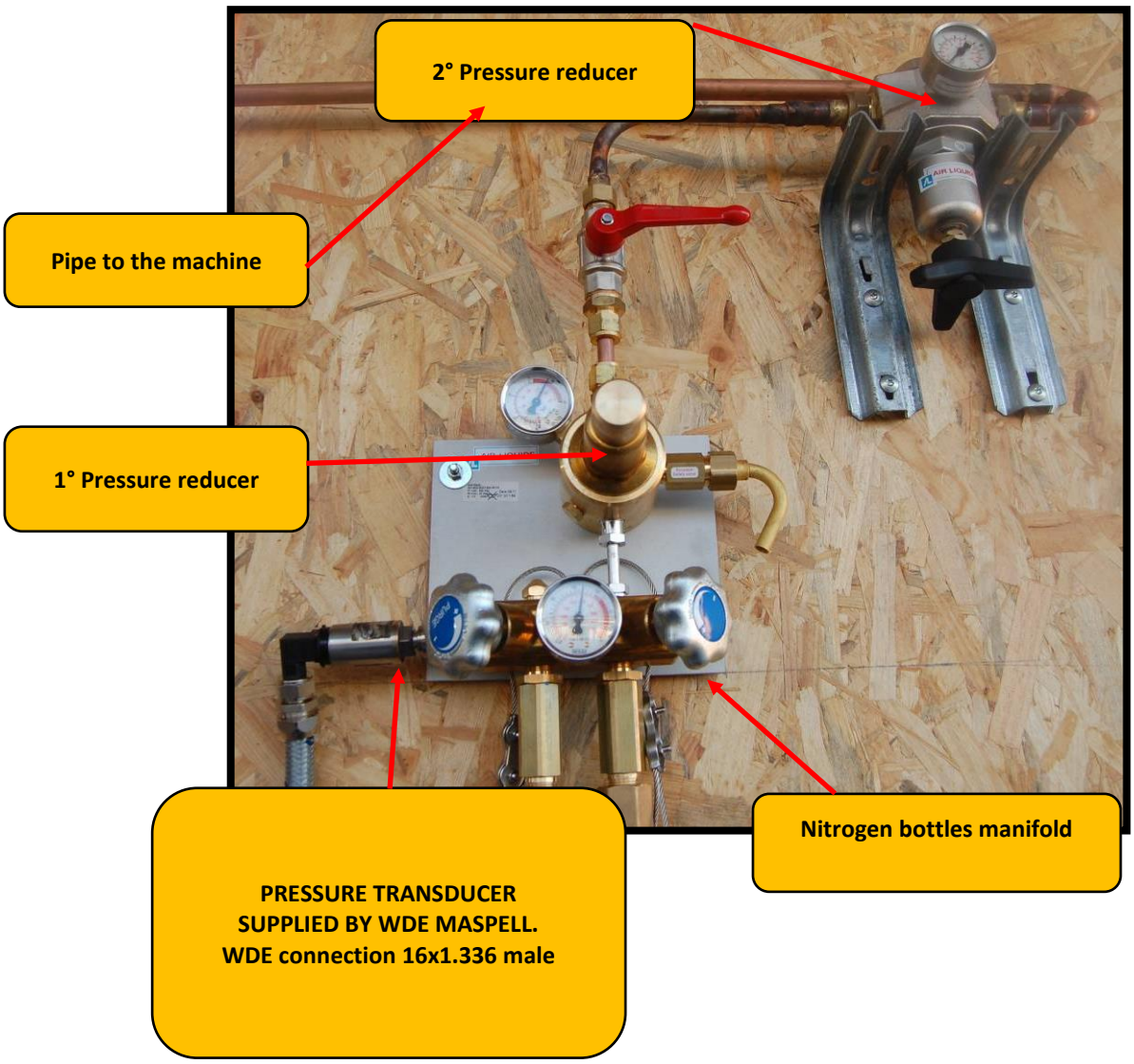
Connection pipes between nitrogen bottles and reduction station (supply and installation by customer).

Nitrogen bottles (supply and installation by customer).

WARNING

At customer's care and responsibility, in compliance with the local laws:

- Nitrogen bottles.
- Connection pipes between nitrogen bottles and pressure reducer.
- Connection pipes between reducer output and TVS input.



CHAPTER 6 **COMMISSIONING.**

6.1 PRELIMINARY CHECKS AND TESTS.

The first drying should be considered as a test to verify that all parts of the equipment are working properly.

This initial commissioning must only be carried out by a WDE technician.

For this reason, we suggest that the dryer be loaded with predried wood of a fine thickness (e.g., 27 mm) to minimize the risk of damaging the wood.

WARNING

Improper use of the machine can result in serious injury or death!

Have you read the safety instructions in Section 2, Security?
If not, you are not permitted to work with or on the machine.

WARNING

Improper use of the machine can result in serious injury or death!

These instructions:

- Must have been read and understood before performing any work with or on the machine.
- Must be respected.
- Must be available at the workplace.

DANGER

Inappropriate behavior may cause serious physical injury and material damage.

Before working on components and/or devices installed on the dryer (e.g., vacuum pump, fans, etc.), you must read and understand the manuals of devices and follow the instructions.

DANGER

Risk of electrocution!

Before starting the machine, the dryer must be earthed by a connection made in accordance with safety standards.

WARNING

Work on the dryer can cause a risk of injury by cutting, crushing and burning, among others!

- First, put on personal protective equipment (helmet and gloves, safety shoes).
- Then work on the system.

CHAPTER 7 **WOOD LOADING SYSTEM AND PRACTICAL ADVICE**

7.1 WOOD FAMILIES

The different species of wood can be divided into three families:

- **FAMILY A:** very hard wood, requiring drying PROGRAMS 12, 13, 14, 22, 23, 24, 32, 33, 34 (Section 12.1)

- **FAMILY B:** hardwood, requiring drying PROGRAMS 15, 16, 17, 25, 26, 27, 35, 36, 37 (Section 12.1)

- **FAMILY C:** softwood, requiring drying PROGRAMS 18, 19, 20, 28, 29, 30, 38, 39, 40 (Section 12.1)

Each of these 3 families of wood has drying limits with regard to the thickness and initial moisture, according to the table below.

CAUTION

Risk of damage to the wood.

For each family and each thickness of wood there is a corresponding maximum initial moisture content above which it is inadvisable to subject the wood to the drying treatment according to Tab

See section for information concerning the Drying Programs.

	THICKNESS OF THE WOOD	MAX. INITIAL MOISTURE CONTENT
FAMILY A:	20–30 mm	32–35%
	30–50 mm	30–32%
	>50 mm	25–30%
FAMILY B:	20–40 mm	40–50%
	40–60 mm	35–40%
	>60 mm	30–35%
FAMILY C:	20–60 mm	green

>60 mm	50–60%

7.2 UNIFORMITY OF THE WOOD LOAD

To avoid differences in final moisture content of the wood and/or other defects, you must load the dryer with homogeneous wood, i.e., of the same type, the same thickness and the same initial moisture content.

7.3 STACKING AND STORING WOOD

The quality and speed of drying depend mainly on compliance with the rules for good stacking, i.e.:

a. thickness of the sticks
b. spacing of the sticks
c. alignment of the sticks

For this reason, we recommend the user to observe the following rules:

a) Thickness of the sticks:

THICKNESS OF THE WOOD	THICKNESS OF THE STICKS
18–40 mm	20 mm
40–60 mm	20–25 mm
60–90 mm	25–30 mm
>90 mm	30–40 mm

b) The spacing of the sticks depends on the thickness of the wood:

18–30 mm	=>	50 cm
30–50 mm	=>	70 cm
50–80 mm	=>	100 cm
>80 mm	=>	120 cm

c) To avoid deformations of the wood, the sticks must be vertically aligned.

d) To avoid cracking at the bottom of the planks, the stick must be placed starting at the start of the stack of wood.

7.4 LOADING THE STACKS OF WOOD INTO THE DRYING CHAMBER.

The piles of wood must be placed in the chamber so as to avoid empty spaces where air and/or gas can easily pass without being forced through the piles of wood.
The maximum width of the wooden piles will be 1200 mm.

If, in the nominal volume, space remains without wood, it should be filled up with other waste wood.This is of fundamental importance to achieve adequate drying, to prevent temperature differences between the wooden planks during thermal treatment and, finally, for cooling all of the wood, even in the centre of the stack, at the end of cycle to avoid a wood fire when the cell door is opened.

NOTE: **The stacks are well loaded!**

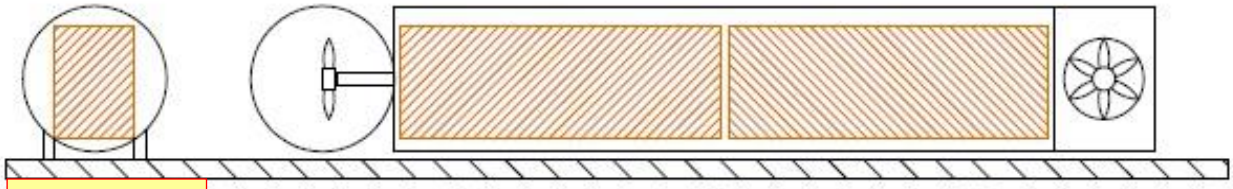


Fig. A

ATTENTION: You need to fill the voids with other woods

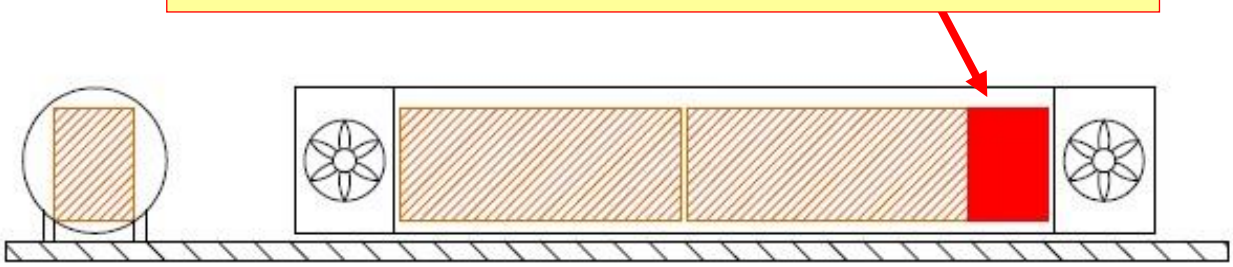


Fig. B

ATTENTION: You need to fill the voids with other woods

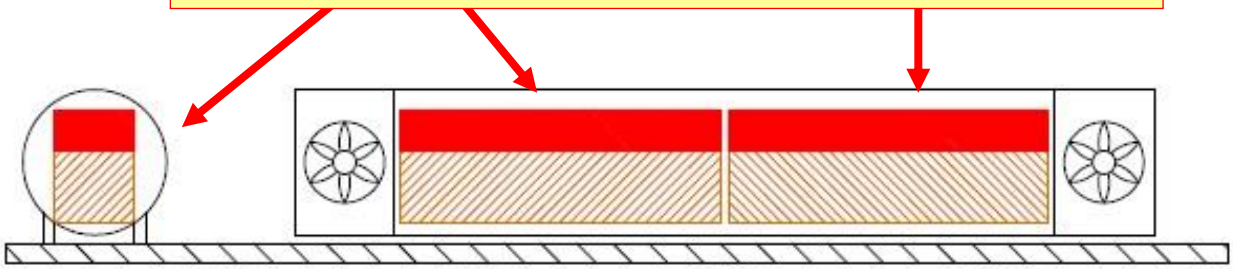


Fig. C

ATTENTION: You need to fill the voids with other woods

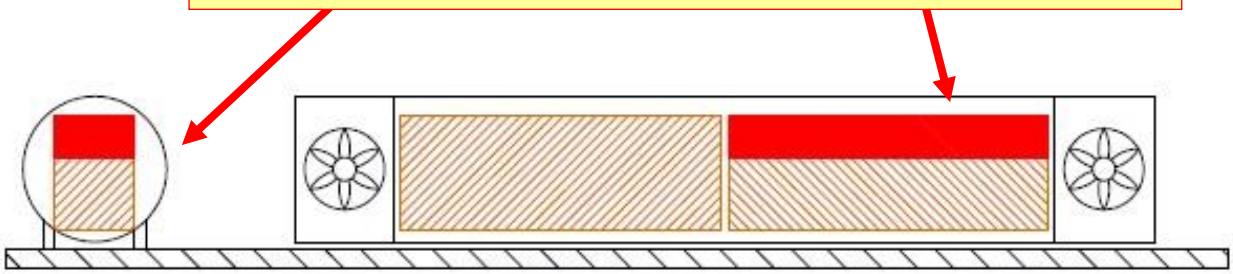


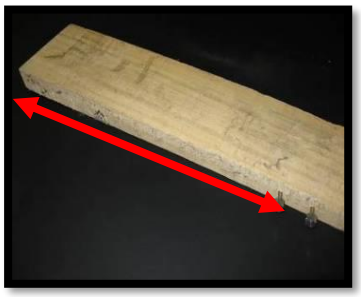
Fig. D

7.5 POSITIONING OF THE MOISTURE SENSORS.

The 3 moisture sensors (each consisting of two nails) must be placed in the middle of a stack of wood in 3 different boards chosen as indicators of drying because they are the dampest and most difficult to dry.

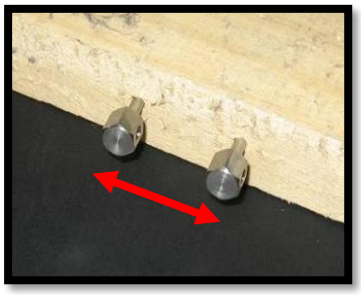
The nails must be positioned on the **side edges** of the boards in 4-mm-diameter holes with a gap of 40 mm between the two nails.

The minimum distance between the sensors and the ends of the boards is 40 centimetres.



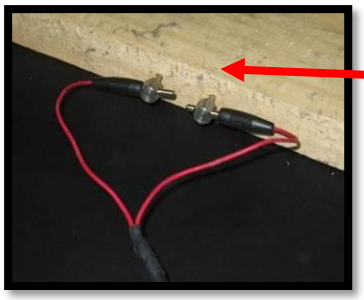
ATTENTION

The minimum distance between the sensors and the ends of the boards is 40 centimeters.



ATTENTION

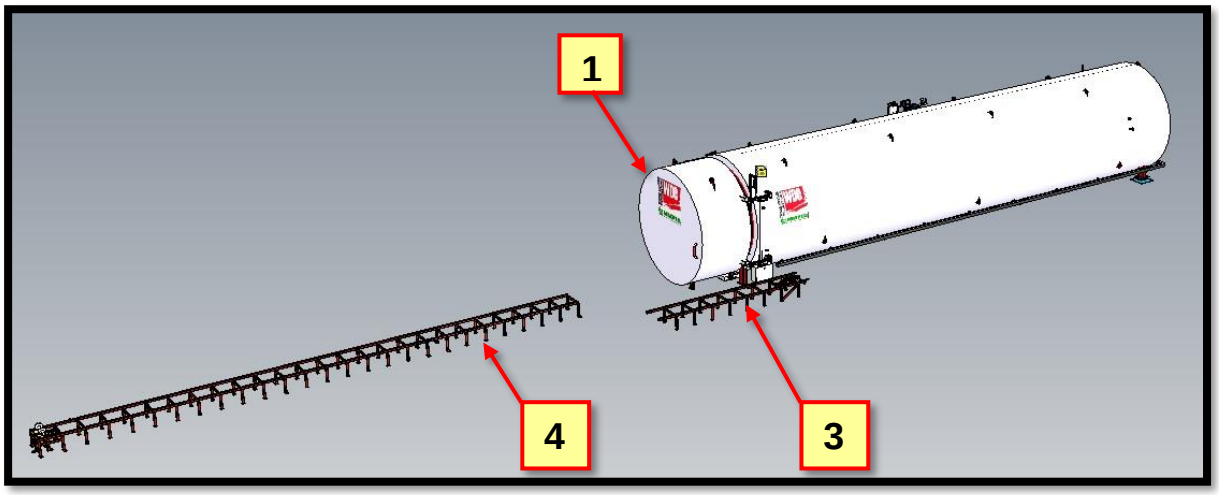
- The gap between the nails is 40 mm.
- The diameter of the holes is 4 mm.
- Position the axes of the mounting holes of the banana jacks horizontally to avoid interference with the wood.



ATTENTION

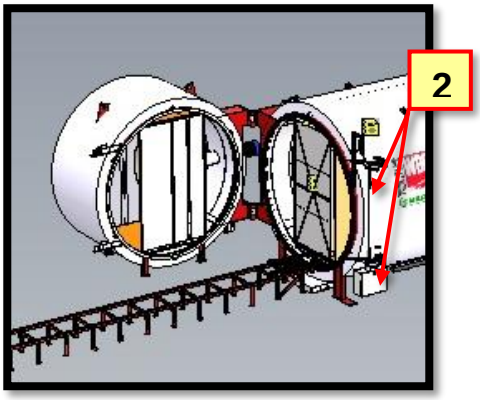
Position the banana jacks with the axes horizontal.
The positioning of the electrical cables of the moisture sensors must be done carefully to avoid faults and/or cuts.

7.6 SEQUENCE OF OPERATIONS FOR A DRYING CYCLE OR THERMOVACUUM CYCLE.



1. Open the door (1) of the THERMOVACUUM after unscrewing the two linear actuators or manual openings (2) that lock the door.

2. Disconnect the humidity probes from the connection board positioned at the entrance of the dryer and extract the wood-core temperature probe from the test table.



3. Place the rail-bridge (3) between the dryer and the external rails (4).

4. Remove with the pulley (6) the wood-loading car (5) from the dryer.

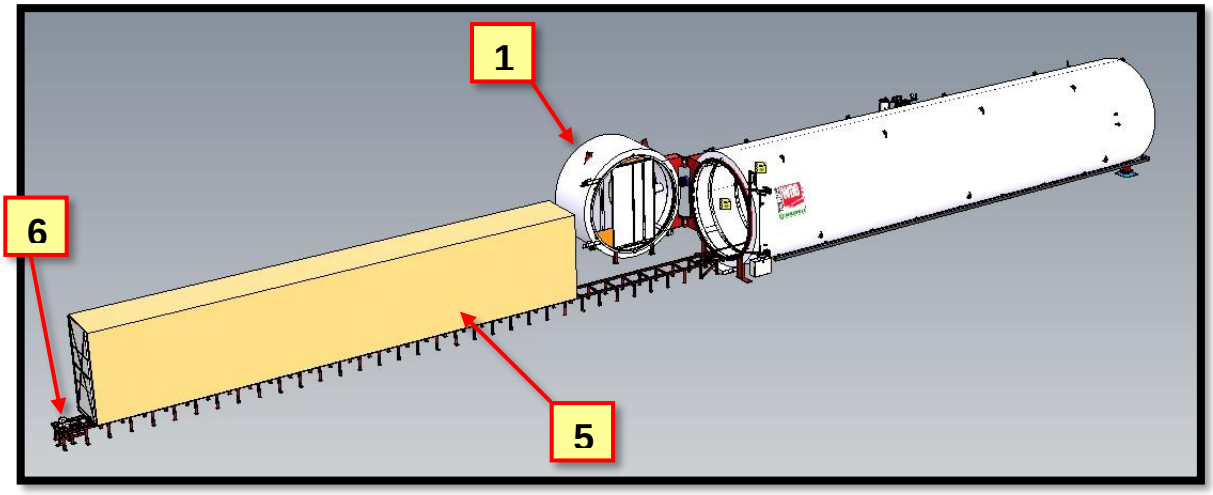
5. Load the pile of wood to dry onto the car.

6. Carefully read and use the “PRACTICAL ADVICE FOR DRYING”.

7. The wood should be stacked according to the rules for good stacking, i.e.:

   - thickness of the sticks
   - spacing of the sticks
   - alignment of the sticks

8. The quality and speed of drying depend mainly on compliance with these conditions. For this reason, users are advised to follow the rules for good stacking.



9. Thickness of the sticks:

DRYING CYCLE	
THICKNESS OF THE WOOD	THICKNESS OF THE STICKS
18–40 mm	20 mm
40–60 mm	20–25 mm
60–90 mm	25–30 mm
>90 mm	30–40 mm

THERMOVACUUM CYCLE	
THICKNESS OF THE WOOD	THICKNESS OF THE STICKS
18–40 mm	20 mm
40–60 mm	20–25 mm
60–90 mm	25–30 mm
>90 mm	30–40 mm

10. The spacing of the sticks depends on the thickness of the wood:

DRYING CYCLE	
THICKNESS OF THE WOOD	SPACING OF THE STICKS
18–30 mm	50 cm
30–50 mm	70 cm
50–80 mm	100 cm
>80 mm	120 cm

THERMOVACUUM CYCLE	
THICKNESS OF THE WOOD	SPACING OF THE STICKS
18–30 mm	25 cm
30–50 mm	50 cm

50–80 mm	70 cm
>80 mm	100 cm

11. To avoid deformations of the wood, the sticks must be vertically aligned.

12. To avoid cracking at the bottom of the planks, the stick must be placed starting from the heads of the stack of wood.

13. To avoid staining the wood, the sticks must be of a white wood.

14. Check that the type, thickness and initial moisture content of the wood to be dried complies with the values in SPECIES CLASSIFICATION AND DRYING PROGRAMS

15. Do not forget to place the humidity probes inside the wood.

16. Push the cars (5) into the dryer. Remove the rail-bridge (3) and close the door (1).

17. Select the treatment program on the PLC touch screen according to the type and thickness of the loaded wood and the desired final characterization.

18. The selectors VACUUM PUMP and DRYER HEATING on the front panel of the electrical cabinet must be switched ON.

19. The drying process consists of three phases:

• PREHEATING
• THERMAL TREATMENT OF WOOD (Phases 1/2/3)
• VAPORIZATION (OPTIONAL)
• WOOD COOLING

The PLC system provides (after entering all the data) to automatically run the heat treatment cycle.

20. Preheating is made up of two periods:
    • The first period of temperature rise, according to a slope chosen by the operator;
    • The second period of heart heating, according to the time decided by the operator (normally 1 hour for each cm of wood thickness).

21. During the following treatment phases (from PH1 to PH3) the PLC system provides to control the vacuum pump to wait for the PROGRAMd vacuum value and the heating so as to keep the set temperature. The PLC system provides, according to the durations of the different phases stored in the program, to change the pressure and temperature value in the cell.

22. At the end of phase 3, the automatic system switches to the vaporization phase if it is defined or directly to final cooling.

23. During this vaporization phase, the drying temperature is lowered by cooling to a temperature for steam. Then, this temperature is maintained for 30 minutes to allow the stack of wood to reach a uniform temperature in all parts. After this phase, the quantity of water vapor is put in the dryer allows to give a greater plasticity of the wood. When the whole quantity of steam has been put in the dryer or the game time has been reached steaming, the machine goes to the final cooling stage.

24. During the cooling phase, the drying heating is stopped, while the fans of the cell and the dryers of the cooling fan of the double wall continue to rotate and the vacuum is maintained at the same value as in the previous phase.

25. If the cooling phase begins after the vapor phase, it stops after reaching the cooling set temperature.

26. After the final cooling period, the dryer stops and the door can be opened to take the carts out with the dry wood.

27. Now the door can be opened to remove the carts with the treated wood.

28. Corrections on successive cycles will be made according to the first results and this up to the optimal cycle (depending on the species, local heating and baguettes conditions).

DANGER

Danger of nitrogen breathing and / or damage to wood.

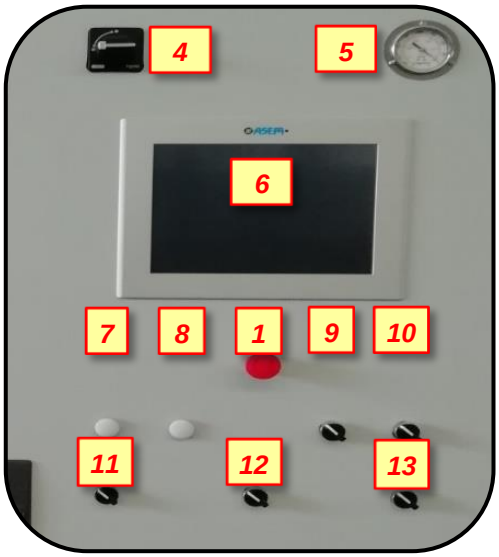
The pneumatic vacuum breaker valve is opened automatically by the PLC only when the temperature inside the cell reaches the Program level and / or, in the event of a major alert, after the injection of nitrogen to inert the cell.
To avoid damaging the wood and / or breathing nitrogen, it is absolutely forbidden to force the opening of the vacuum breaker valve if it is closed.

CHAPTER 8 **FUNCTIONING OF THE PLC.**

8.1 STARTING THE ELECTRICAL CABINET

After verifying that:
• The closing doors of the electrical cabinet and the UPS are correctly closed;
• The general switch dedicated to supplying the electrical cabinet is in the “ON” position;
• there are no disconnected plug and play cables or plugs;
The operator can close the main switch (3) to supply power to the “power” part of the electrical cabinet, then the operator can close the UPS power switch (4) and therefore also in the orders section.
Now the electrical cabinet, power and controls part, is supplied and the PLC switched on, so after having checked that:
• The emergency stop button (1) is in the working position;
• The 400 V-AC power supply light (7) is on;
• The 24 V-DC power supply lamp (8) is on;
• The vacuum pump selector (7) is in the “ON” position
• The heating selector (8) is in the “ON” position
• The three manual operation selectors (11) (12) (13) are in the “OFF” position
The operator can proceed with the use of the PLC control system according to the following indications.

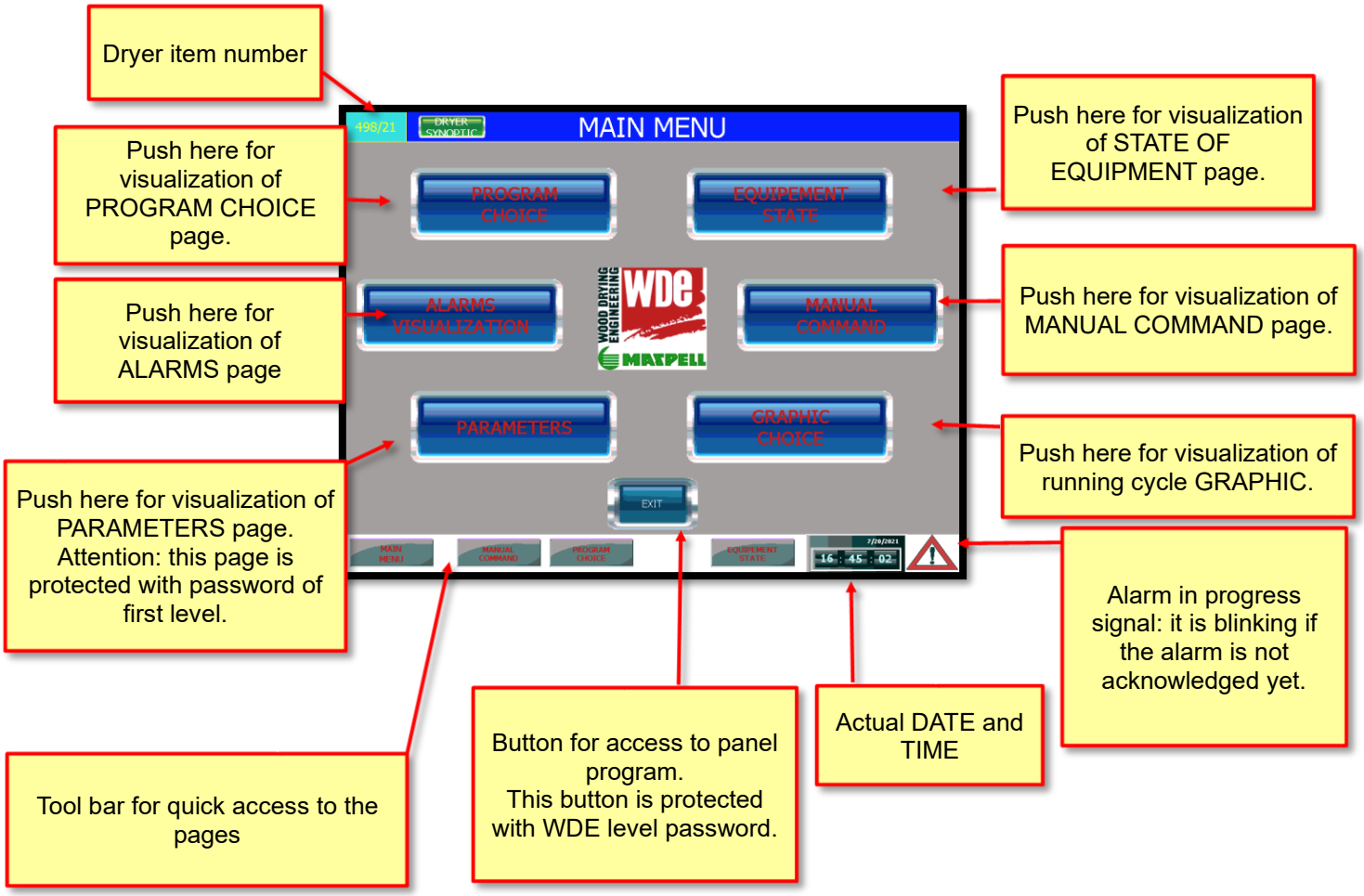
1. BOUTON D’ARRET D’URGENCE
2. ALARM
3. INTERRUPTEUR GENERALE
4. INTERRUPTEUR ALIM. DA L’UPS
5. VACUOMETRE
6. SYSTEME DE CONTROLE PLC – PANNEAU TACTILE
7. 400V-AC ON
8. 24V-DC ON
9. POMPE VIDE OFF-ON
10. CHAUFFAGE OFF-ON
11. VIDE AUT-MAN
12. TOUR REFROID. AUT-MAN
13. REFR. SECHOIR AUT-MAN



8.2 START-UP: PLC CONTROL AND MAIN MENU.

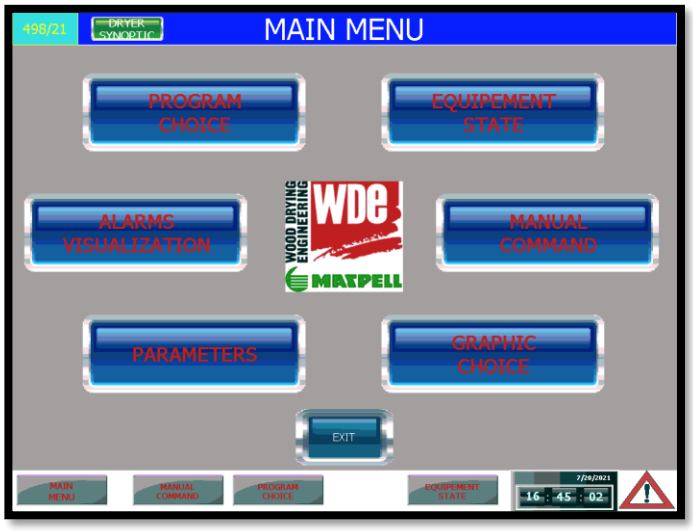
When the electrical cabinet starts up, the PLC touch screen displays shows the following page: MAIN MENU page:

The MAIN MENU page allows to enter in the press control pages.

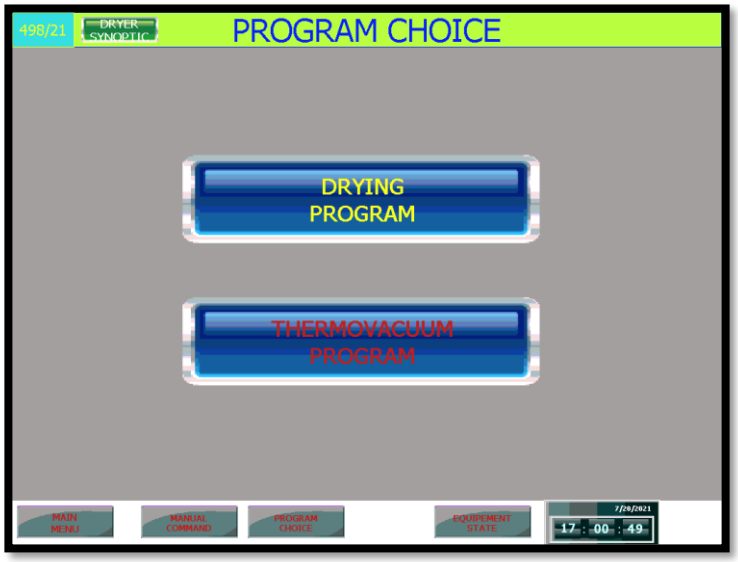


8.3 CHOICE OF DRYING OR THERMOVACUUM PROGRAM..

Choose the type of cycle, pressing the “PROGRAM CHOICE” button in the MAIN MENU.



The PROGRAM SELECTION page appears: press the DRYING PROGRAM button for the wood drying or on the HEAT TREATMENT PROGRAM button for the for high temperature wood heat treatment.



8.4 STARTING A DRYING CYCLE

DRYING: CHOICE OF PROCESS AND STARTING A DRYING PROGRAM

The DRYING cycle is made up of:

PREHEATING
DRYING
COOLING

The **PREHEATING** phase consists of two sub-phases:

Sub-phase A: progressive heating according to a predetermined temperature gradient up to until it reaches the setpoint temperature set in the PH1 drying sub-phase.

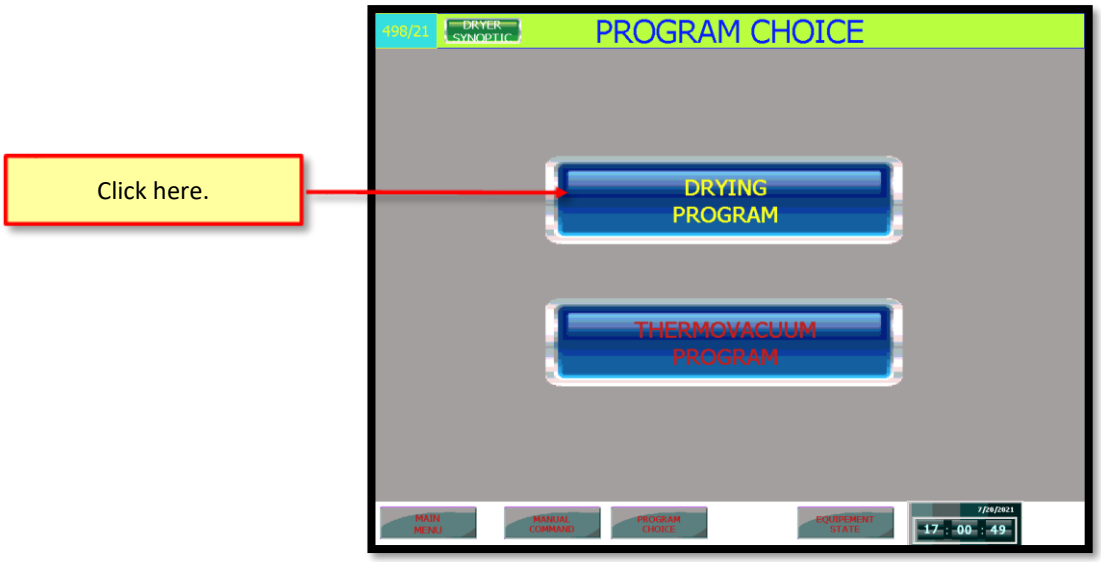
Sub-phase B: heating to the temperature of the PH1 sub-phase of drying, for a predetermined time, to ensure that the wood reaches the same temperature also at its core.

The **DRYING** phase consists of eight sub-phases:

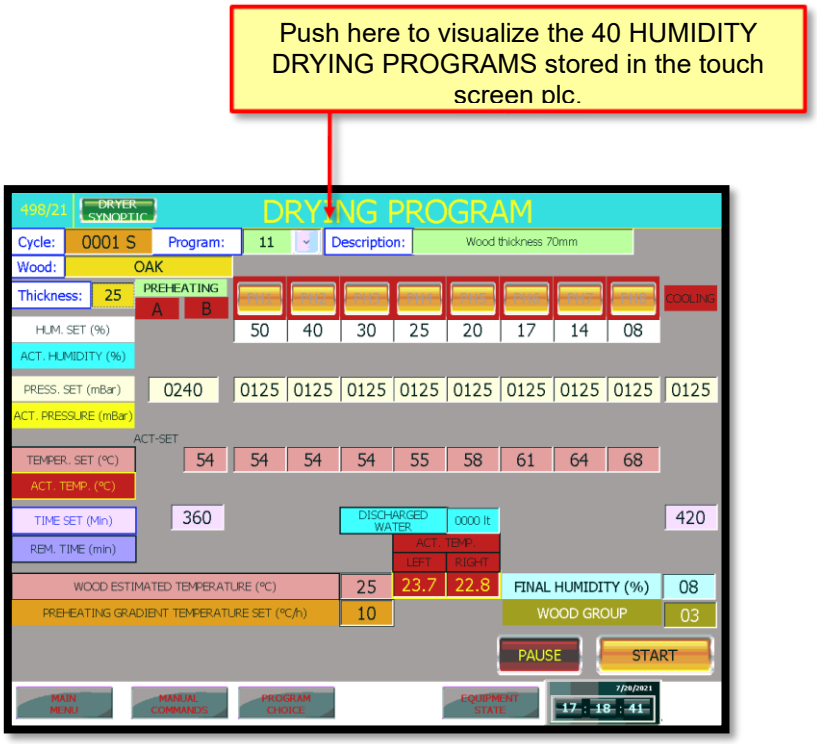
PH1 to PH8: each sub-phase has predetermined values of humidity, pressure and temperature. In each sub-phase, it is heated to the predetermined temperature and pressure until the predetermined humidity value is obtained: once this value is reached, the program proceeds to the next sub-phase.

The **COOLING** phase is necessary to achieve the wood uniformly, a suitable temperature before unloading.

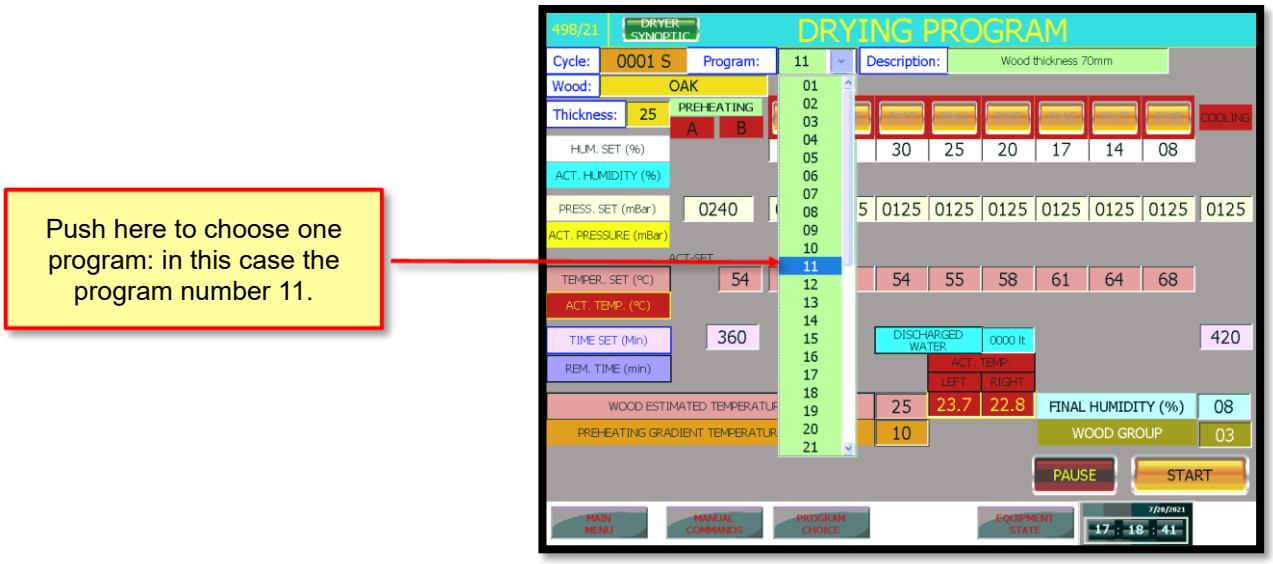
To start a drying cycle, click on the “PROGRAM SELECTION” button in the MAIN MENU:



The DRYING PROGRAM page appears, and the user can recall the most suitable drying program:

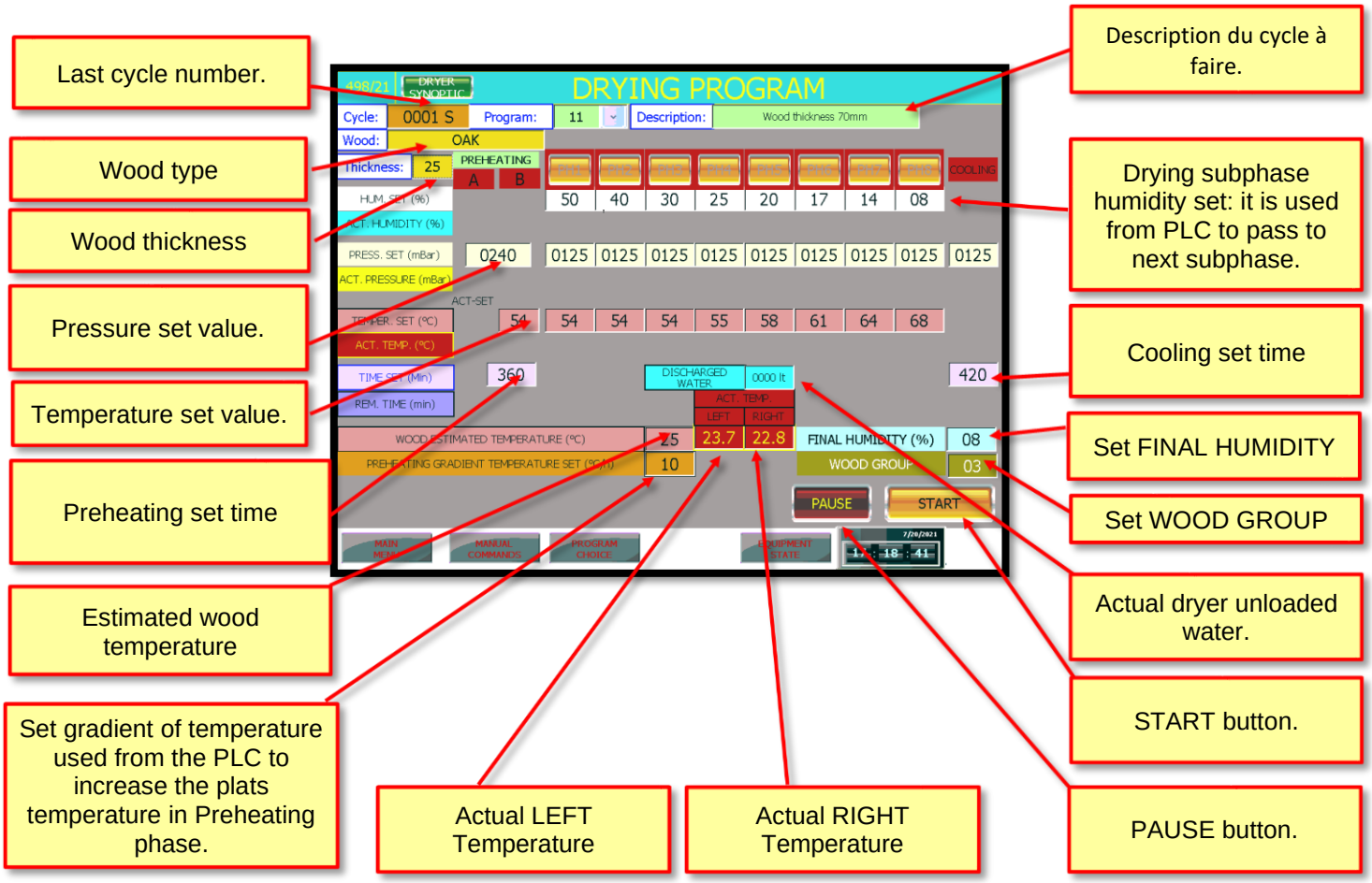


A menu appears with the 40 drying programs: choose the desired program (Program 11 in our case).



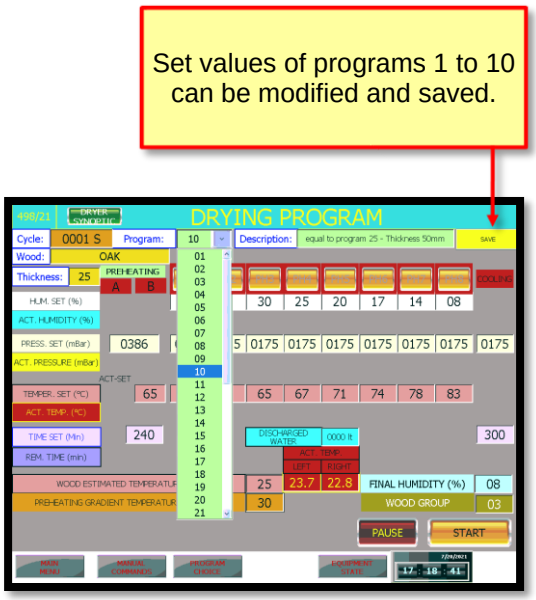
The program 11 page appears: on this page are stored all the data necessary for the execution of cycle 11 (see the drying cycles table), from the PREHEATING phase to the COOLING phase.

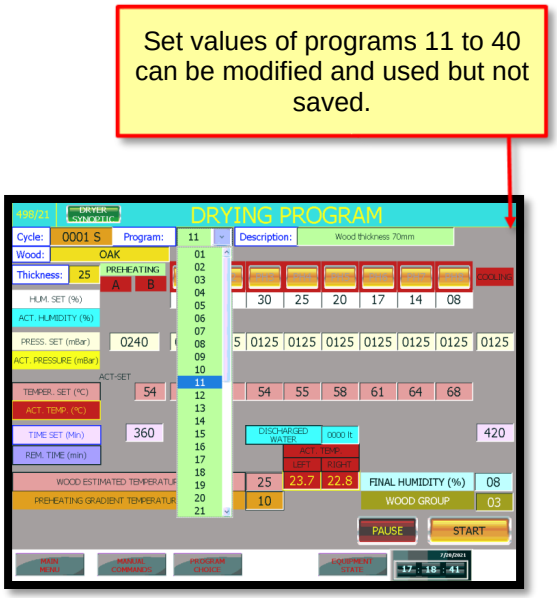
The program 11 page appears: on this page are stored all the data necessary for the execution of cycle 11 (see the drying cycles table), from the PREHEATING phase to the COOLING phase.
The WOOD ESTIMATED TEMPERATURE must be adapted each time to the actual conditions in which the wood has been maintained before being loaded.
The final HUMIDITY SET will be modified to obtain the desired drying result.
The data WOOD GROUP will be modified for the type of wood loaded (see the table of types of wood)
The TYPE and THICKNESS of the wood must be inserted each time before the start of a cycle: if this data is not entered, the indications "**Wood**" and "**Thickness**" flash and the cycle cannot be started.



The data of programs 1 to 10 can be modified and saved.

The data of programs 11 to 40 can be modified but not saved.

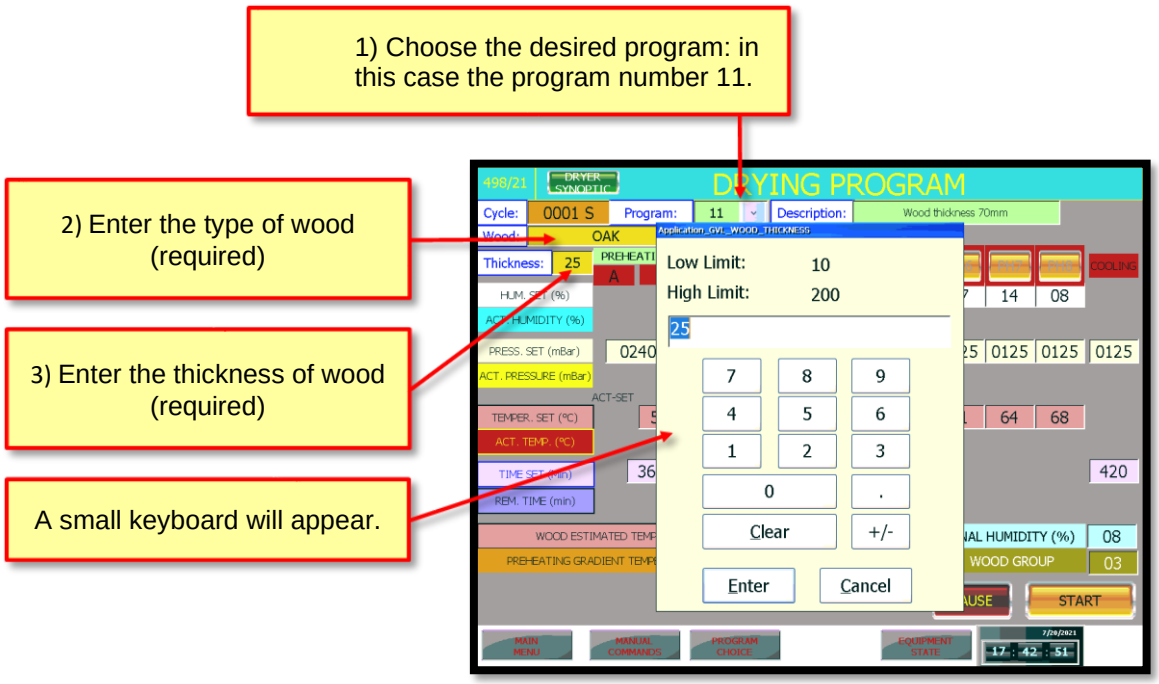


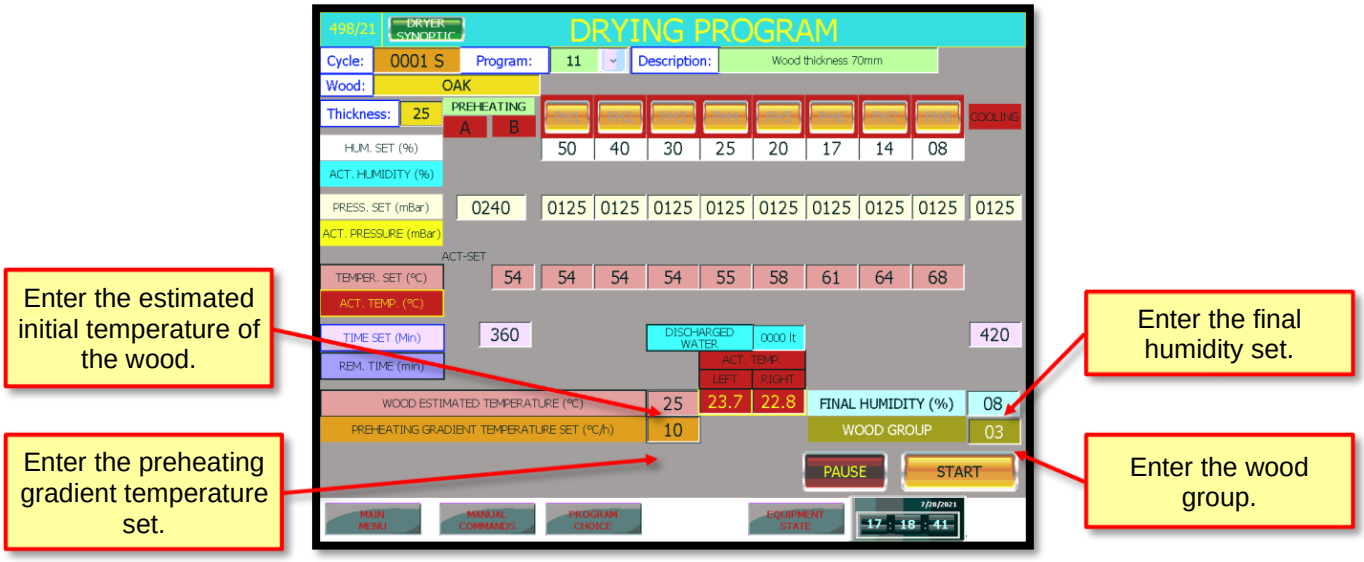


8.4.1 DRYING CYCLE

For a drying cycle:

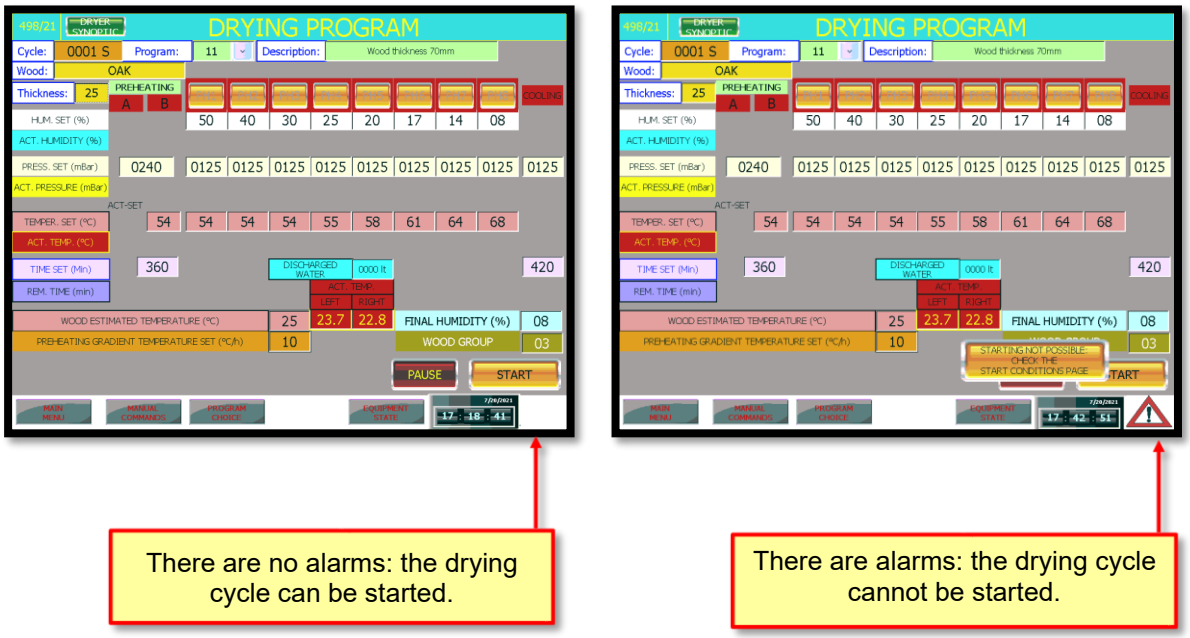
1. Choose the desired program: in this case the program number 11.
2. Enter the type of wood (required).
3. Enter the thickness of wood (required).
4. Modify, if necessary, the estimated temperature of the wood.
5. Modifier, si nécessaire, l'humidité finale désirée.
6. Check all other data and, if necessary, modify them as you wish.
7. If the program number is 1 to 10, you can save the modified data.
8. If the program is 11 to 40, you can start the cycle with the modified data, but you cannot save them.





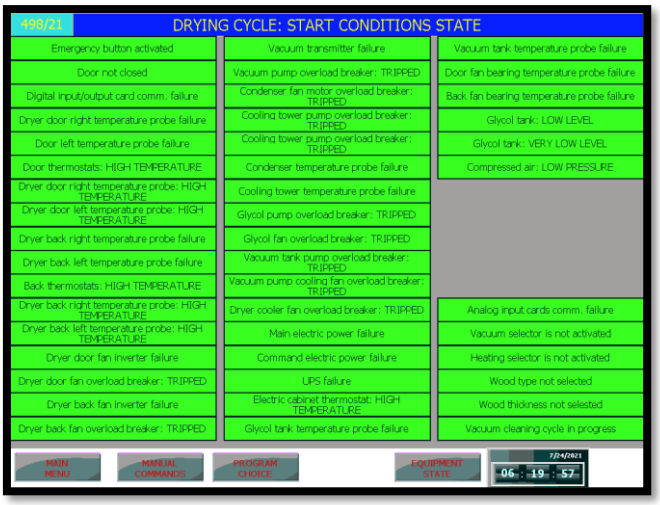
At this point, modify, the estimated initial temperature of the wood, the gradient temperature set, the final humidity and the wood group.

After checking all other data and verifying that there are no alarms, the drying cycle can be started.

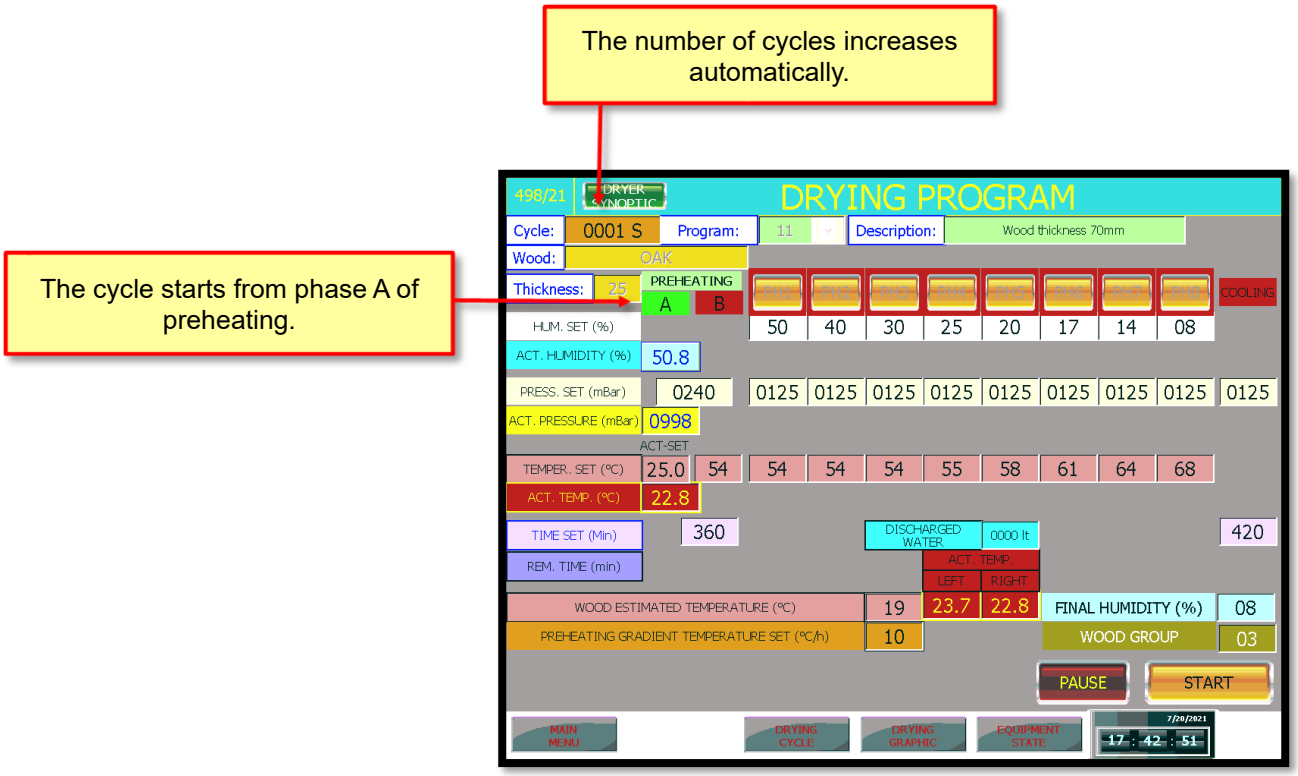


If there are one or more equipment not right condition the **STARTING NOT POSSIBLE: CHECK THE START CONDITIONS PAGE** button appears and clicking it the **DRYING CYCLE: START CONDITIONS STATE** page appears.

In this diagnostic page is possible easily find the conditions that do not allow the cycle to start: in red is highlighted the wrong conditions and so is possible to resolve the problem.
Only if all the cells in the page are green is possible to start the cycle.



To start the drying cycle, press the "**START**" button. The PLC starts the drying cycle, and the DRYING PROGRAM page appears as follows:

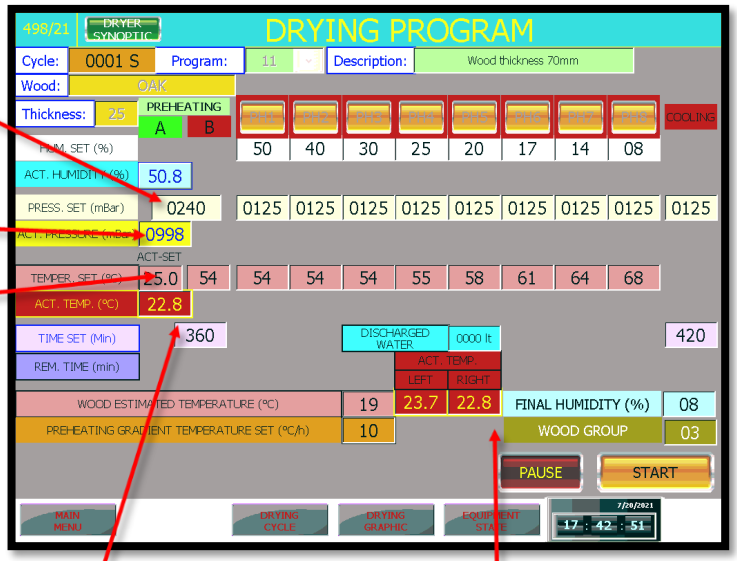


The PLC starts the vacuum pump and the dryer heating: the door and back fans are not started until the set pressure (in our case 900mBar), is not reached.

Visualization of the absolute pressure set

Visualization of the actual absolute pressure in the dryer

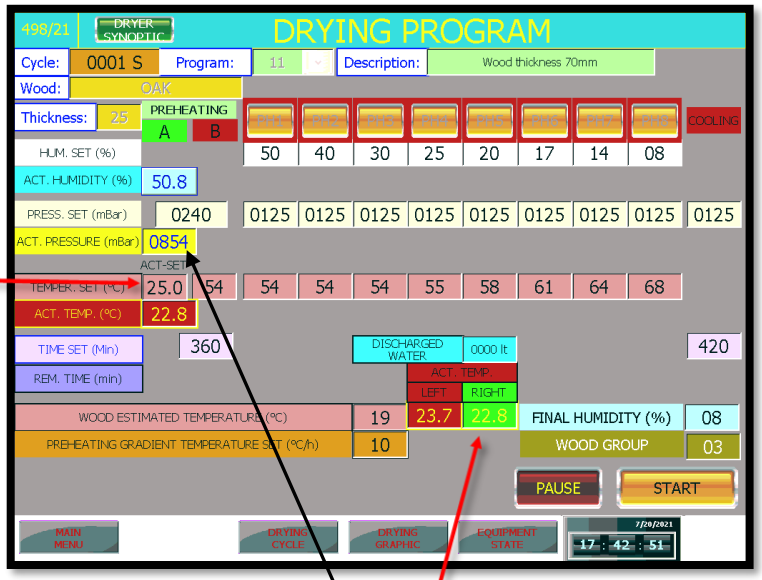
Visualization of the actual temperature set: in the preheating phase A, the temperature set starts from the estimated value of the wood temperature and with the set gradient, increases every minute until it reaches the value set for the PH1 drying phase.



Visualization of the actual temperature in the dryer.

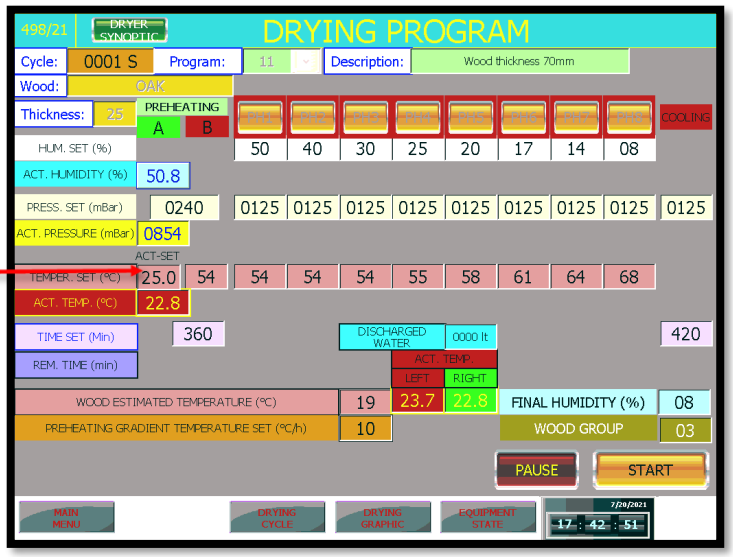
The absolute pressure in the dryer is greater than the set pressure (900mBar): the door and bottom fans are not started.

Visualization of the actual temperature in the dryer: the value is given by the right temperature probe, because it is in the process of right ventilation.



The absolute pressure in the dryer is lower than the set pressure (900mBar): the door and bottom fans are started.
The green color indicates the direction of rotation: in our case it is right.

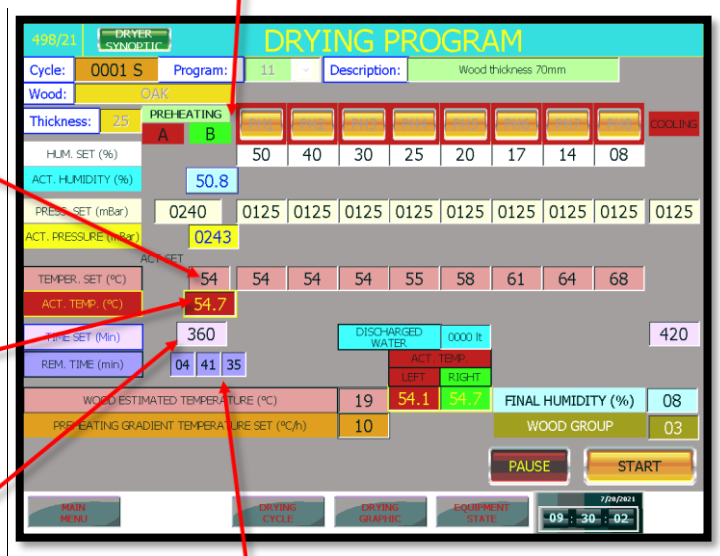
During phase "A" of preheating, the temperature setting is increased every minute by the set gradient: in our case 10 ° C per hour.



During phase "A" of preheating, the temperature setting is increased every minute by the set gradient: in our case 10 ° C per hour.

After the set temperature has reached the value set on phase PH1 and the actual temperature inside the dryer is higher than the one set, for at least 2 minutes, the PLC automatically switches to preheating phase B and the page DRYING PROGRAM appears as follows.

At the end of phase, A of preheating, the PLC automatically switches to phase B of preheating.



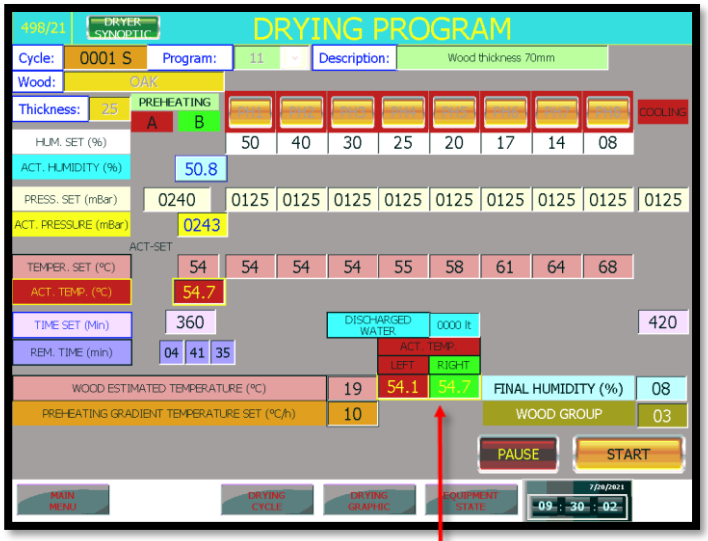
Visualization of the temperature set: the value is the same as defined for the PH1 drying phase.

Visualization of the actual temperature in the dryer: the value is given by the right temperature probe, because it is being ventilated on the right.

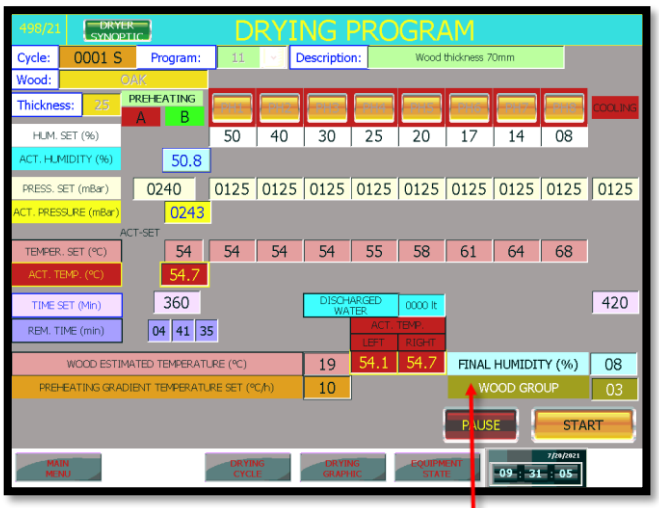
Visualization of the duration set for preheating phase B.

Visualization of the remaining time of phase B of preheating.

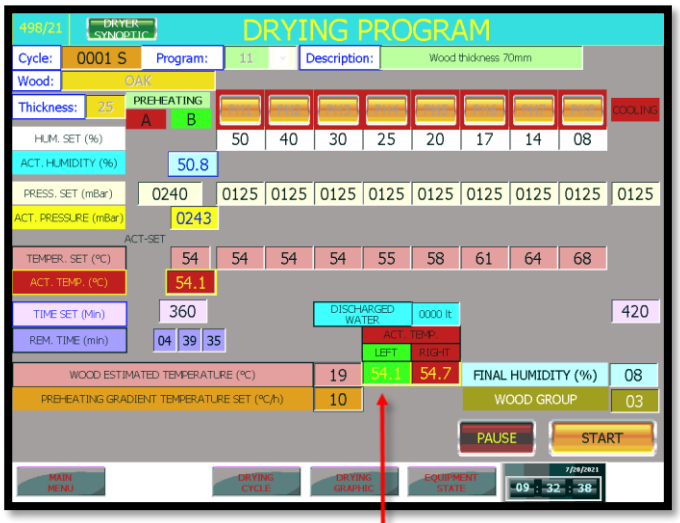
Reverse ventilation.
Every hour, the PLC automatically command the reverse of ventilation: stops fan motors then there is a 2 minute wait time before restart the fans in the opposite direction to the previous one.



Right Ventilation



Stop fans motors: wait time 2 minutes to stop fans rotation completely.



Restart in left ventilation

Passage to phase PH1 of drying cycle.

At the end of preheating phase B time, the PLC automatically switches to drying phase PH1.

At the end of phase B of preheating, the PLC automatically switches to phase PH1 of drying.

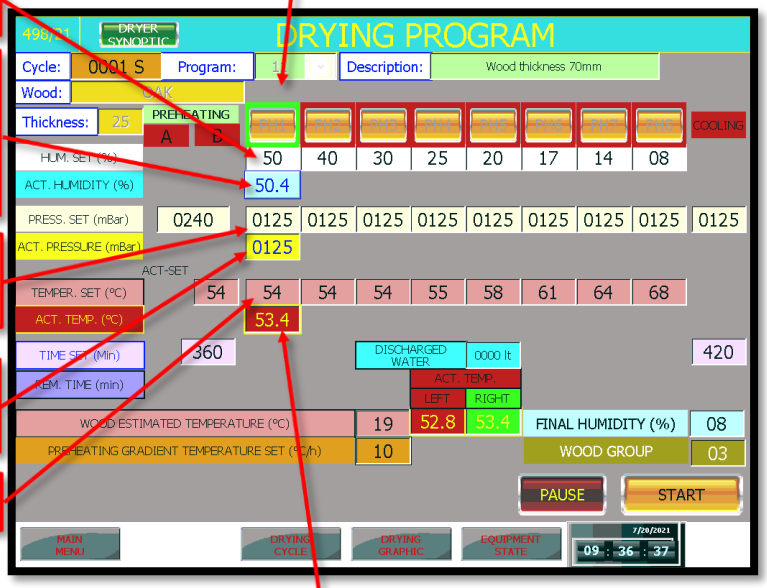
Visualization of the actual humidity set.

Visualization of the actual average humidity: this value is calculated by averaging the active humidity probes.

Visualization of the absolute pressure set.

Visualization of the actual absolute pressure in the dryer.

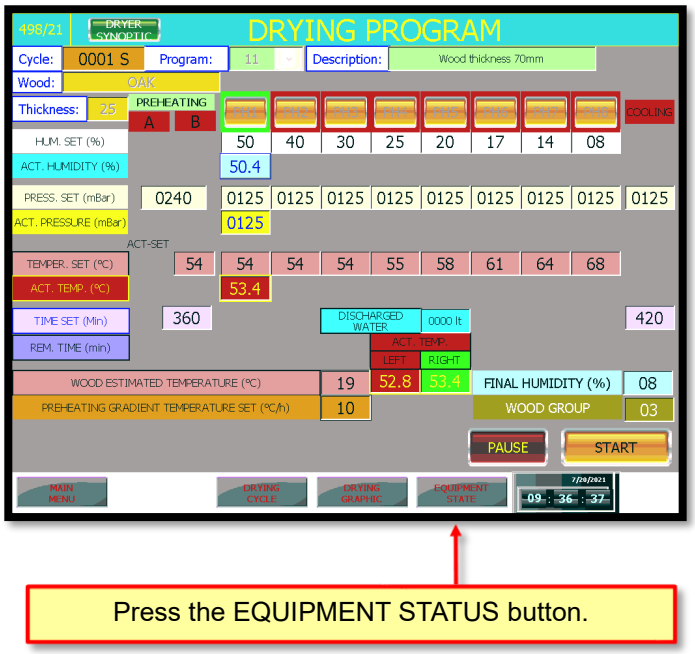
Visualization of the temperature set.



Visualization of the actual temperature in the dryer: the value is given by the right temperature probe, because it is being ventilated on the right.

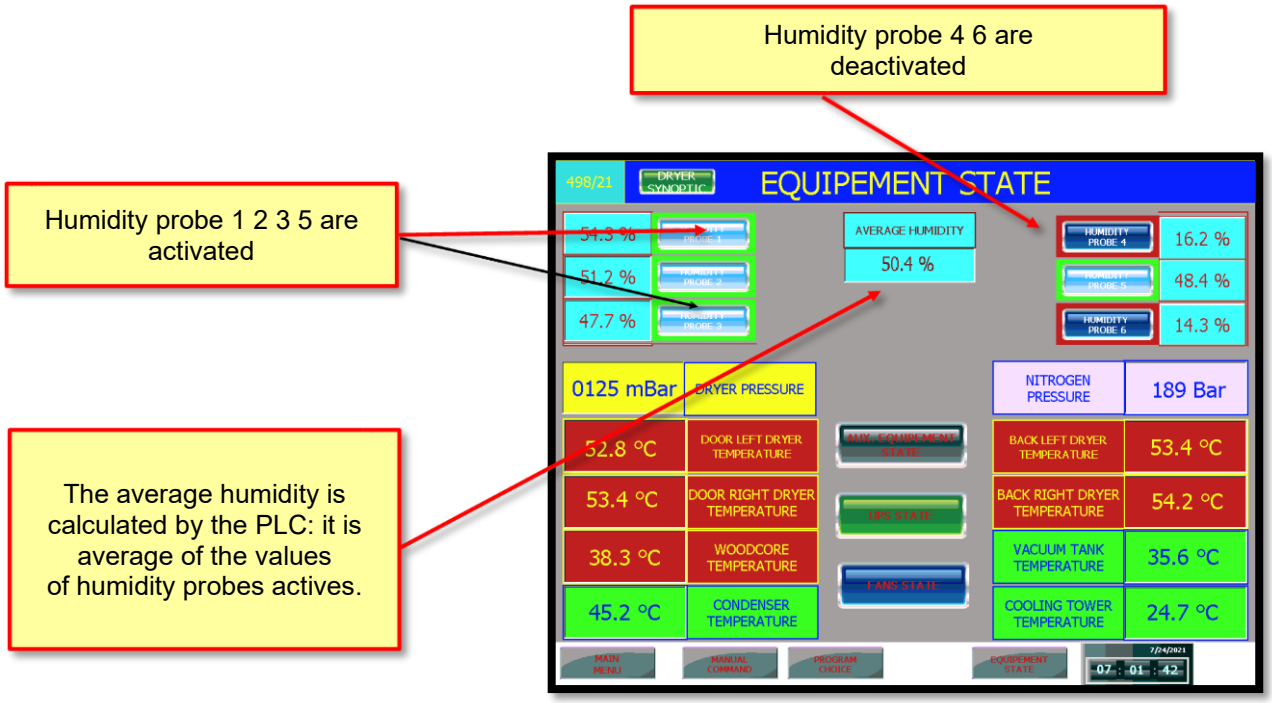
Activation and deactivation of humidity probes.

The value of humidity, used by the PLC for the transition from a phase of drying to the next, is calculated by the average values measured by humidity probes inserted.
For the activation or deactivation of humidity probes referee to the page EQUIPMENT STATE page.
Press the **EQUIPMENT STATE** button.

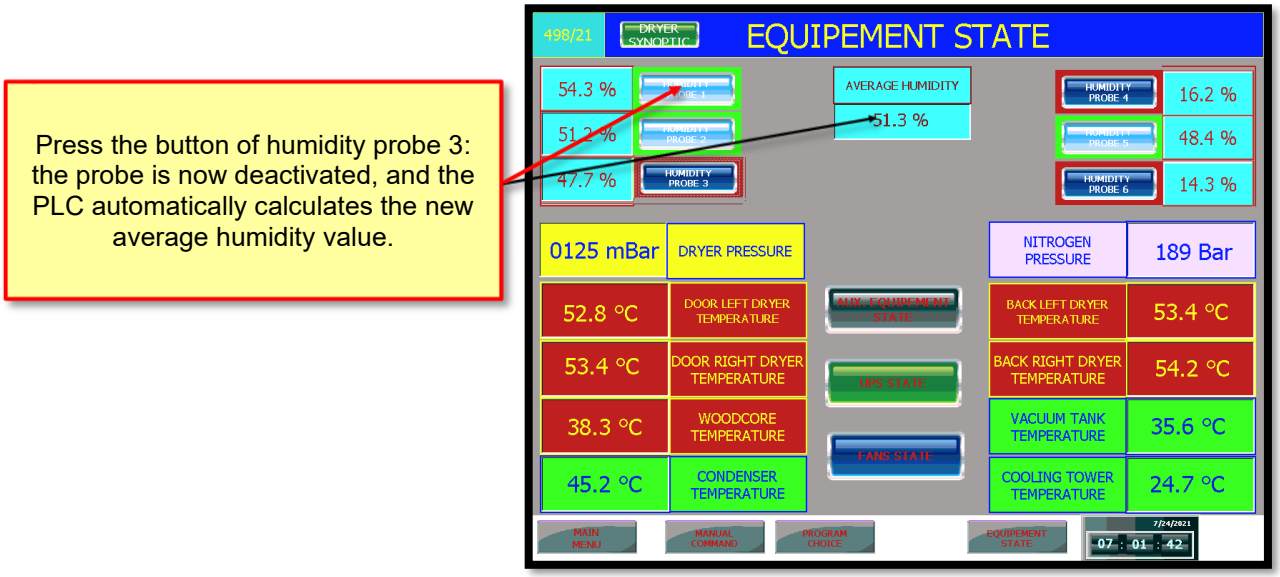


Press the EQUIPMENT STATUS button.

The EQUIPMENT STATUS page appears.

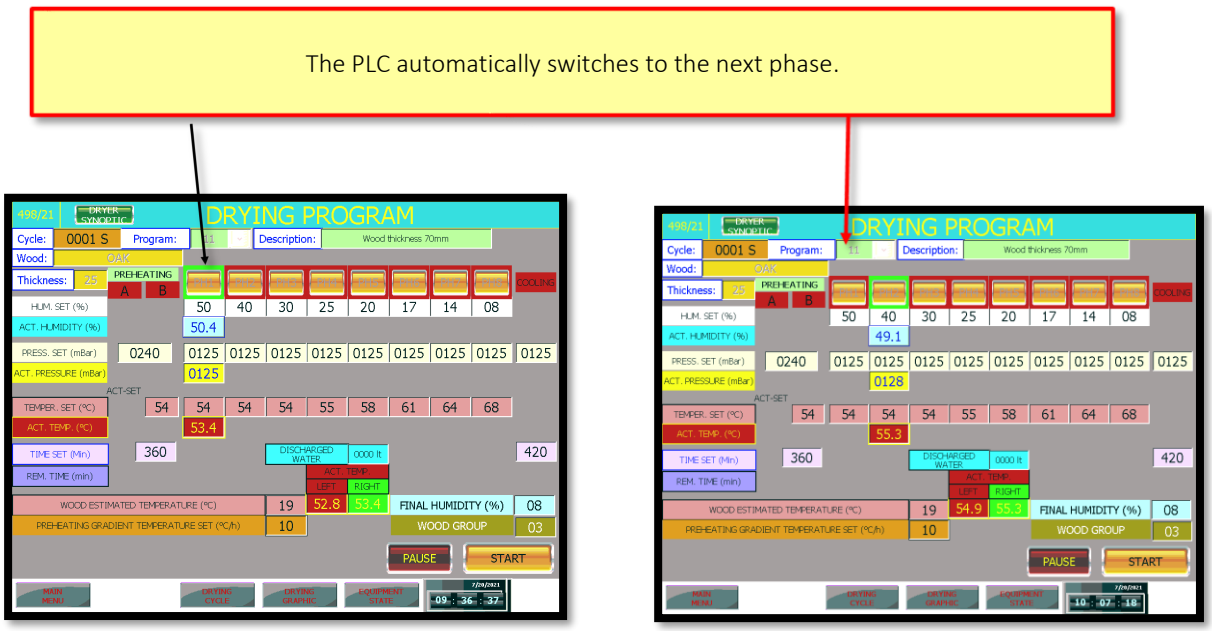


To activate or deactivate a humidity probe, press the relative probe button.



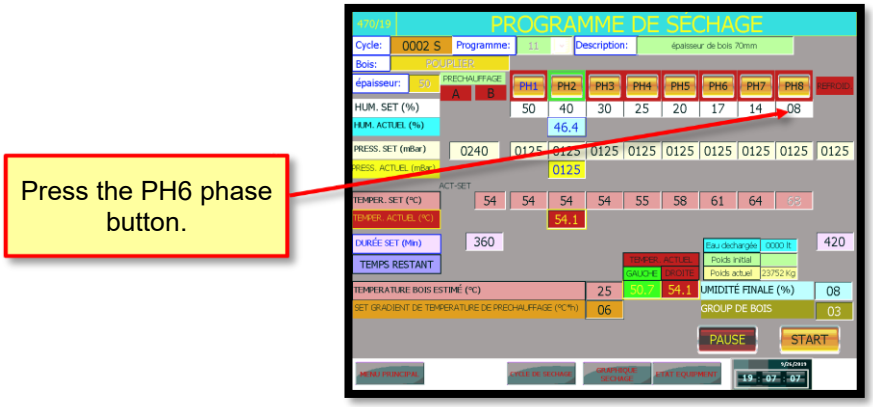
Warning: if there is only one humidity sensor active, this cannot be deactivated.

Passage to the next drying phase.
After the average humidity value has reached the phase set value
for at least 2 minutes, the PLC automatically switches to the next phase.

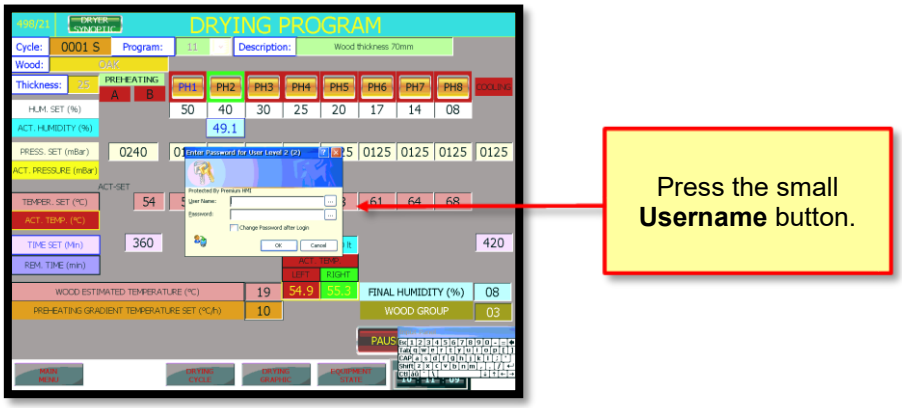


Manual control of the passage from the current phase to a next or previous phase.

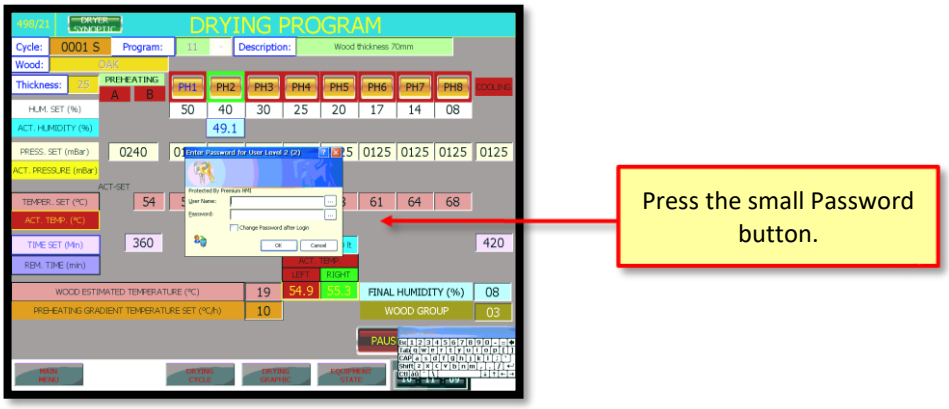
If during the cycle it is necessary to force the passage from one phase to the next or previous one, press the button of the phase which has been chosen, phase PH6 for example.



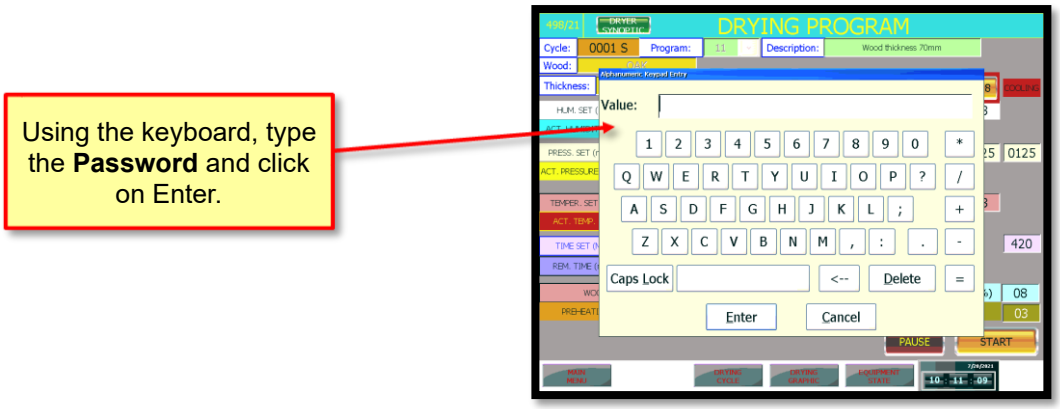
This operation is password protected and a small page appears.
Press the small **Username** button and through the keyboard enter the Username.
Press the small **Password** button and through the keyboard enter the Password.



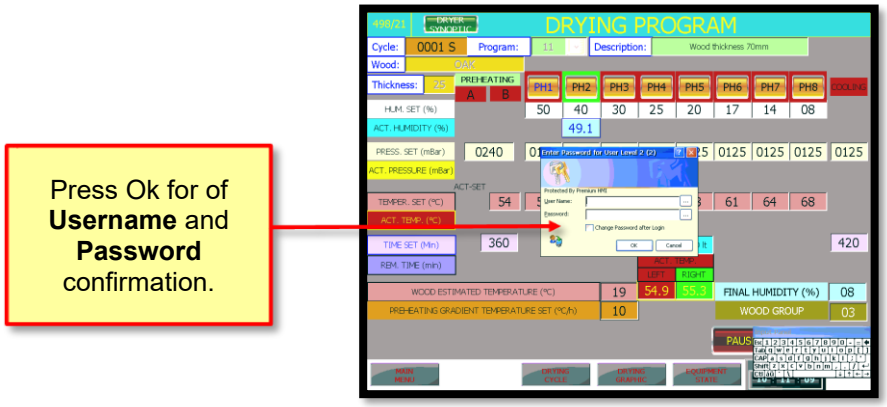
Press the small Password button.



Using the keyboard, type the Password and then click Enter.



Press Ok for of Username and Password. confirmation

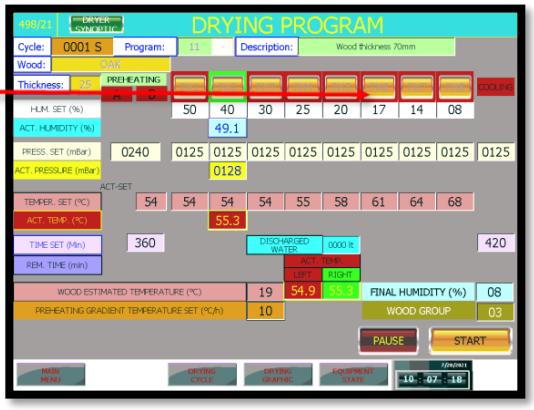


Now press the PH6 phase button again.

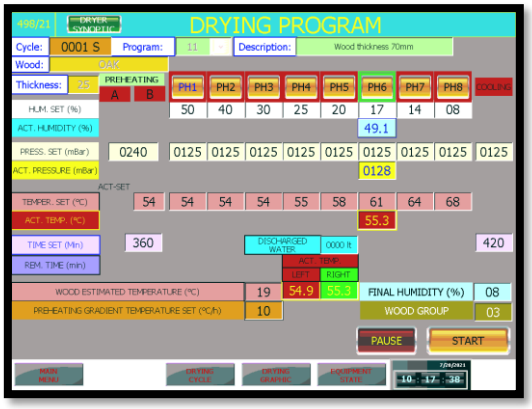
Please note: the access validity period is only for 60 seconds.

After this time, you must reenter USERNAME and PASSWORD.

Press the PH6 phase button.



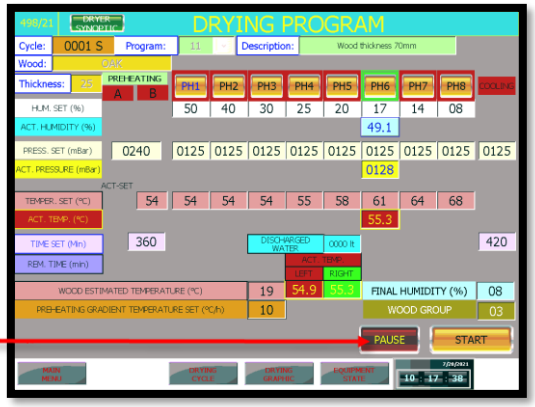
The PLC is now in PH6.

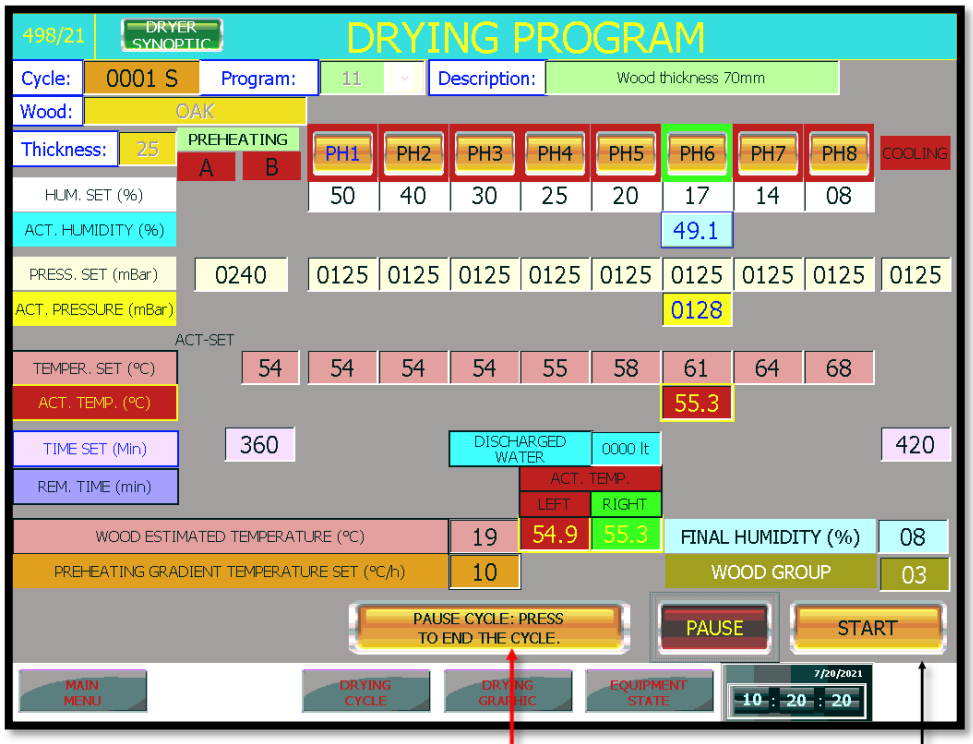


Pause or interrupt the drying cycle.

If necessary, the drying cycle can be suspended or terminated with the PAUSE button.
If you press the PAUSE button the PLC stops all the equipment.
The cycle can then be restarted or terminated.

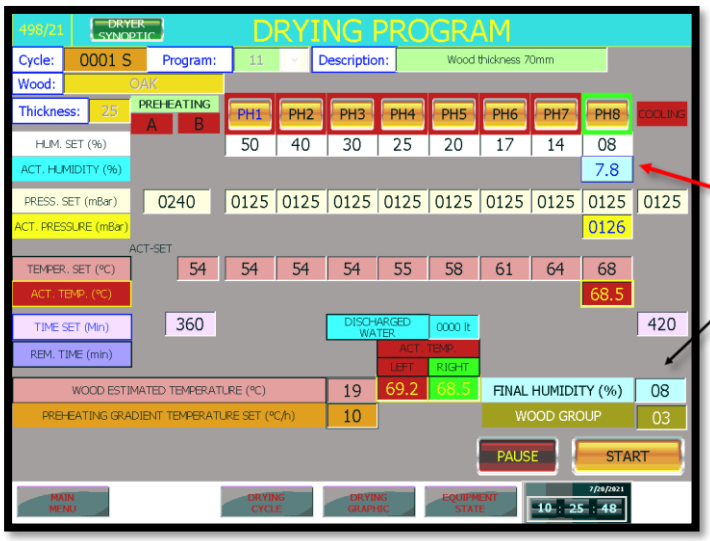
Press the PAUSE button.





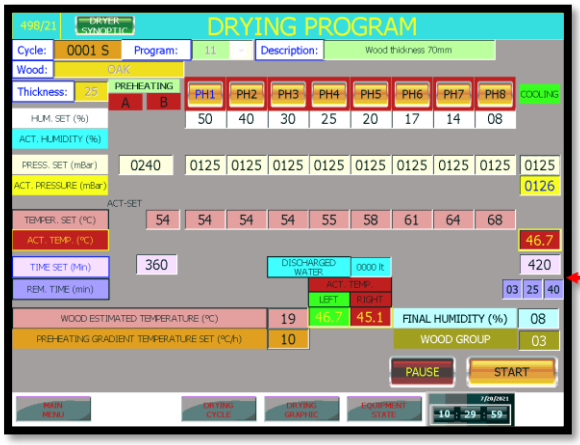
The PLC stops all the equipment, and a button appears with a message PAUSE CYCLE: PRESS TO END THE CYCLE You can press this button to terminate the cycle or press the START button to restart the cycle.

The drying cycle continues in order to phase 8: when the humidity is lower than the final humidity setpoint, for at least 2 minutes the PLC goes to cooling phase.



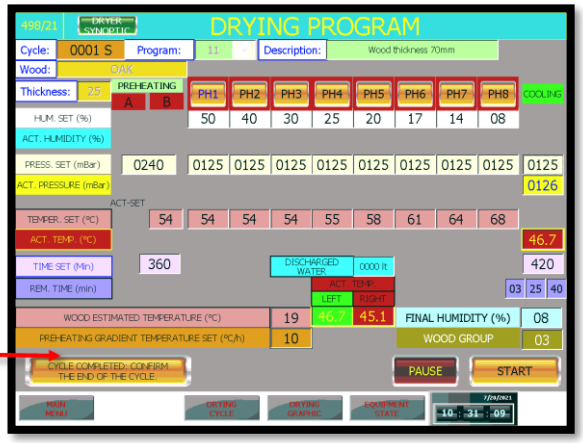
If the humidity is lower than the final humidity set, for at least 2 minutes, the PLC goes to the cooling phase.

At the end of drying, the PLC switches to the cooling phase.



Remaining time for the cooling phase.

At the end of the cooling phase, the PLC automatically stops all the machines and the button CYCLE COMPLETED: CONFIRM THE END OF THE CYCLE. appears:
click on this button and the cycle is finished.



Press this button to confirm the end of the cycle.

The PLC is ready to start a new cycle.

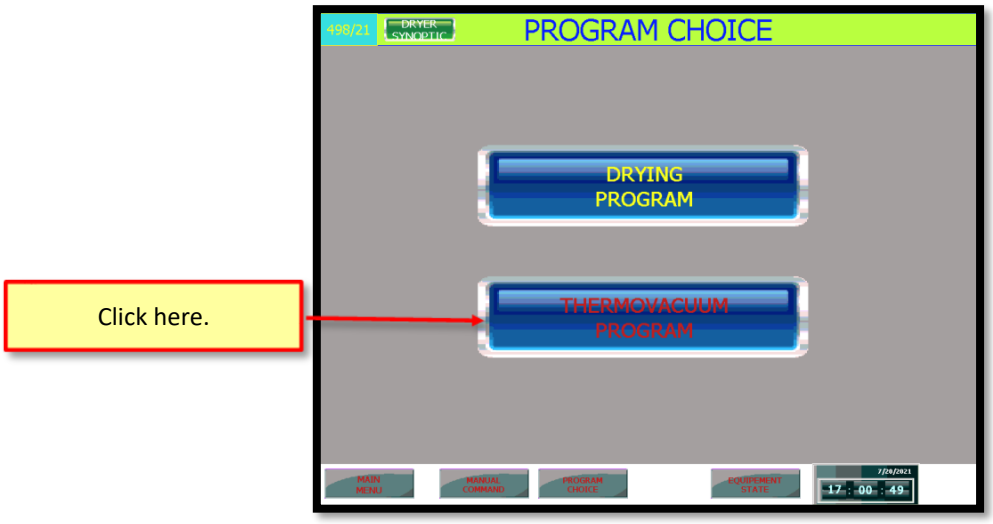
8.4.2 CHANGING THE SET-POINT DURING THE DRYING CYCLE.

During drying it is possible to change the pressure and temperature values.
During drying it is possible to change the duration set values of phase A preheating and cooling only if the countdown has not yet started

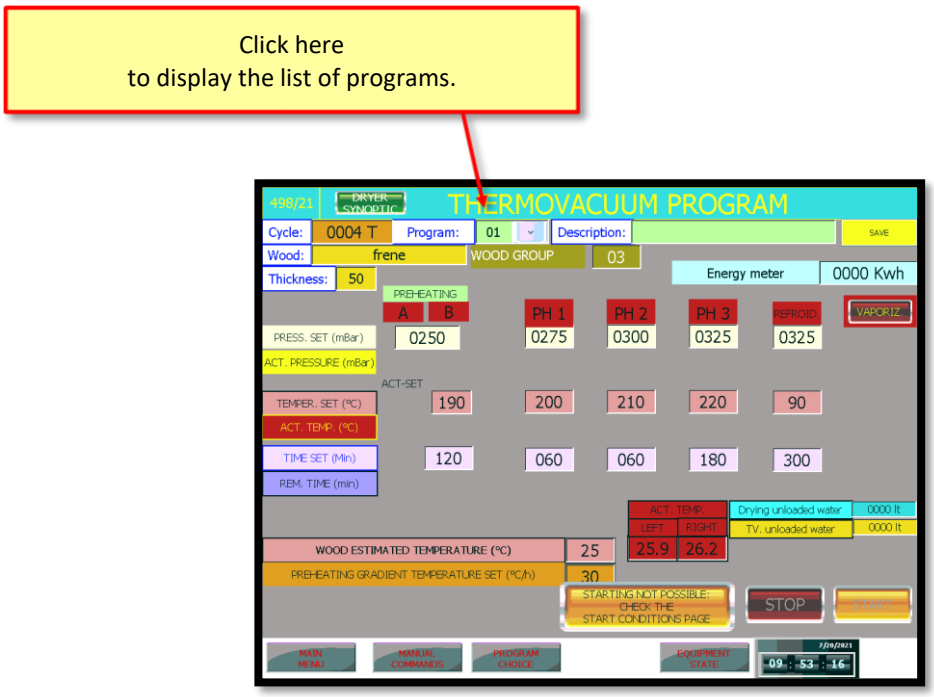
To modify a drying cycle time, proceed as follows:
Pause the cycle with the PAUSE button.
Change the time set.
Restart the cycle with the START button.

8.5 STARTING A THERMOVACUUM PROGRAM

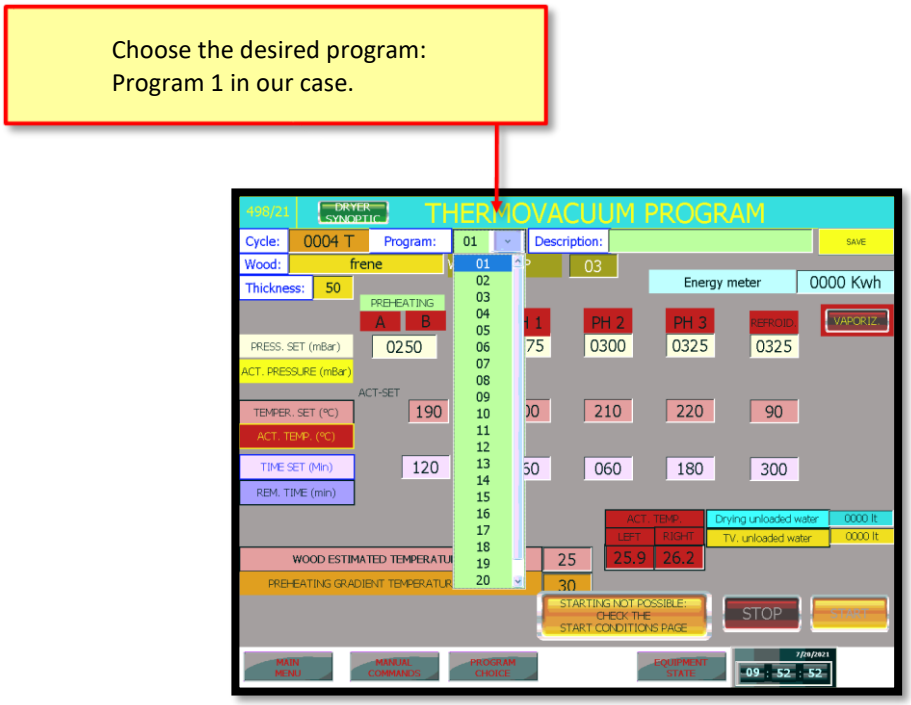
To start a drying cycle, press the “HEAT TREATMENT PROGRAM” button on the PROGRAM SELECTION page:



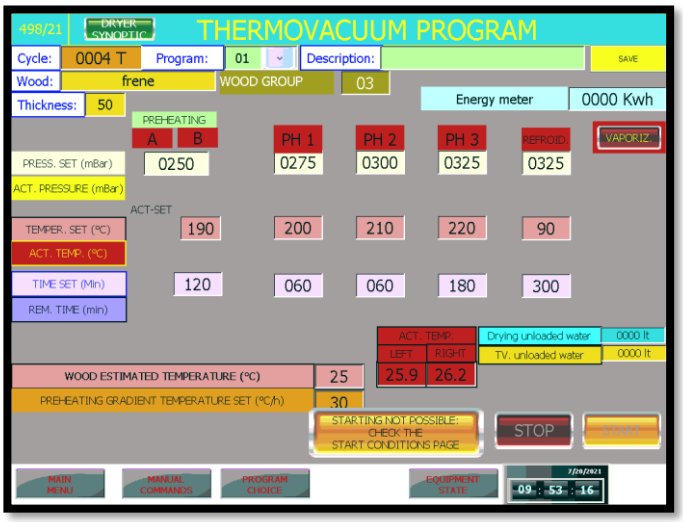
It is possible to program and save 20 Thermovacuum programs.

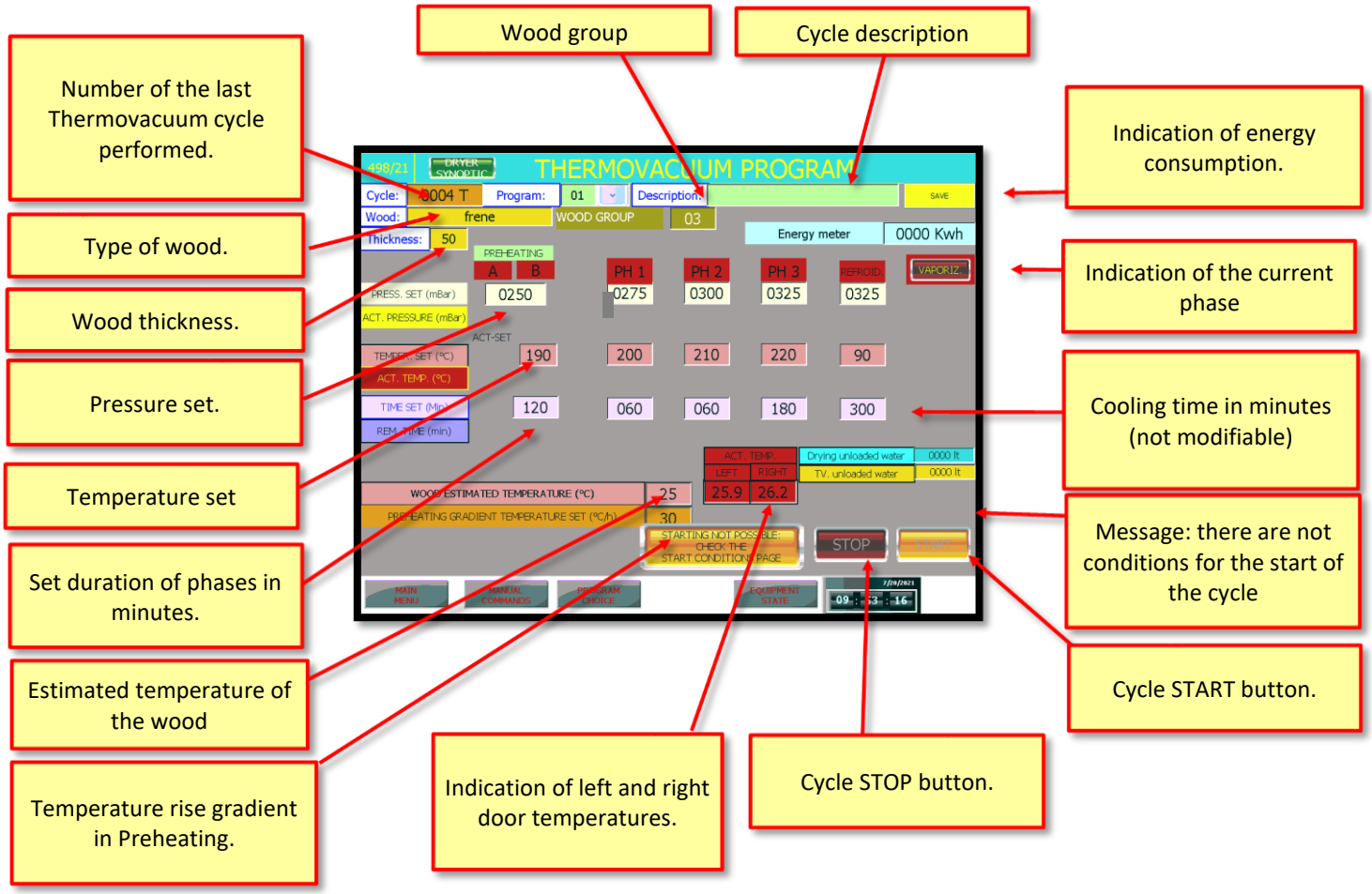


A menu appears with the 20 Thermovacuum programs: choose the desired program (Program 1 in our case).



The program page 11 appears: on this page are stored all the data necessary for the execution of Thermovacuum cycle 1, from the **PREHEATING** phase to the **COOLING** phase.
The data for **ESTIMATED WOOD TEMPERATURE** must be adapted each time to the real conditions in which the wood has been kept before being loaded.
The **WOOD GROUP** data will be modified for the type of wood loaded (see the table of types of wood).
The type and thickness of the wood must be inserted each time before the start of any cycle: if this data is not inserted the cycle cannot be started.





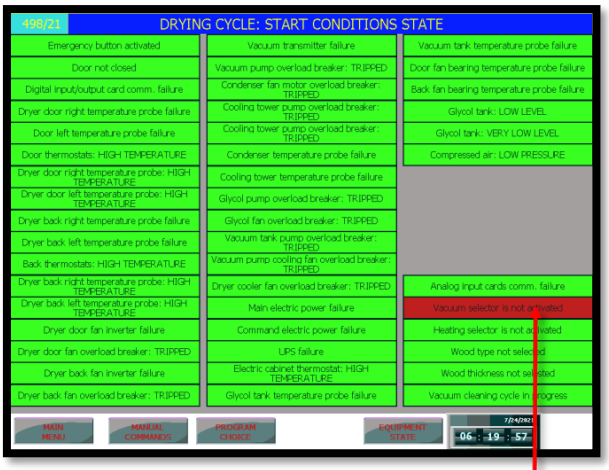
For a Thermovacuum cycle:

1. Choose the desired program (Program 1 in our case).
2. Enter the type of wood (required).
3. Enter the thickness of the wood (required)
4. Modify, if necessary, the estimated temperature of the wood

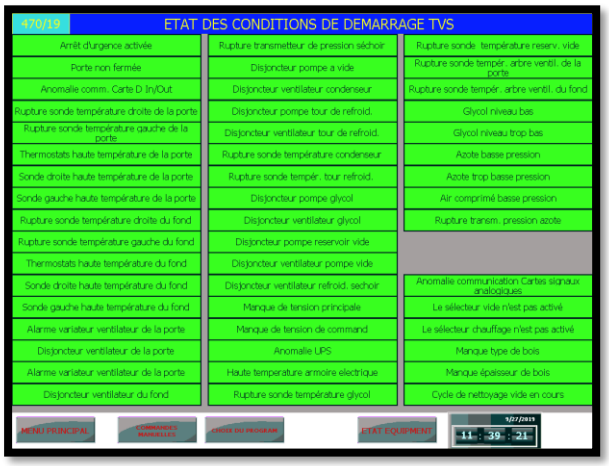
5. Check all other data and, if necessary, modify them as you wish.

After checking all the data and if the message "**START NOT POSSIBLE: CHECK THE START CONDITIONS PAGE**" is not present, it is possible to start a Thermovacuum cycle: press the START button.
Otherwise press the button and the "**THERMOVACUUM CYCLE: START CONDITIONS STATE**" page appears.

In this diagnostic page is possible easily find the conditions that do not allow the cycle to start: in red is highlighted the wrong conditions and so is possible to resolve the problem.
Only if all the cells in the page are green is possible to start the cycle.

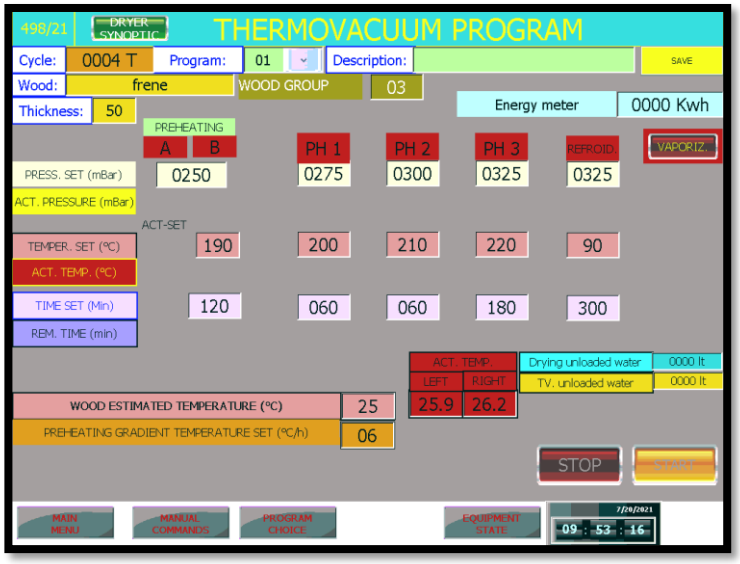


In this case the Vacuum Pump selector is in OFF position

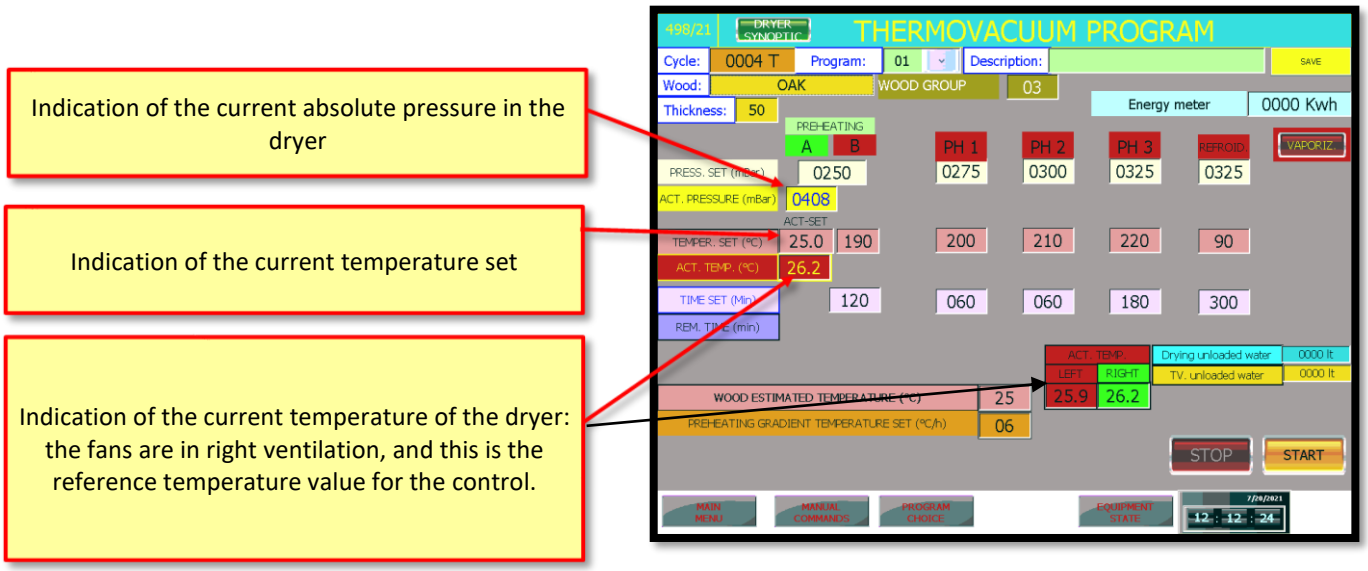


Set the vacuum pump selector to 1: now there are all the conditions for starting a heat treatment cycle.

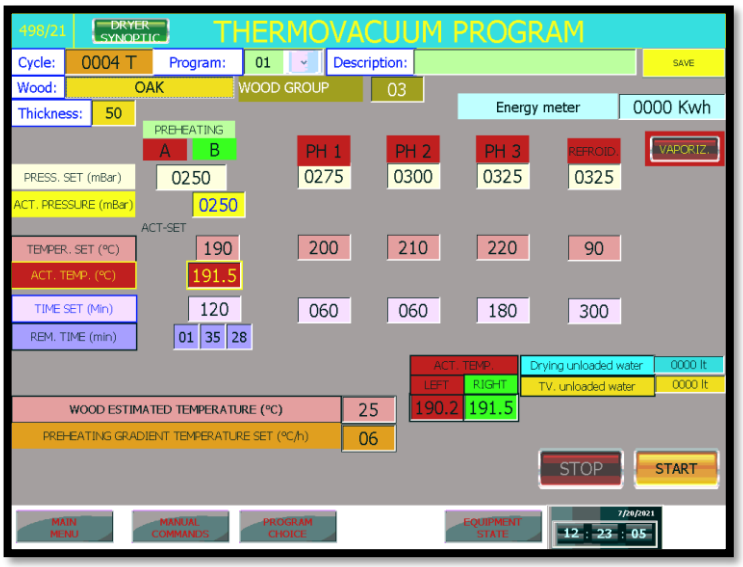
After having checked all the data and if the message “START NOT POSSIBLE: CHECK THE START CONDITIONS PAGE” is not present, it is possible to start a heat treatment cycle: press the START button.



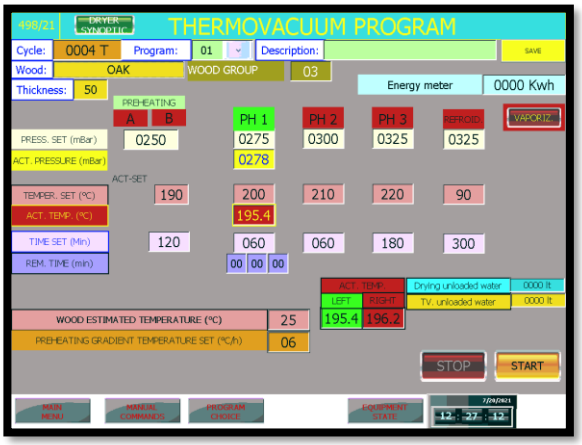
The cycle starts from the preheating phase A



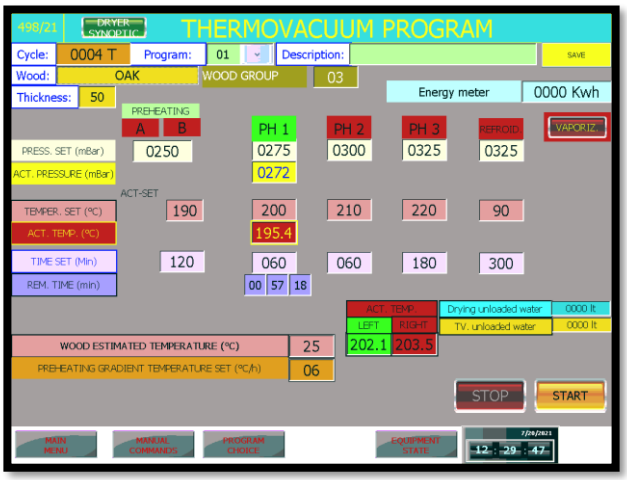
When the temperature setting reaches the preheating setpoint and the air temperature inside the dryer is higher than the set value, for at least two consecutive minutes, the PLC goes to phase B of preheating and the time count begins.



When the programmed time has elapsed, the PLC goes to phase 1.

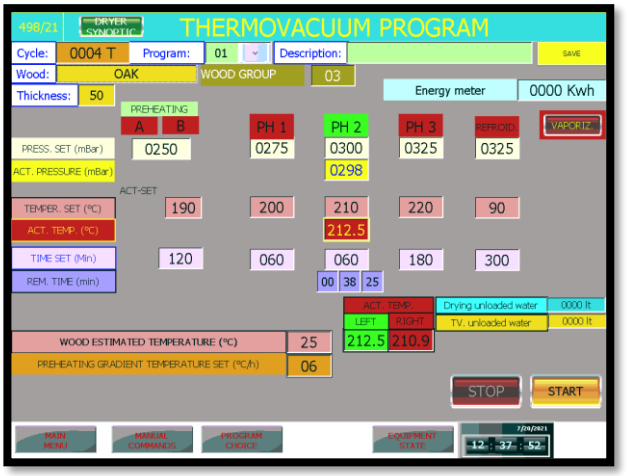


When the air temperature inside the dryer is higher than the set value, for at least two consecutive minutes the time count starts.

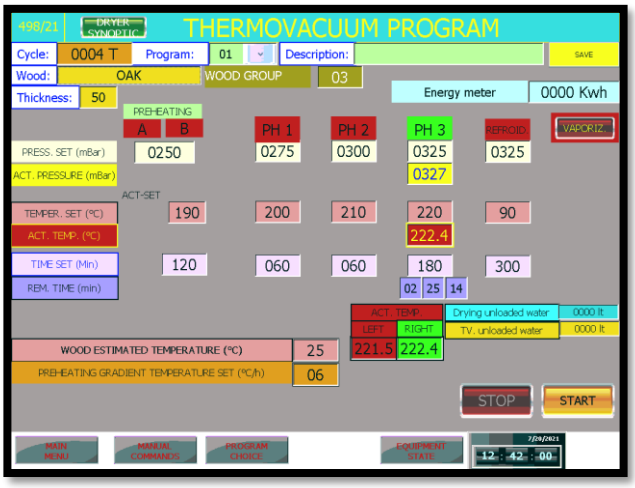


When the time programmed for phase 1 has elapsed, the PLC switches to phase 2.

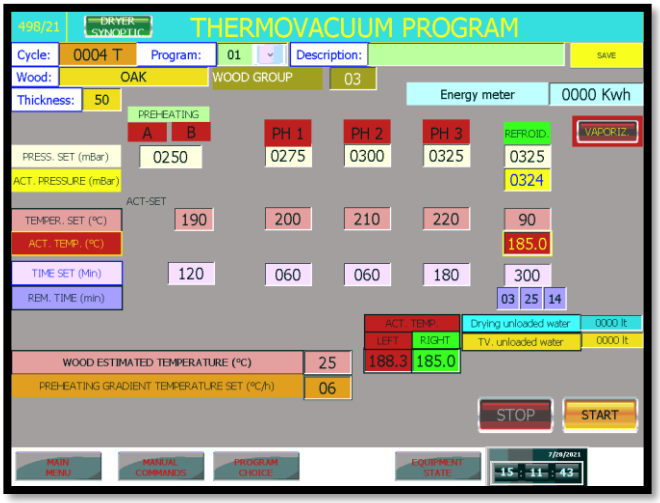
Also, for phase 2 the time counting starts when the air temperature inside the dryer is higher than the set value, for at least two consecutive minutes.



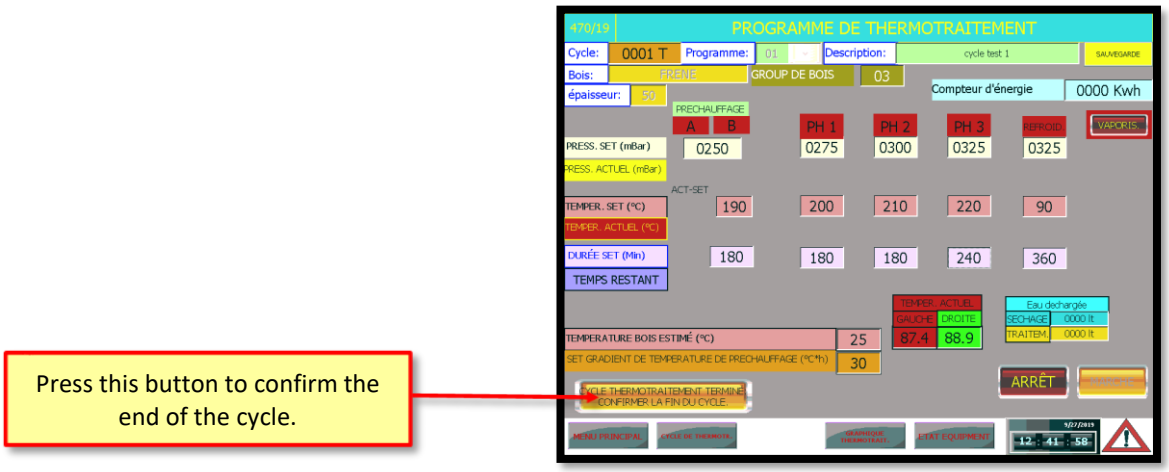
When the time programmed for phase 2 has elapsed, the PLC goes to phase 3 and for phase 3 the time counting starts when the air temperature inside the dryer is higher than the set value, for at least two consecutive minutes.



When the time programmed for phase 3 has elapsed, the PLC switches to the cooling phase and the time counting begins.



The cooling phase ends when the safety time has elapsed (not modifiable) and the air temperature inside the dryer has fallen below the set.
All the equipment is stopped and the button with the message.
CYCLE THERMOVACUUM COMPLETED: CONFIRM THE END OF THE CYCLE. appears: press this button to confirm the end of the cycle.



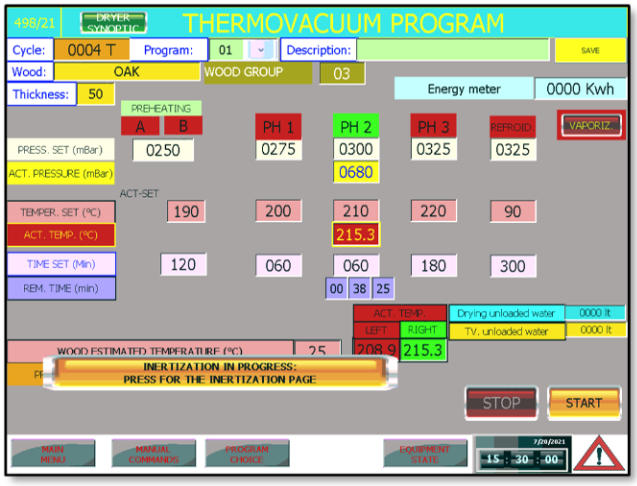
Press this button to confirm the end of the cycle.

8.5.1 INERTIZATION

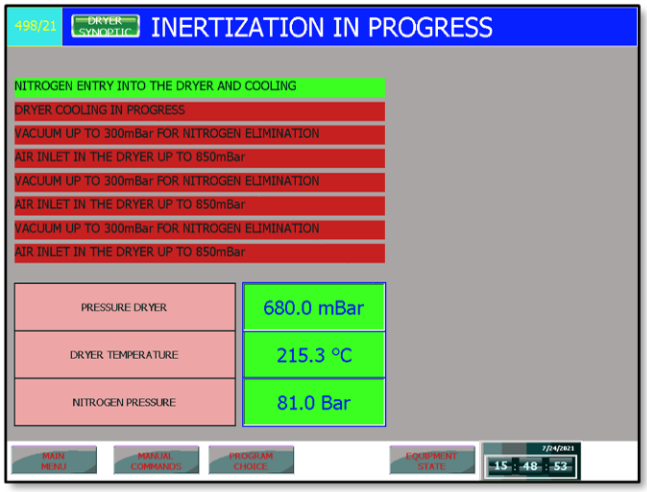
During a Thermovacuum cycle, if the temperature is greater than 180° and the absolute pressure inside the dryer exceeds 600mBar, or if the temperature inside the dryer exceeds 240° C, the PLC controls the inertization with nitrogen, to prevent too high temperature of the wood.

During inertization the PLC controls the cooling of the dryer, stops the heating while all other equipment remains active, minus the vacuum pump, which is activated only for the final washing of the atmosphere inside the dryer.

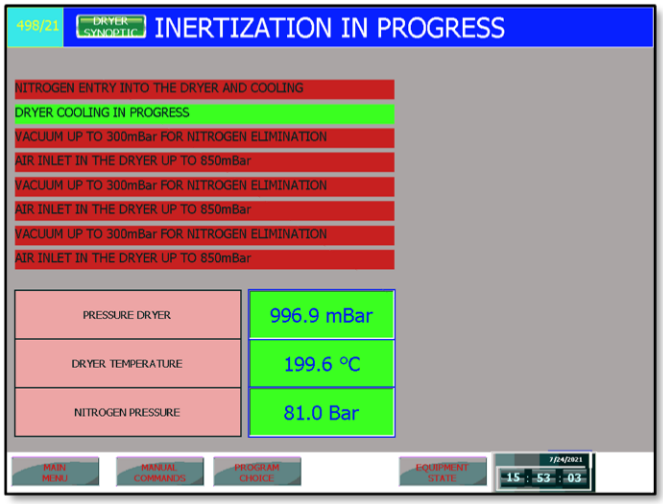
If inertization phase is activated, the THERMOVACUUM PROGRAM page appears as below with a warning button: **INERTIZATION IN PROGRESS: PRESS FOR THE INERTIZATION PAGE**



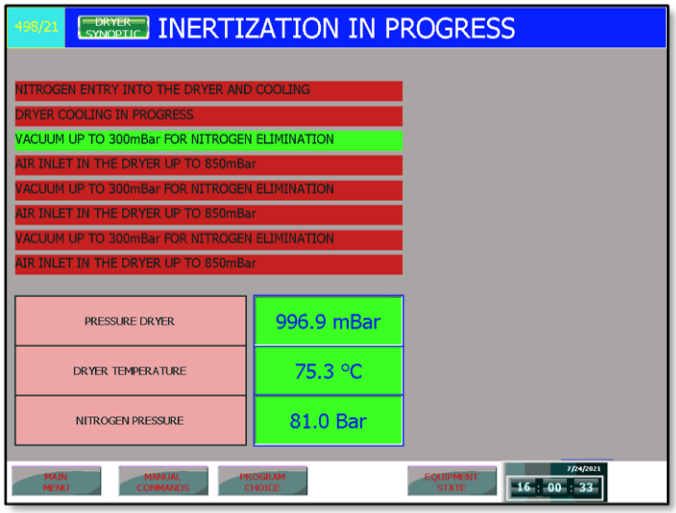
The INERTIZATION IN PROGRESS page appears: in green the inertization phase in progress is highlighted.
The first action controlled by the PLC is the entry of nitrogen into the dryer and the operation of the dryer cooling fan.



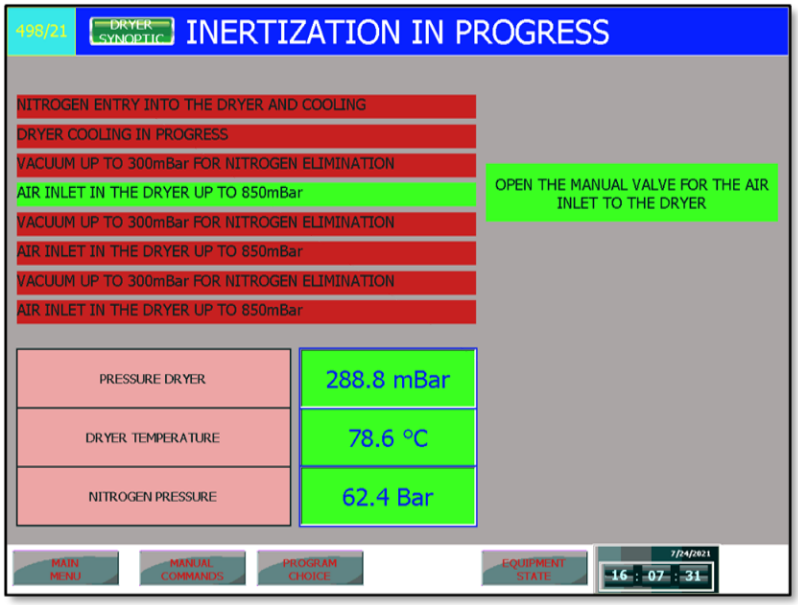
When the safety thermostat, mounted on the dryer vent pipe, confirms that the dryer has been filled with nitrogen, the PLC closes the nitrogen inlet valve to the dryer and continues with the dryer cooling.



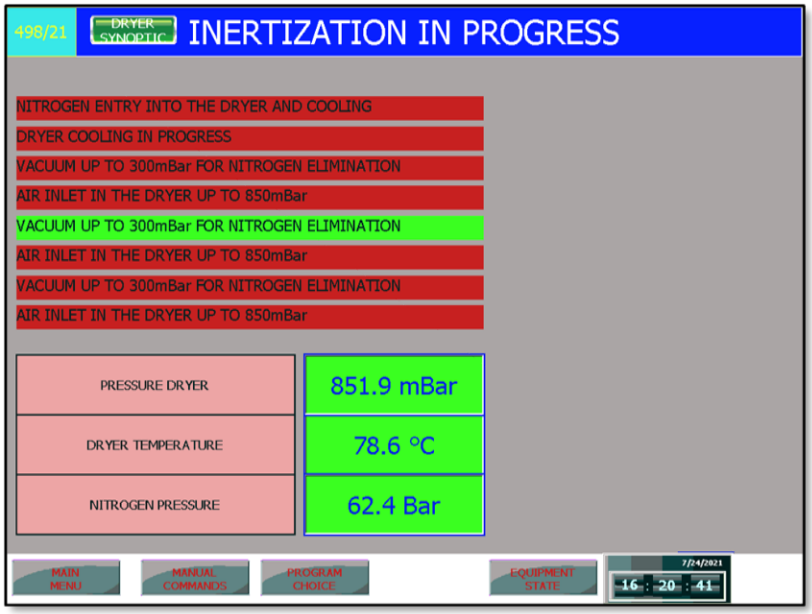
When the air temperature in the dryer is less than 80 ° C, the PLC start the phase of removing nitrogen from the dryer: this operation is very important because is necessary to remove all the nitrogen from the dryer before opening the door.
The first phase of this operation controlled by the PLC is the turning on the vacuum pump up to 300mBar.



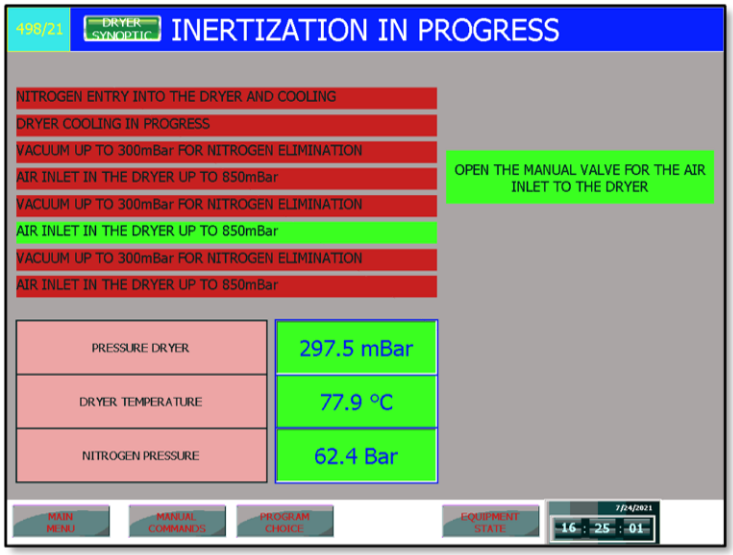
The PLC then commands the opening of the air inlet valve in the dryer and the message **OPEN MANUAL VALVE FOR AIR INLET TO THE DRYER** appears: open the manual valve for air inlet and leave it open until the nitrogen removal cycle is complete.



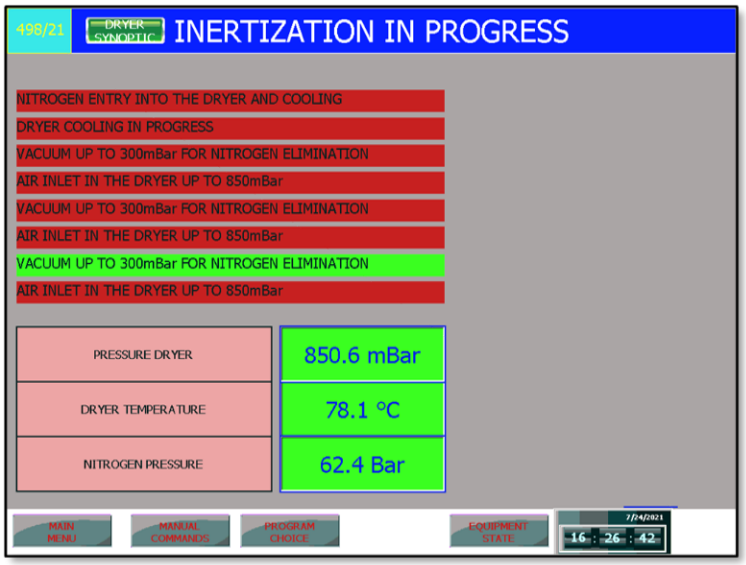
When the pressure of the dryer is greater than 850mBar, the PLC turn on the vacuum pump again up to 300mBar.



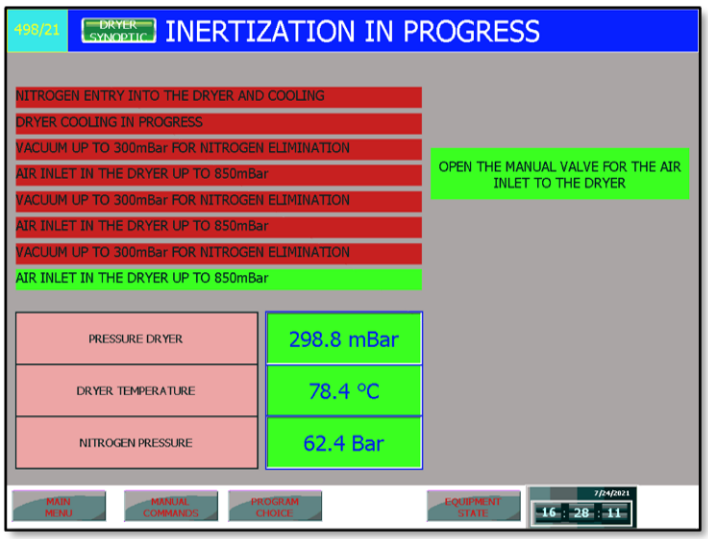
When the pressure in the dryer is less than 300mBar, the PLC open the air inlet valve.



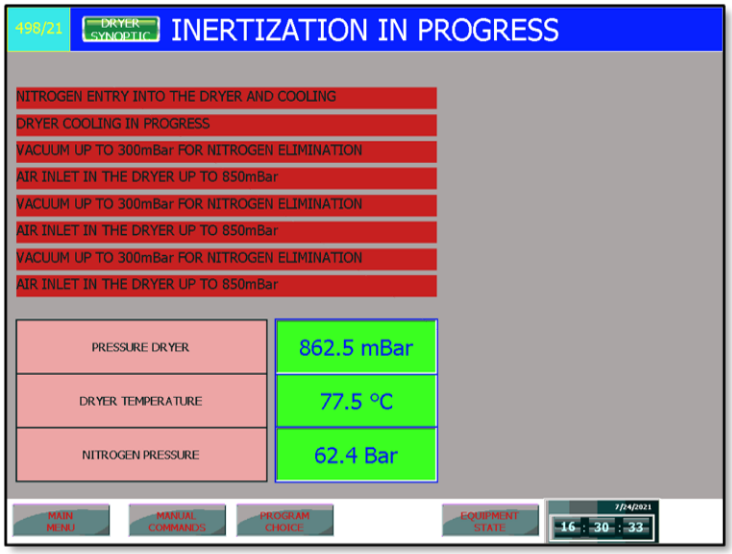
When the pressure of the dryer is greater than 850mBar, the PLC turn on the vacuum pump again up to 300mBar.



When the pressure in the dryer is less than 300mBar, the PLC open the air inlet valve.

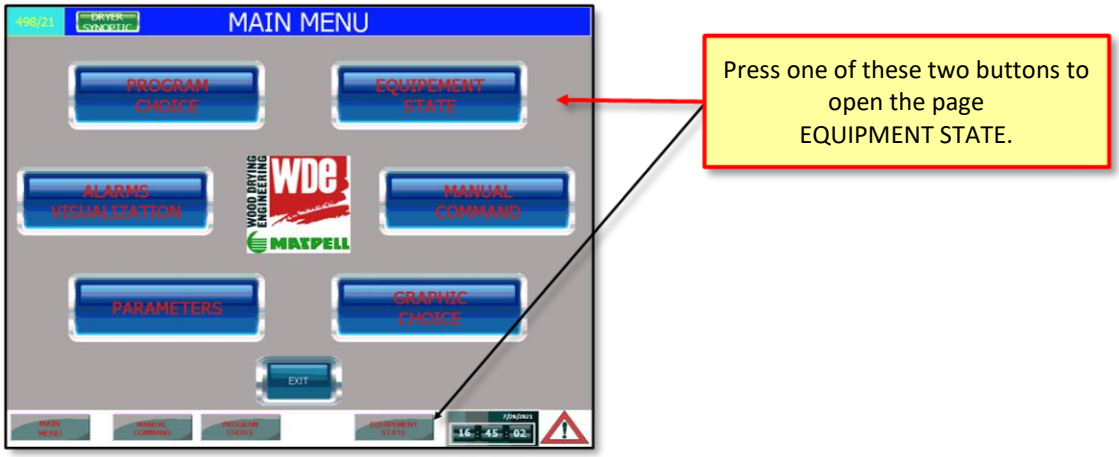


When the pressure of the dryer is greater than 850mBar, the nitrogen elimination cycle is finished.

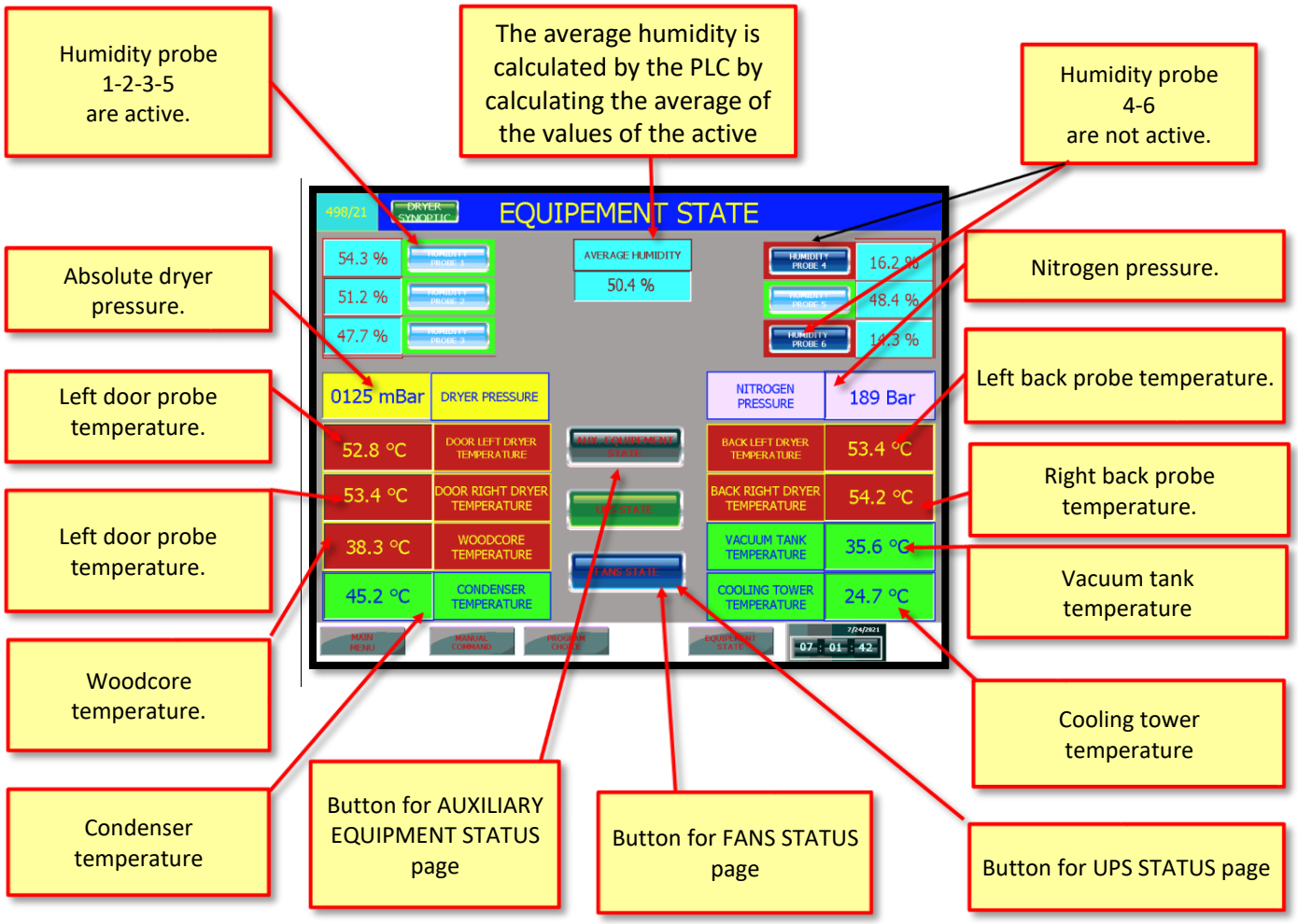


8.6 DISPLAY OF DRYER VARIABLES.

In the **EQUIPMENT STATE** page, it is always possible to view the temperature, pressure and humidity values measured by the probes.
The **EQUIPMENT STATE** page can be opened from the **MAIN MENU** page or by command bar on all pages.

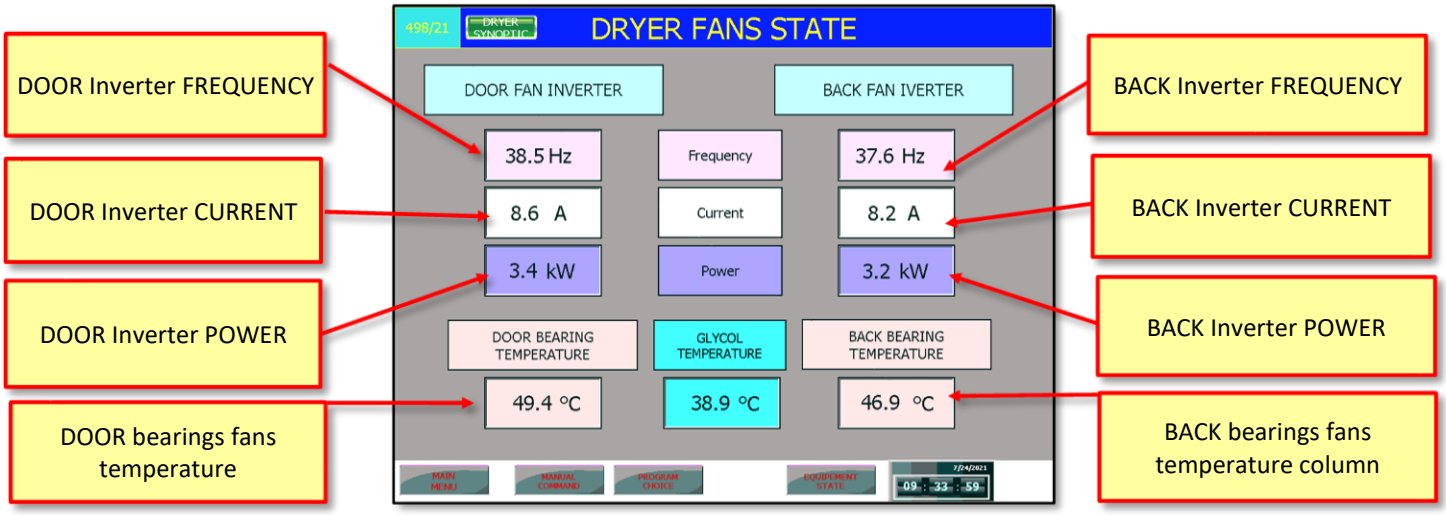


The EQUIPMENT STATUS page appears.

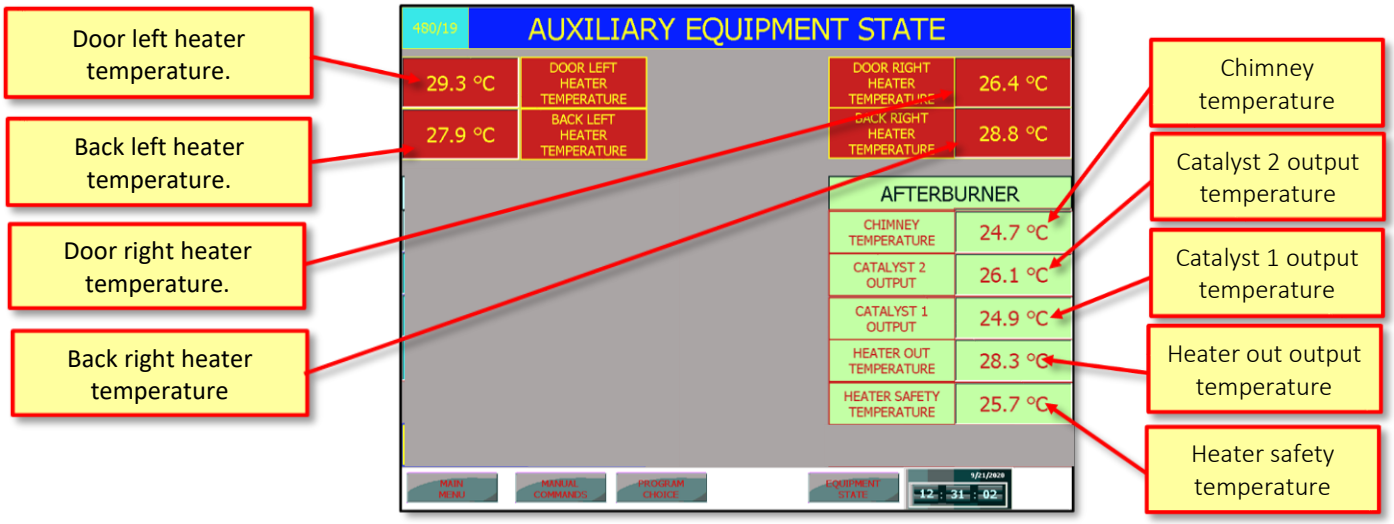


Press the FANS STATE button: the **DRYER FAN STATE** page appears:

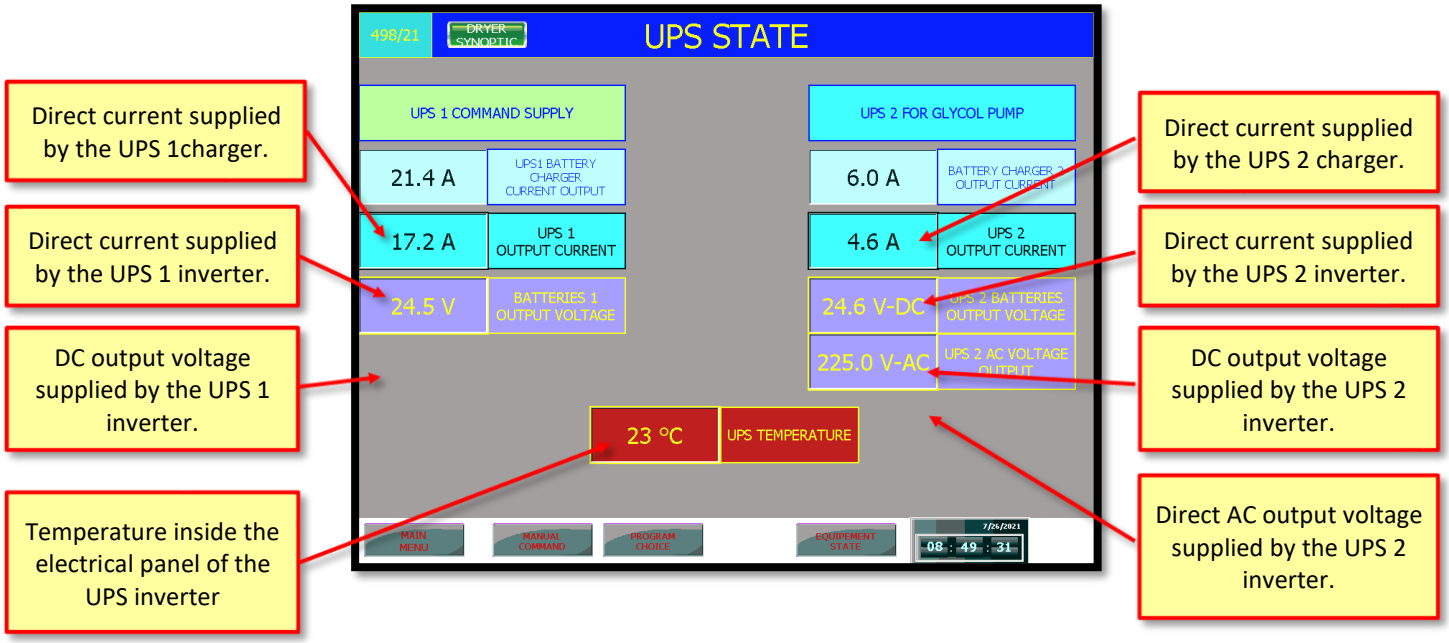
In this page there are all the information regarding to dryer fans and the inverter state in two different table: one for door fans and one for back fans.



Press the **AUX. EQUIPMENT STATE** button: the **AUX EQUIPMENT STATE** page appears:

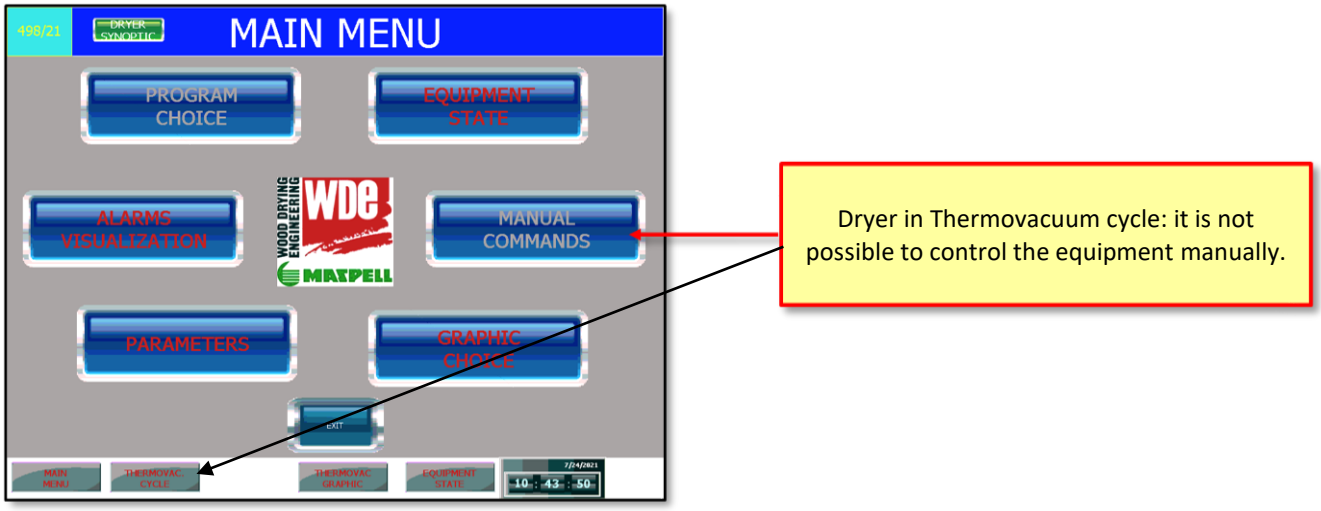


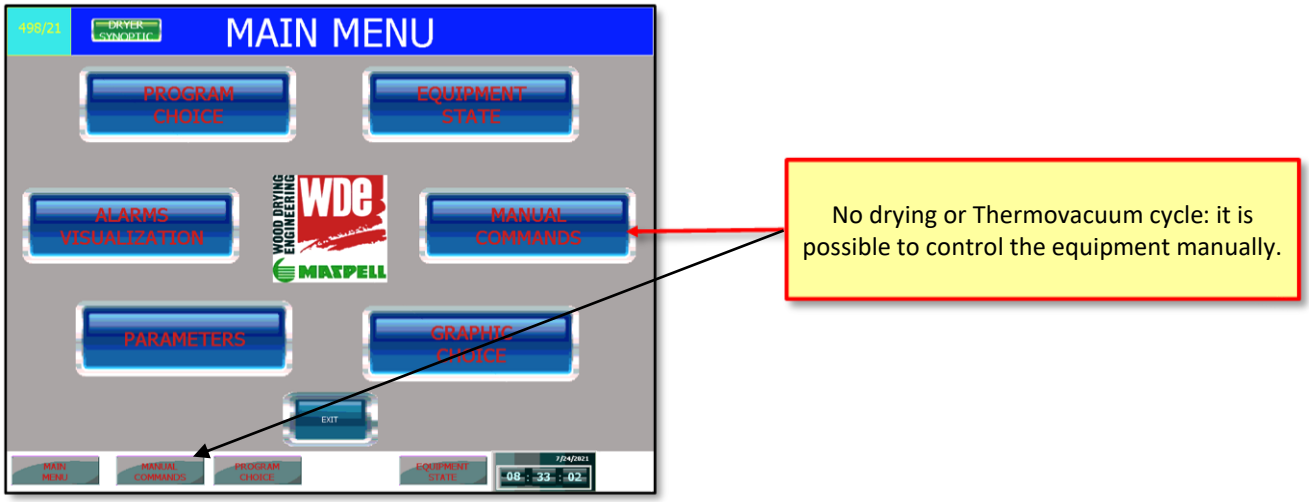
Press the UPS **STATE:** the UPS STATE page appears:



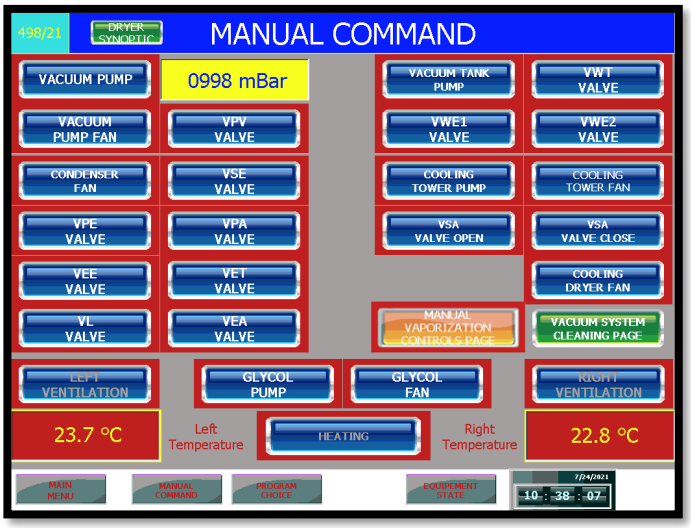
8.7 MANUAL COMMANDS.

If the dryer does not operate a drying or Thermovacuum cycle, it is possible to control the equipment manually.



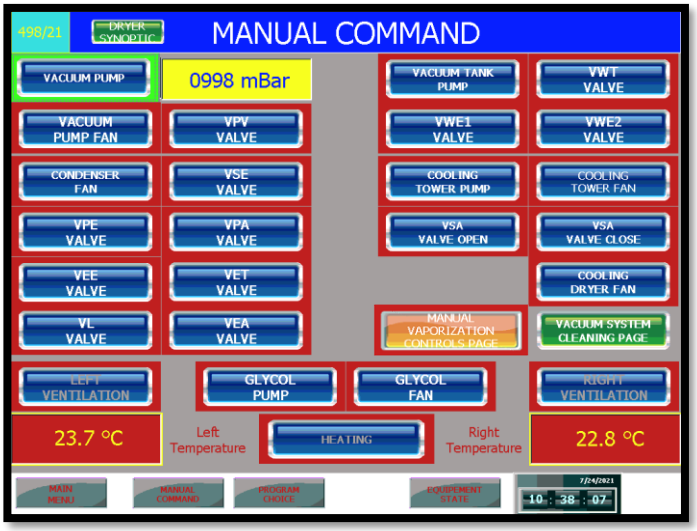


Press the **MANUAL COMMANDS** button: the following page appears.

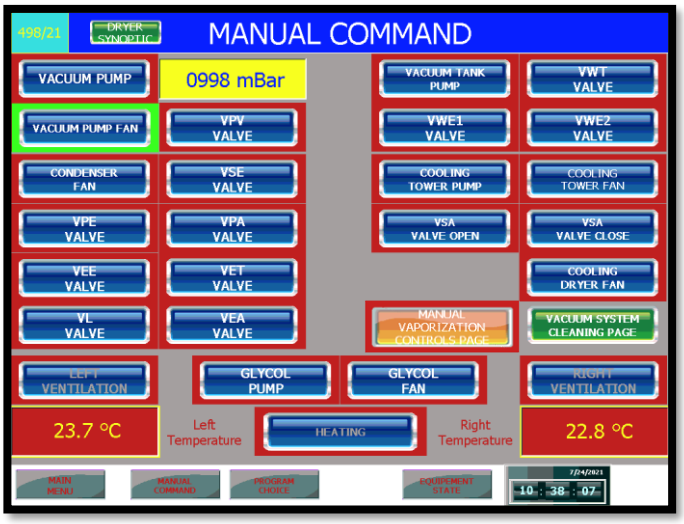


Press the **VACUUM PUMP** button: the button frame turns green and, if there are all conditions, the PLC turn on the vacuum pump.
Press the button again to stop the vacuum pump.

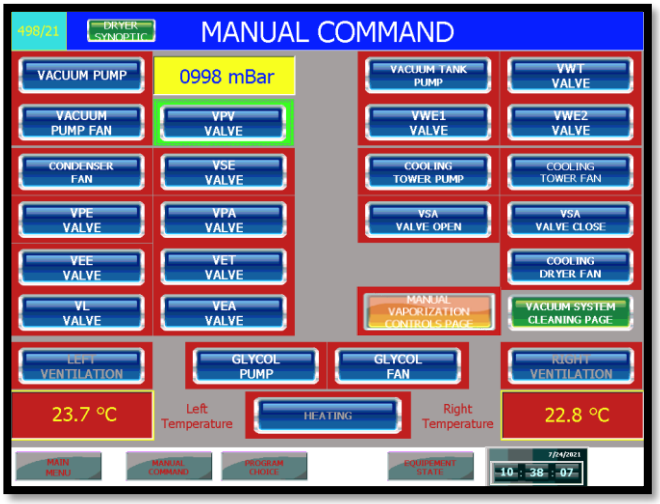
Warning: make sure the water supply to the vacuum pump.



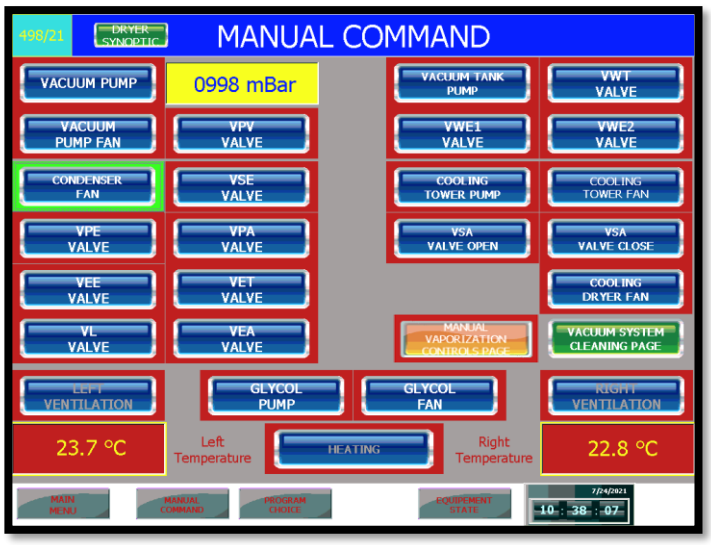
Press the **VACUUM PUMP** FAN button: The button frame turns green and, if there are all conditions, the PLC turn on the cooling fan of the vacuum pump motor.
Press the button again to stop the fan.



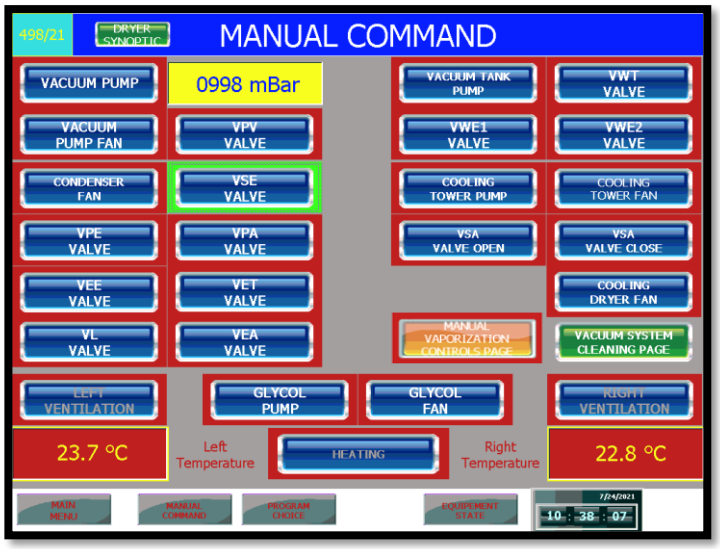
Press the **VPV VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.



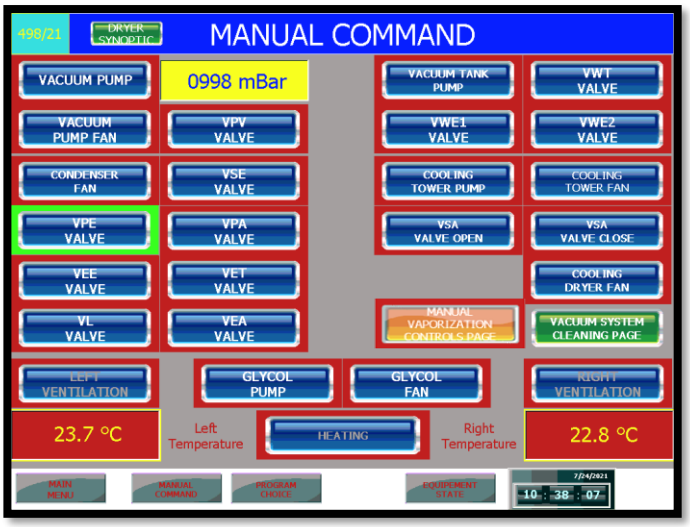
Press the **CONDENSER FAN** button: the button frame turns green and, if there are all conditions, the PLC turn on the condenser fan.
Press the button again to stop the condenser fan.



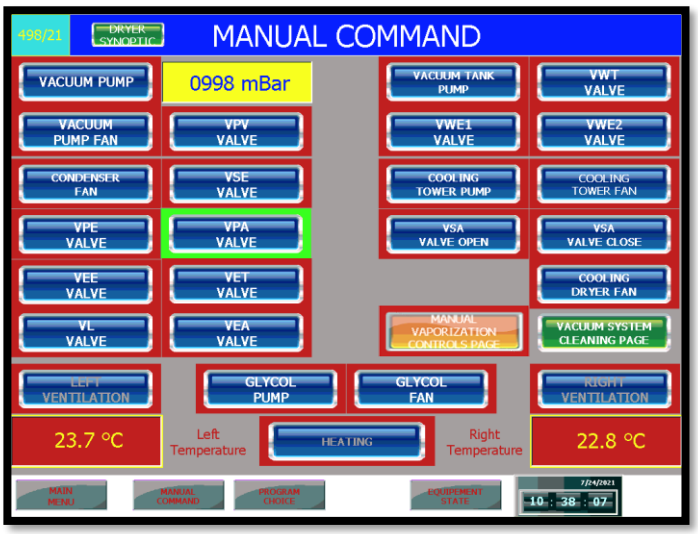
Press the **VSE VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.



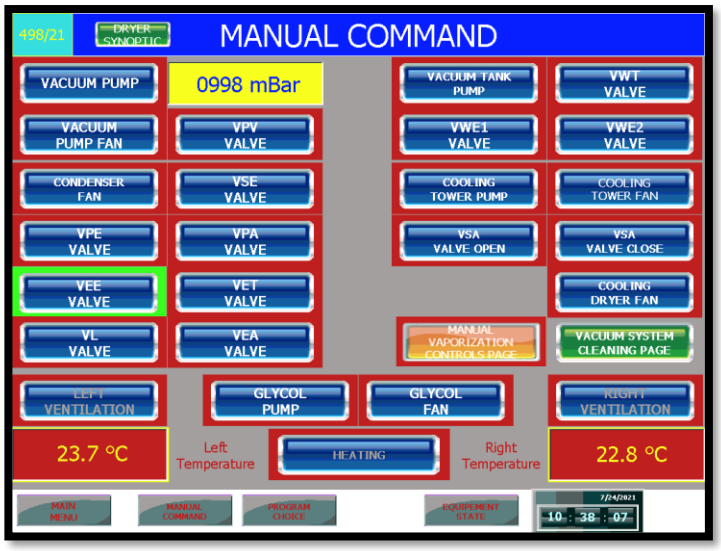
Press the **VPE VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.



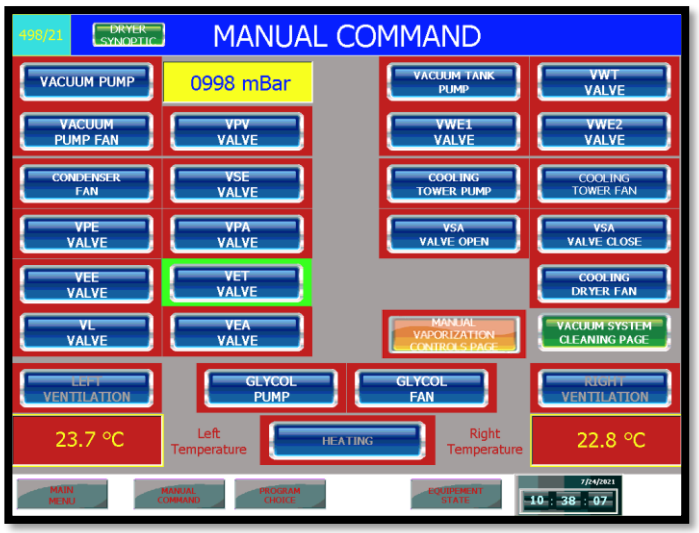
Press the **VPA VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.



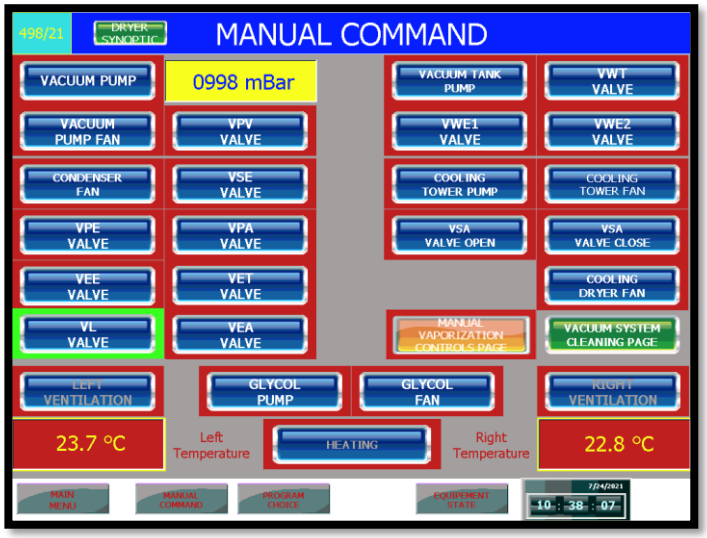
Press the **VEE VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.



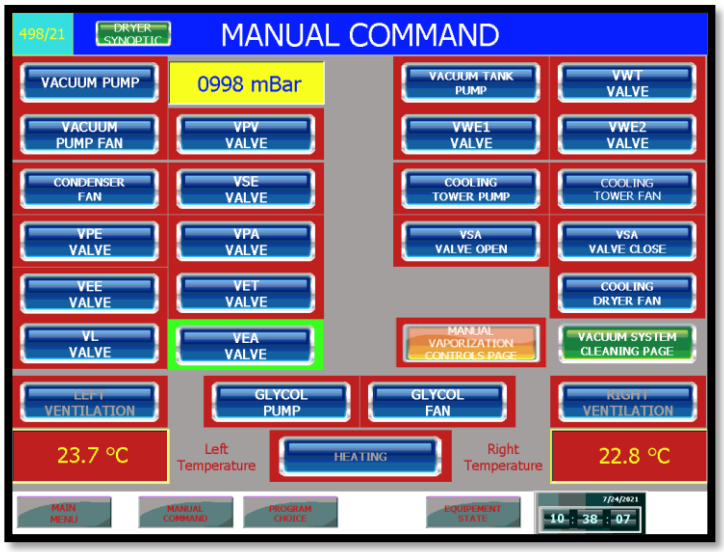
Press the **VET VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.



Press the **VL VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.

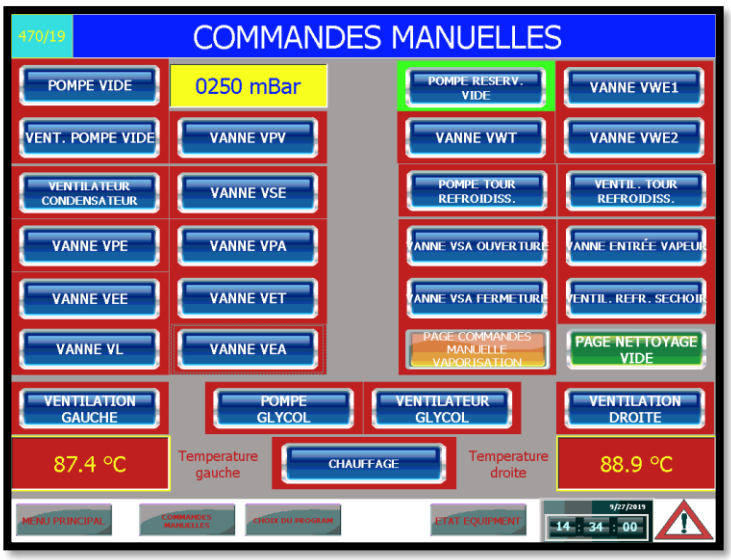


Press the **VEA VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.

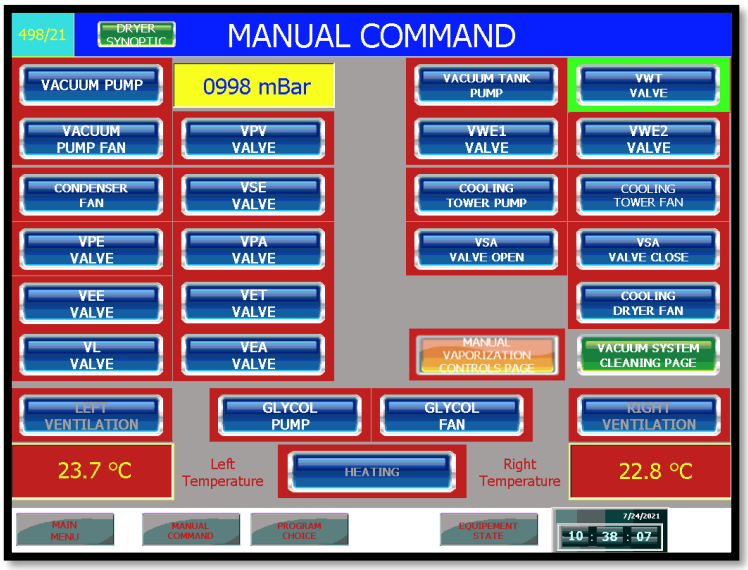


Press the **VACUUM TANK PUMP** button: the button frame turns green and, if there are all conditions, the PLC turn on the vacuum tank pump.
Press the button again to stop the vacuum tank pump.

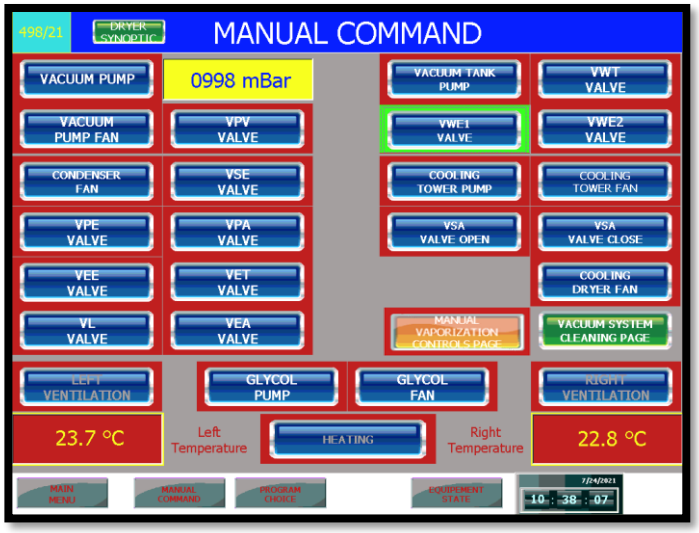
Warning: make sure the water level in the vacuum tank is correct.



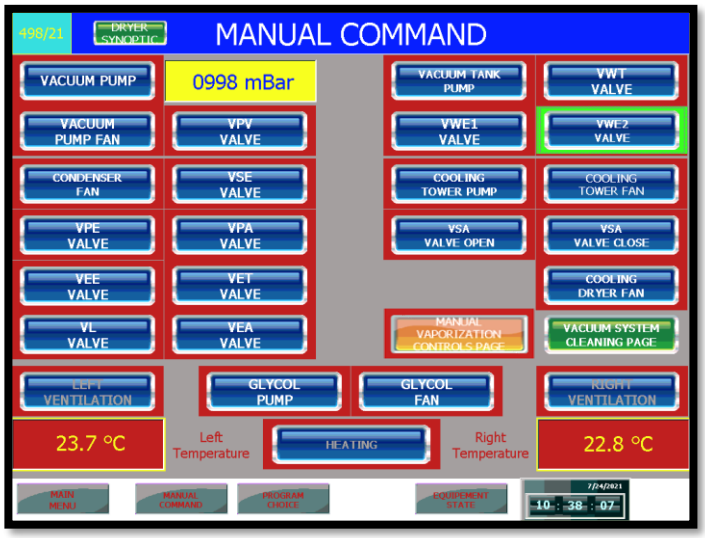
Press the **VWT VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.



Press the **VWE1 VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.

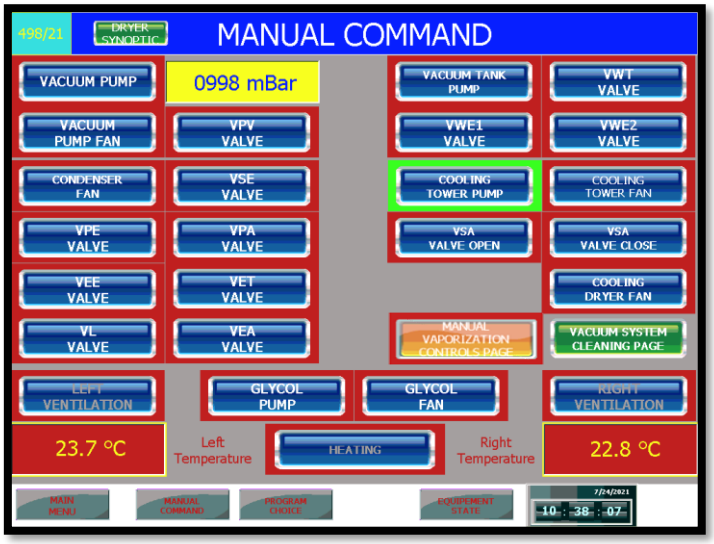


Press the **VWE2 VALVE** button: the button frame turns green and, if there are all the conditions, the PLC open the valve.
Press the button again to close the valve.

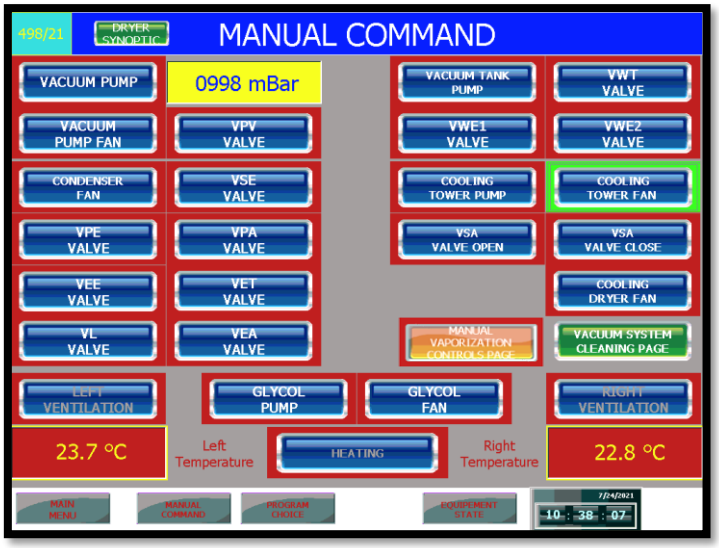


Press the **COOLING TOWER PUMP** button: the button frame turns green and, if there are all conditions, the PLC turn on the cooling tower pump.
Press the button again to stop the cooling tower pump.

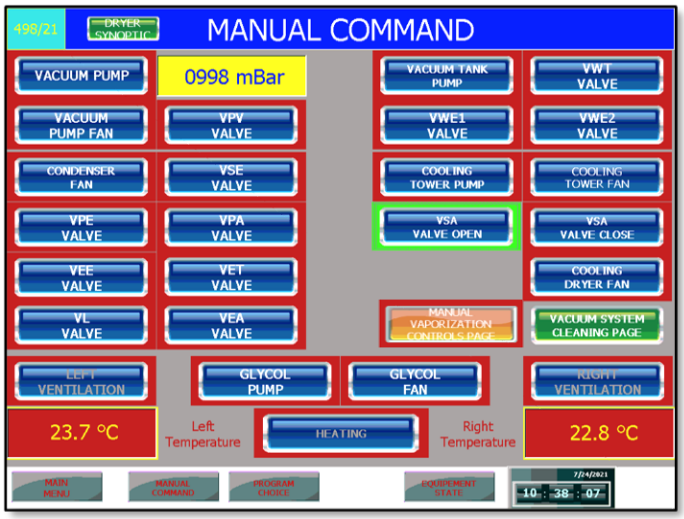
Warning: make sure the water level in the cooling tower is correct.



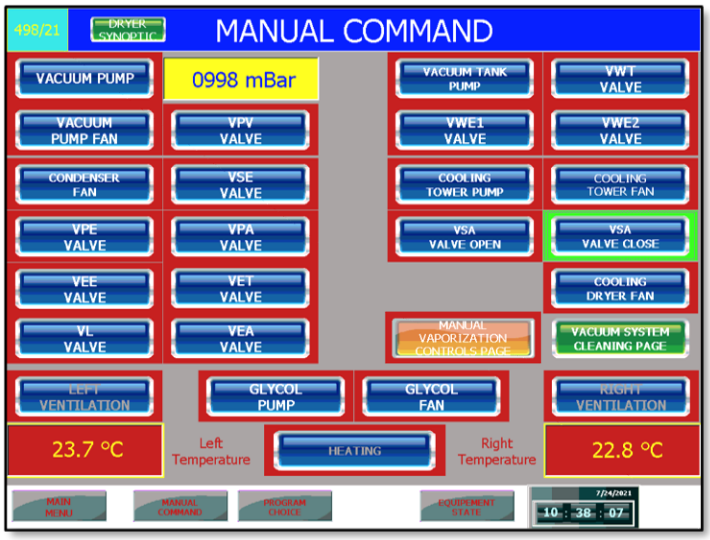
Press the **COOLING TOWER FAN** button: the button frame turns green and, if there are all conditions, the PLC turn on the cooling tower fan.
Press the button again to stop the cooling tower fan.



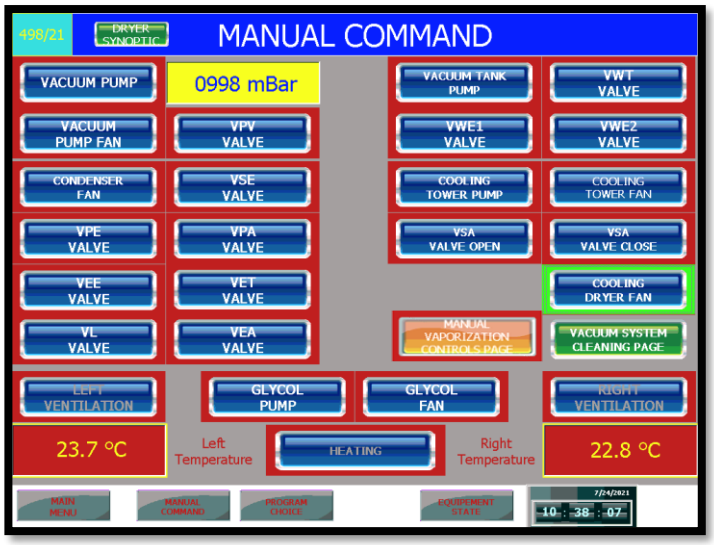
Press the **VSA VALVE OPEN** button: the button frame turns green and, if there are all conditions, the PLC open the shutter of the cooling dryer system.



Press the **VSA VALVE CLOSE** button: the button frame turns green and, if there are all conditions, the PLC close the shutter of the cooling dryer system.

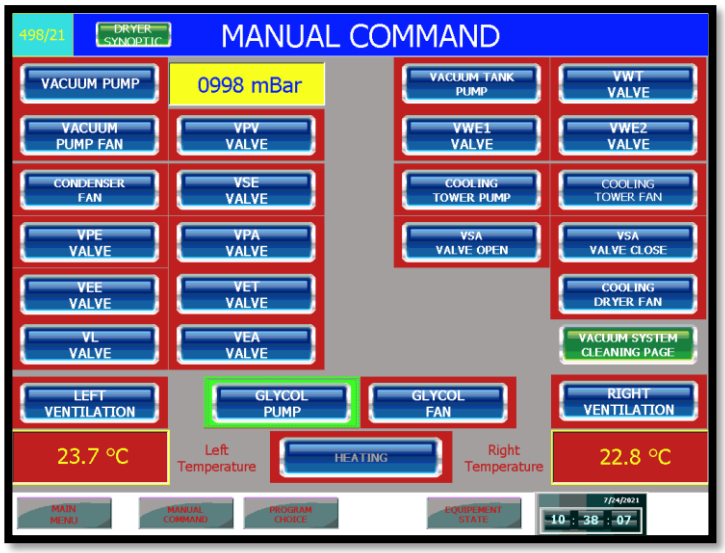


Press the **COOLING DRYER FAN** button: the button frame turns green and, if there are all conditions, the PLC turn on the cooling dryer fan.
Press the button again to stop the cooling dryer fan.

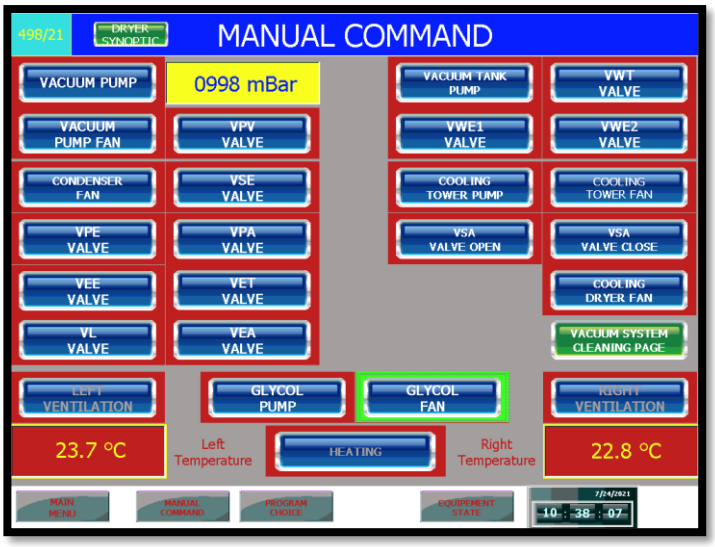


Press the **GLYCOL PUMP** button: the button frame turns green and, if there are all conditions, the PLC turn on the glycol pump.
Press the button again to stop the glycol pump.

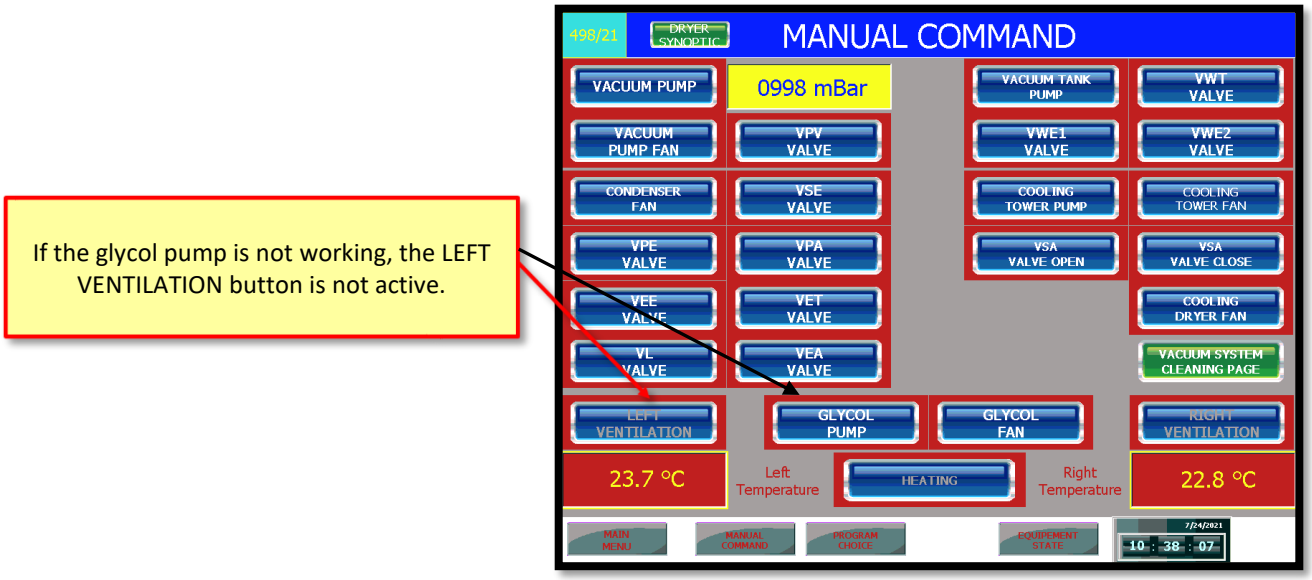
Warning: make sure the water level in the glycol tank is correct.



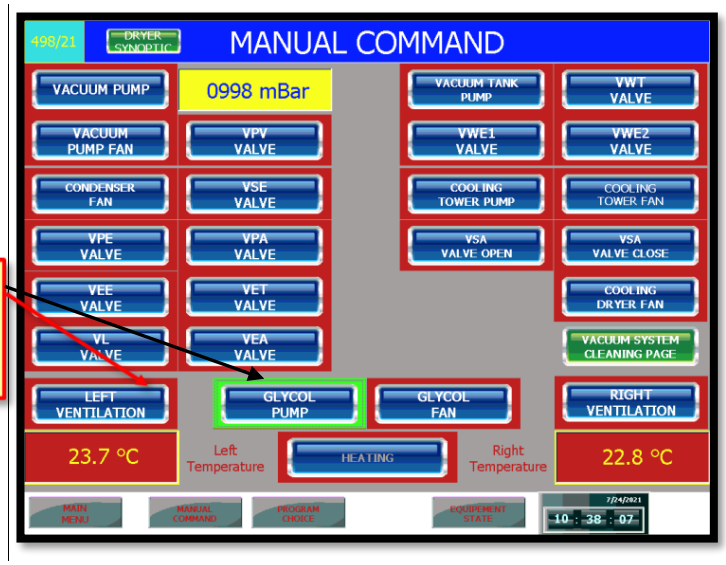
Press the **GLYCOL FAN** button: the button frame turns green and, if there are all conditions, the PLC turn on the glycol fan.
Press the button again to stop the glycol fan.



For **LEFT VENTILATION** manual command, the glycol pump must be on: if the glycol pump is not working, the **LEFT VENTILATION** button is not active.

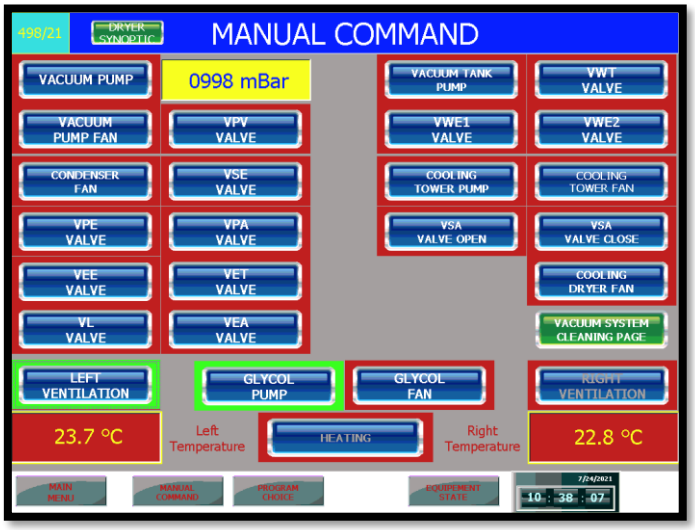


If the glycol pump is working, the LEFT VENTILATION button is active.

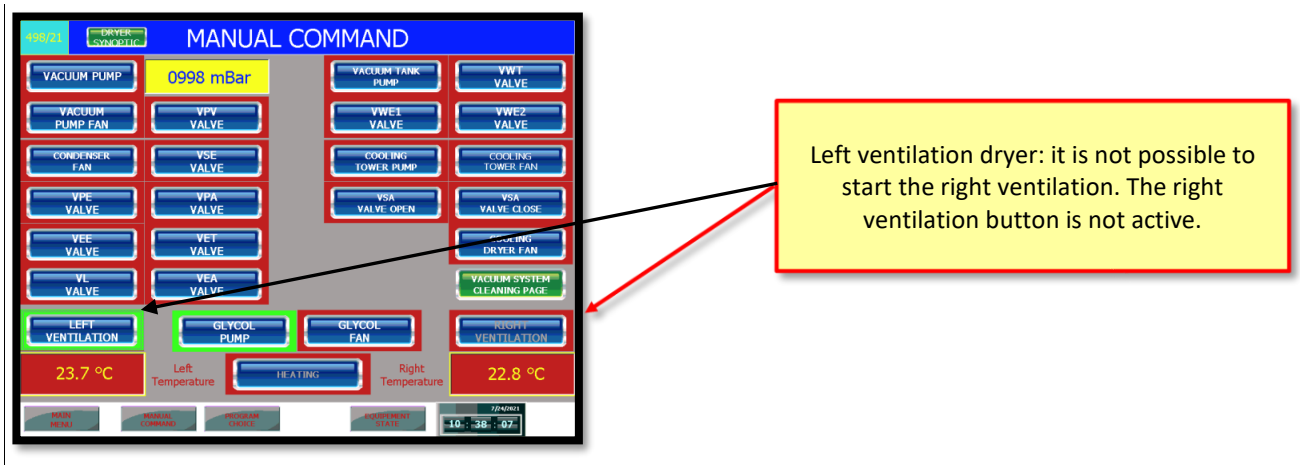


Press the **LEFT VENTILATION** button: the button frame turns green and, if there are all conditions, the PLC turn on the dryer fans in left rotation.
Press the button again to stop the fans.

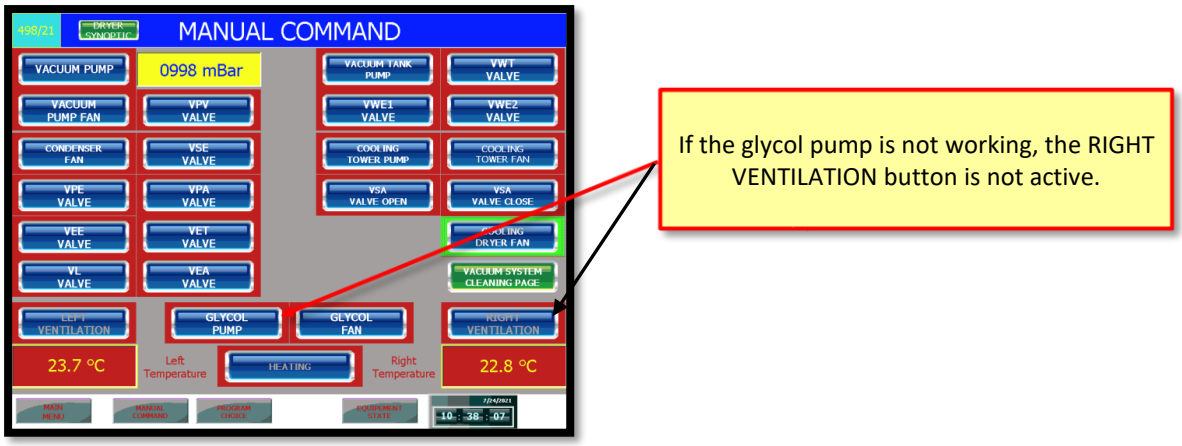
Warning: the fans starts only if the dryer door is closed.

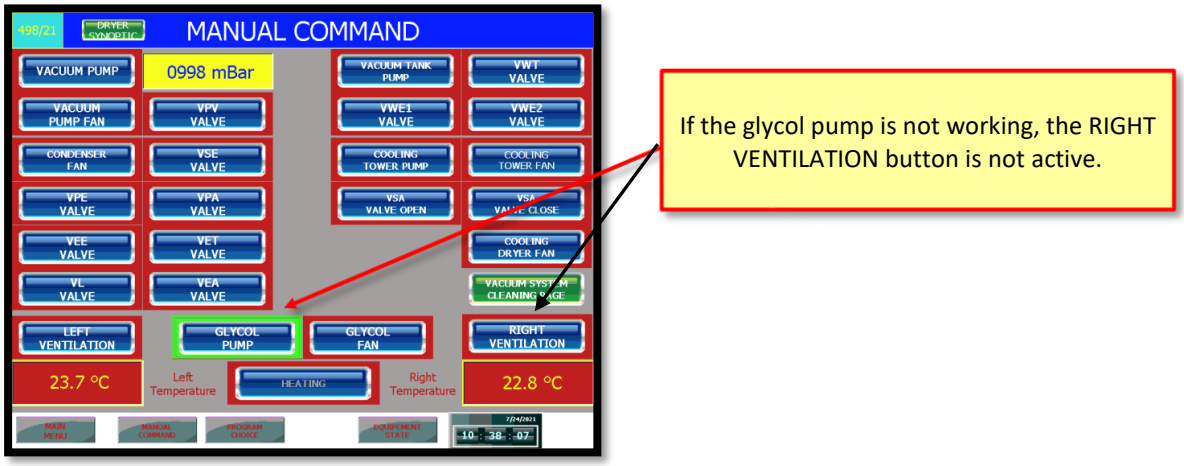


If you are in the left ventilation, it is not possible to start the right ventilation: the button of the right ventilation is not active.
The right ventilation button will only be active after 2 minutes, the left ventilation has been stopped.



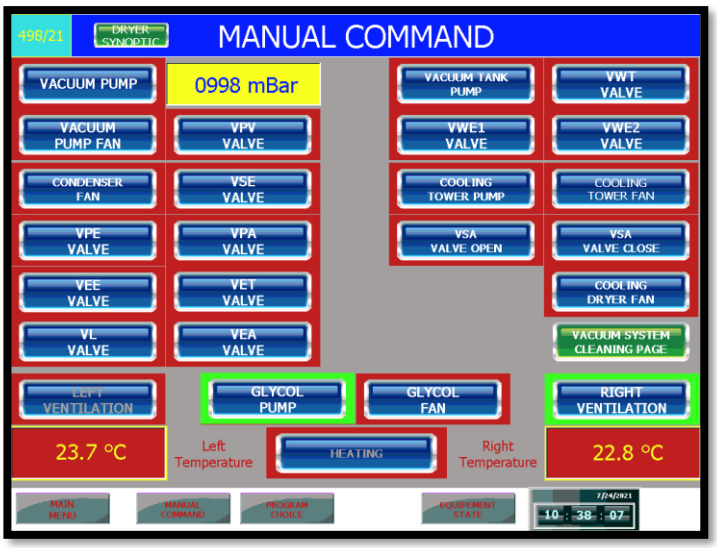
For **RIGHT VENTILATION** manual command, the glycol pump must be on: if the glycol pump is not working, the **RIGHT VENTILATION** button is not active.





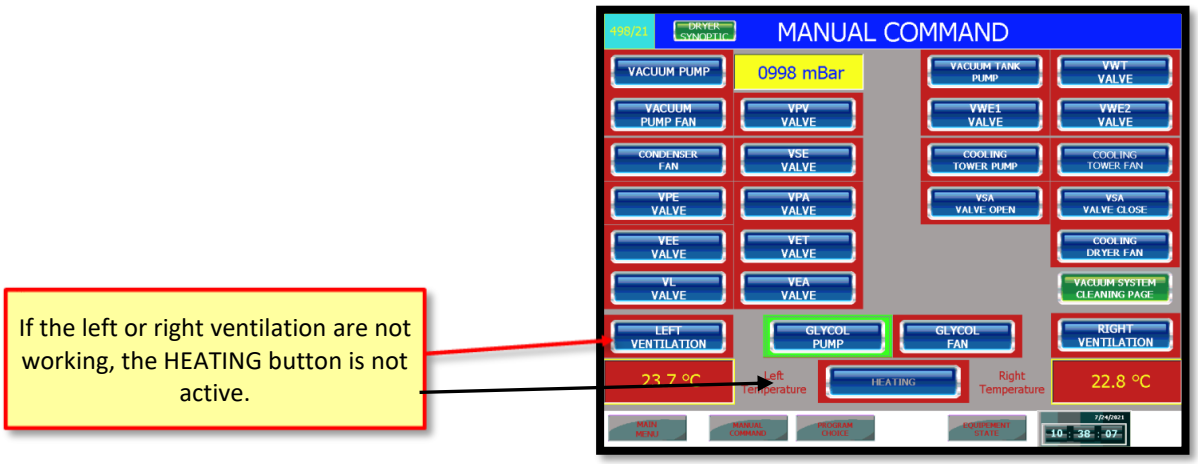
Press the **RIGHT VENTILATION** button: the button frame turns green and, if there are all conditions, the PLC turn on the dryer fans in right rotation.
Press the button again to stop the fans.

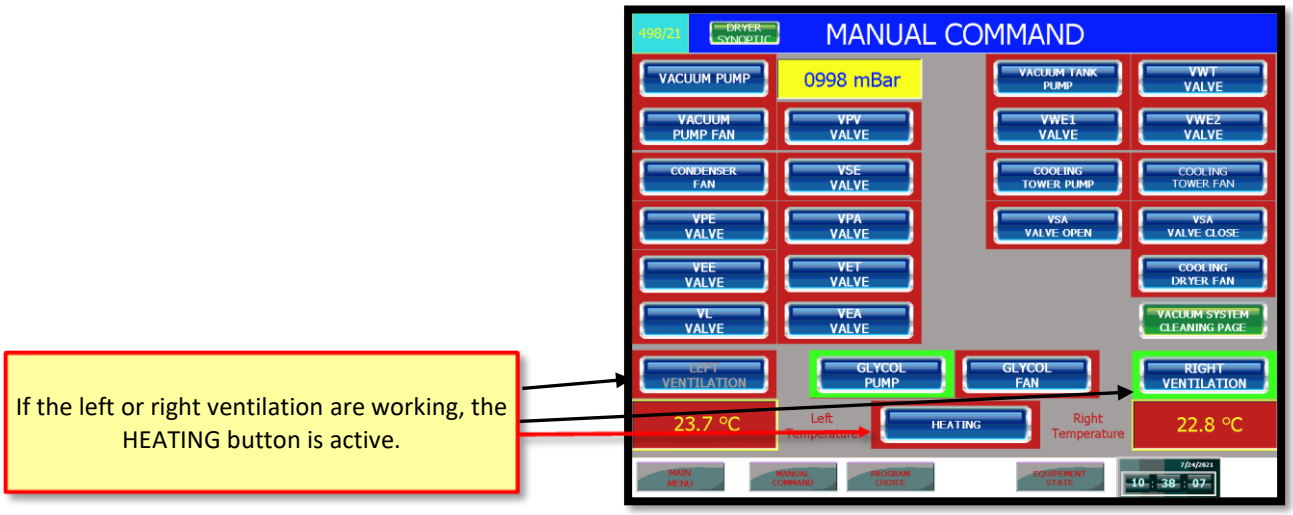
Warning: the fans starts only if the dryer door is closed.



If you are in the right ventilation, it is not possible to control the left ventilation: the left ventilation button is not active: The left ventilation button will only be active after 2 minutes, it has been activated. stopped the right ventilation.

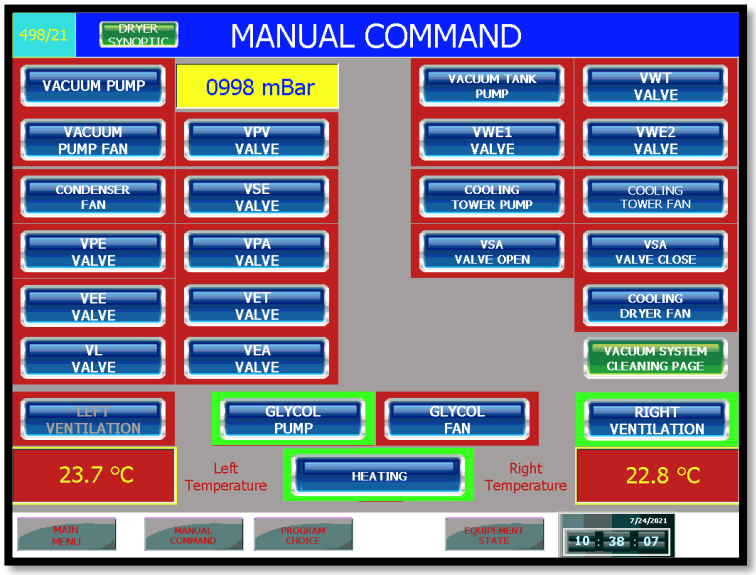
For manual control of the heating, the left or right ventilation must be on: if the left or right ventilation does not work, the **HEATING** button is not active.





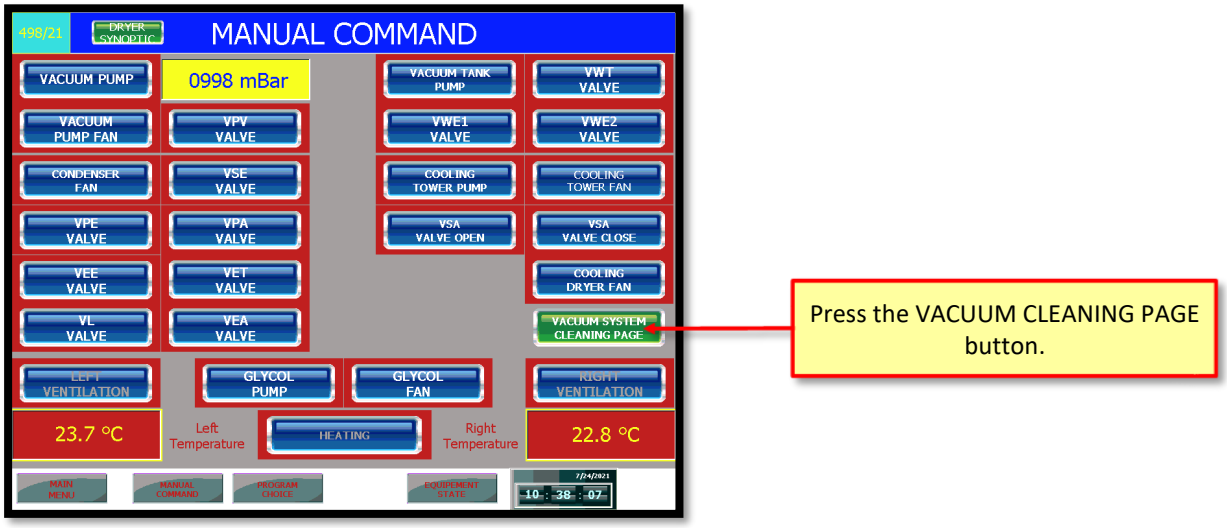
Press the **HEATING** button: the button frame turns green and, if there are all conditions, the PLC controls the heating.
Press the button again to stop the heating.

Warning: the heating only works if the dryer door is closed.

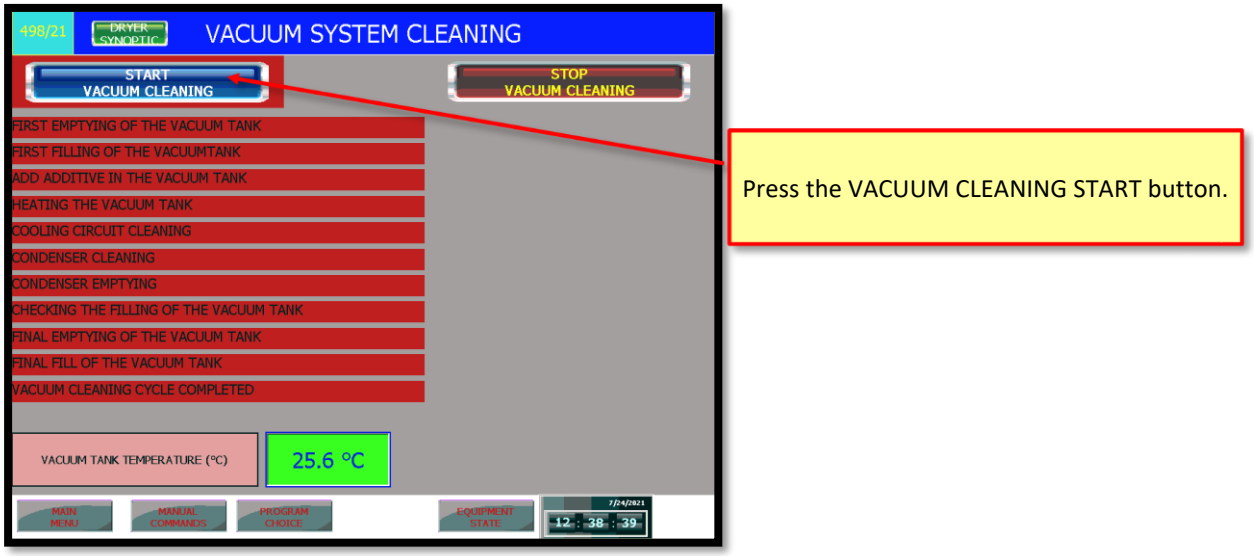


8.7.1 CLEANING THE VACUUM CIRCUIT.

The cleaning of the vacuum circuit is a very important operation for the good functioning of the dryer.
After a certain number of Thermovacuum cycles (established with the customer), the PLC does not allow the start of a new Thermovacuum or drying cycle, if you do not perform a cleaning of the vacuum circuit.
Press the **VACUUM CLEANING PAGE** button.

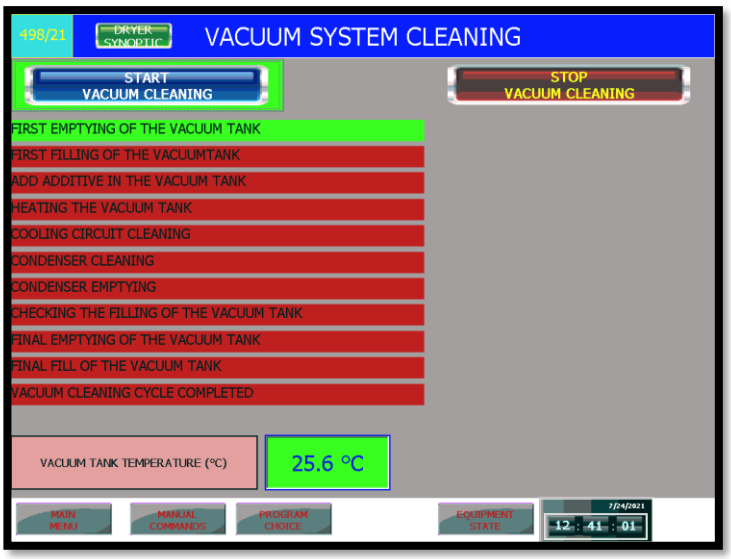


The **VACUUM SYSTEM CLEANING** page appears: press the VACUUM CLEANING START button.

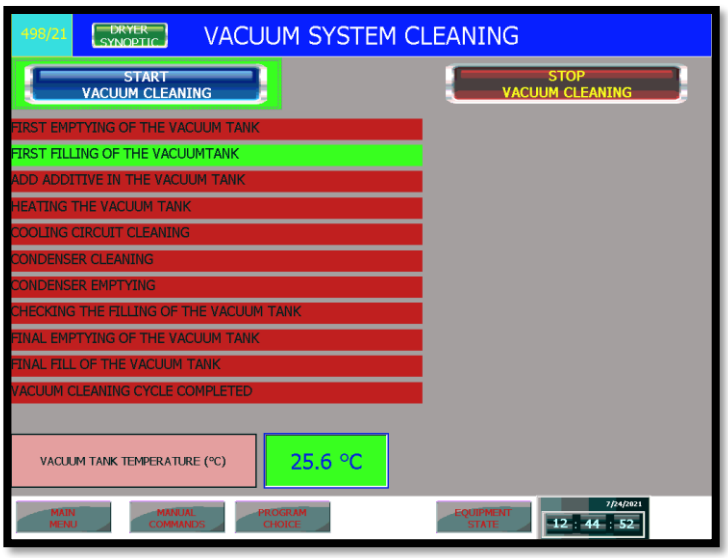


The frame of the **START VACUUM CLEANING** button turns green and, if all conditions exist, the PLC controls the first stage of the automatic vacuum circuit cleaning cycle.

The **FIRST EMPTY TANK EMPTY** dialog box turns green and the PLC controls if the vacuum tank is empty.
If you want to interrupt the automatic cleaning cycle of the vacuum circuit, press the **STOP VACUUM CLEANING** button.

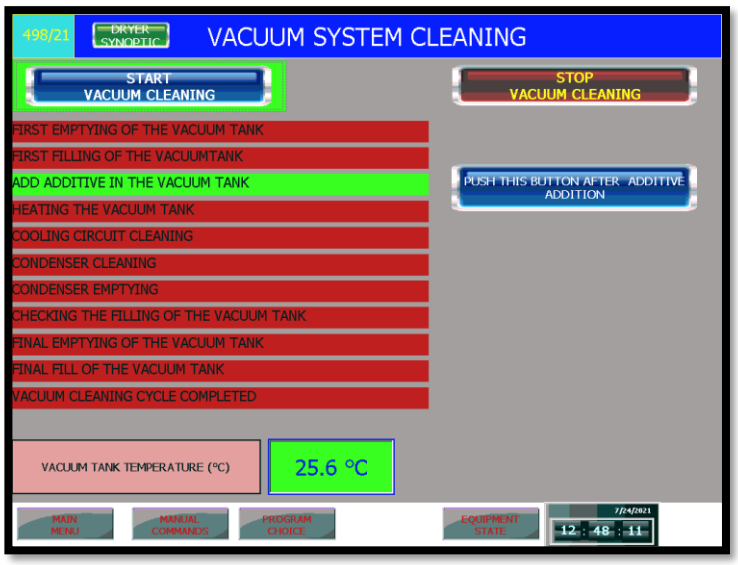


After the PLC controls the filling of the vacuum tank with the VWT valve: the **FIRST FILLING OF EMPTY TANK** dialog box turns green.

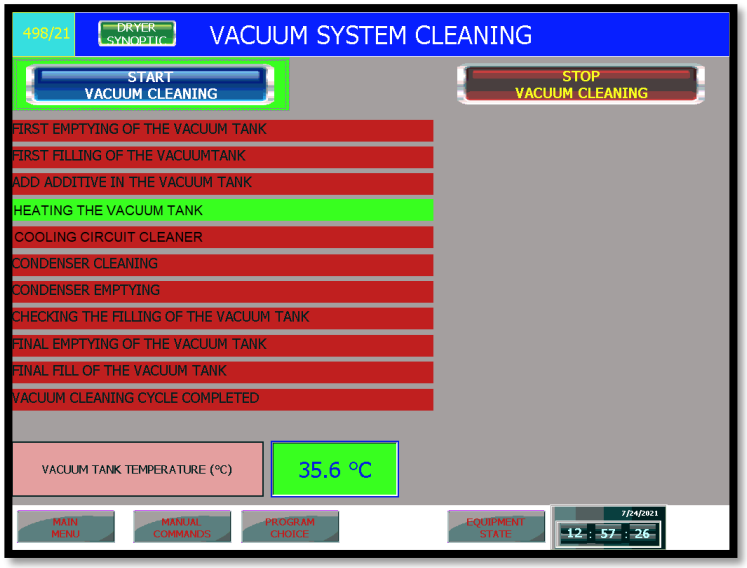


After filling the vacuum tank, the PLC asks to add the vacuum circuit cleaning additive: the **ADD ADDITIVE TO VACUUM TANK** dialog box turns green and appears the button **PRESS THIS BUTTON AFTER ADDITIVE ADDITION**.

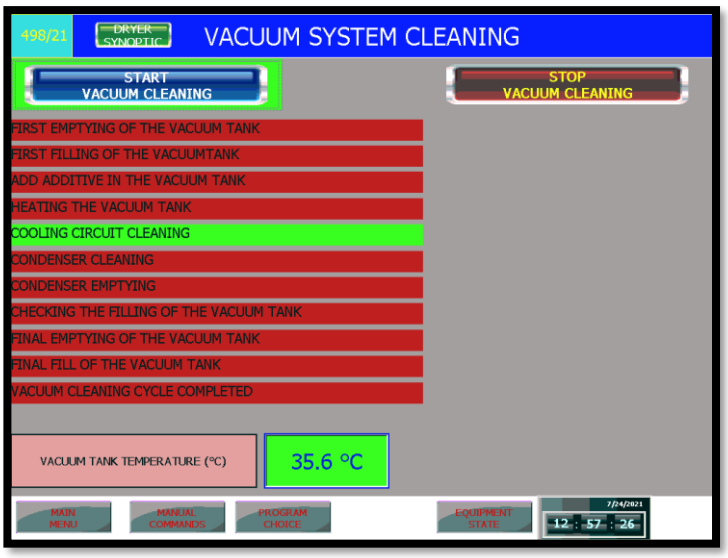
Put the additive in the vacuum tank, then press the button **PRESS THIS BUTTON AFTER ADDITIVE ADDITION**.



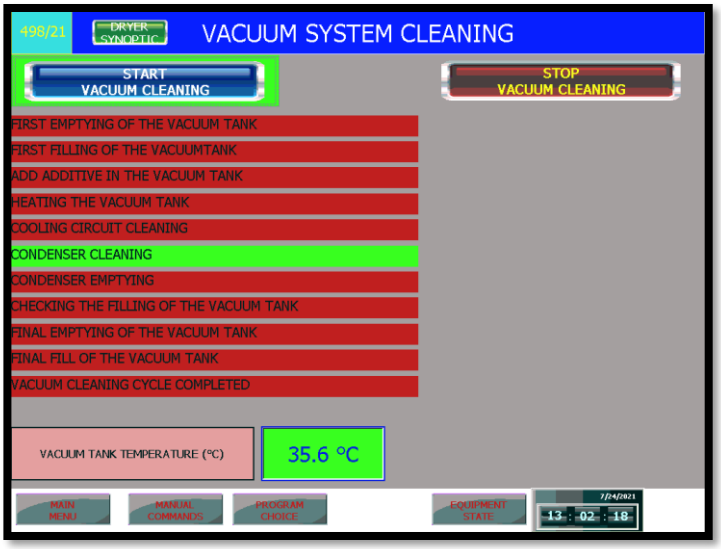
Put the additive in the vacuum tank, then press the button **PRESS THIS BUTTON AFTER ADDITIVE ADDITION**.
The PLC starts the heating of the water in the vacuum tank: the **VACUUM TANK HEATING** dialog box turns green.
Below you can see the water temperature in the vacuum tank.



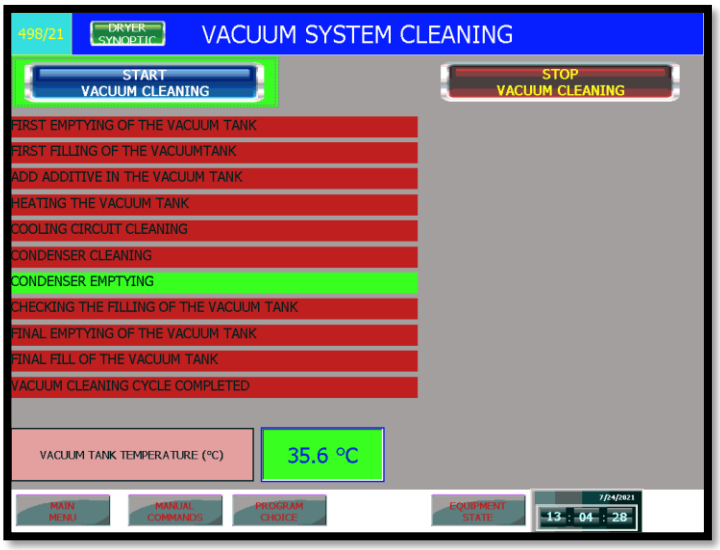
After the water temperature in the vacuum tank has reached 35 ° C, the PLC starts the cleaning of the vacuum tank/cooling tower heat exchanger: the **COOLING CIRCUIT CLEANING** dialog box turns green.
This operation goes on for 10 minutes.



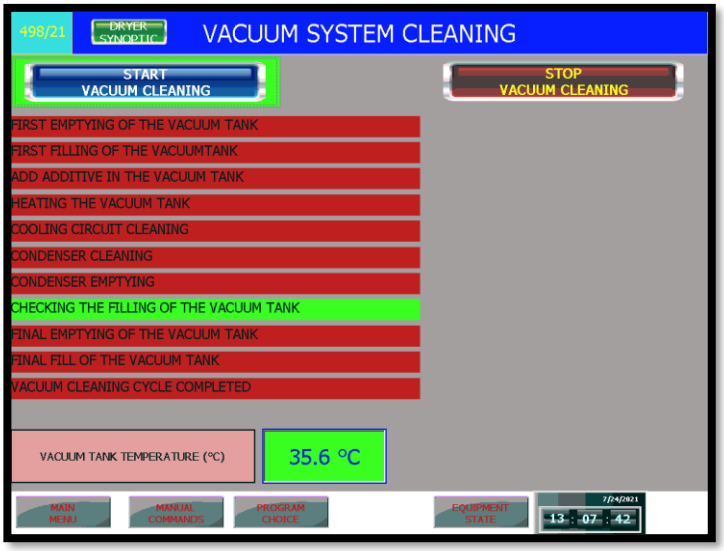
After the PLC starts the condenser cleaning: the **CONDENSER CLEANING** dialog box turns green.
Also, this operation goes on for 10 minutes.



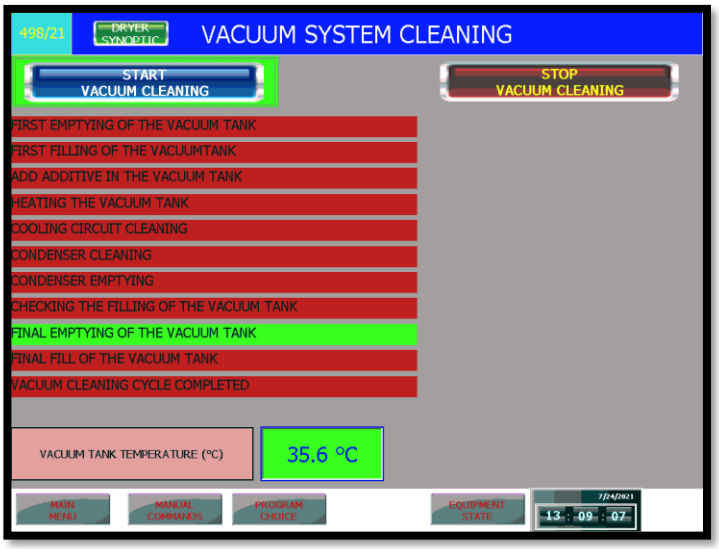
After, the PLC starts the emptying of the condenser: the dialog box **CONDENSER EMPYING** turns green.



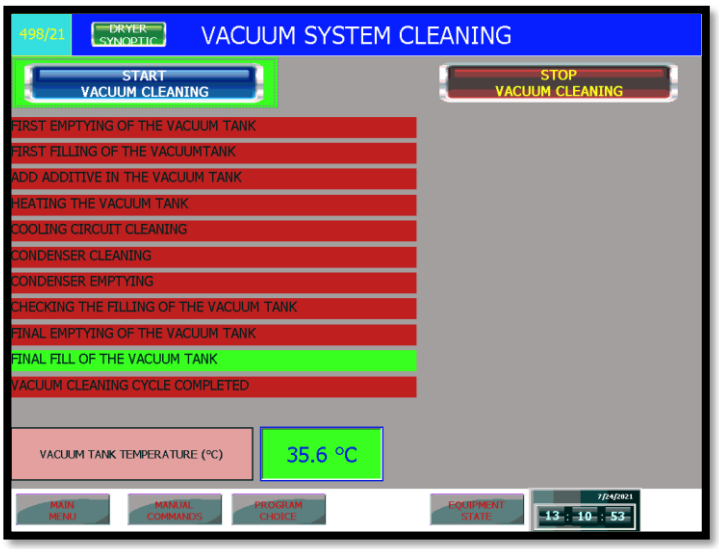
After emptying the condenser, the PLC checks the level of the vacuum tank and, if necessary, refills the missing water: the dialog box **CHECKING THE FILLING OF THE VACUUM TANK** turns green.



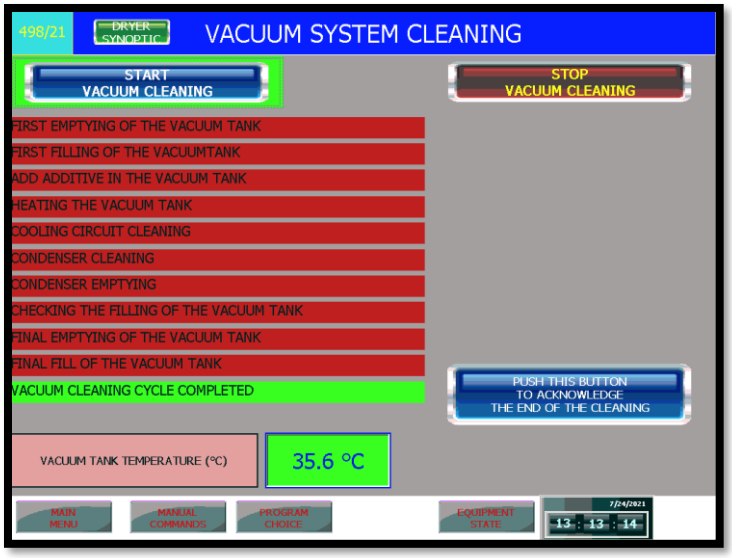
After the PLC starts the final emptying of the vacuum tank: the **FINAL EMPTYING OF THE VACUUM TANK** dialog box turns green.



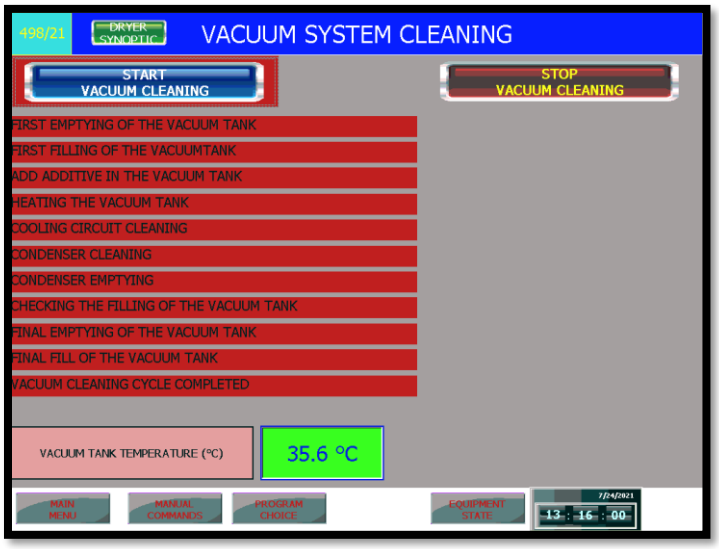
After the PLC starts the final filling of the vacuum tank: the **FINAL FILLING OF THE VACUUM TANK** dialog box turns green.



Finally, the PLC informs that the vacuum circuit cleaning is finished: the **VACUUM CLEANING CYCLE COMPLETED** dialog box turns green and a button with the message **PUSH THIS BUTTON TO ACKNOLEDGE THE END OF CLEANING** appears.

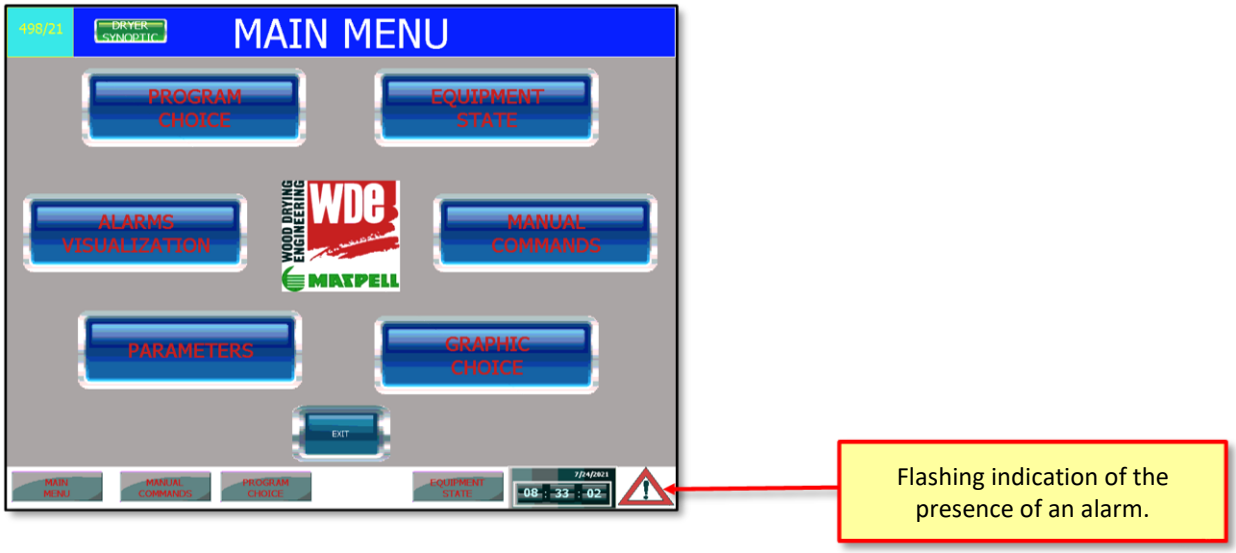


Press the button **PUSH THIS BUTTON TO ACKNOLEDGE THE END OF CLEANING**: the PLC commands the end of the automatic cleaning of the vacuum circuit and the page appears as below.

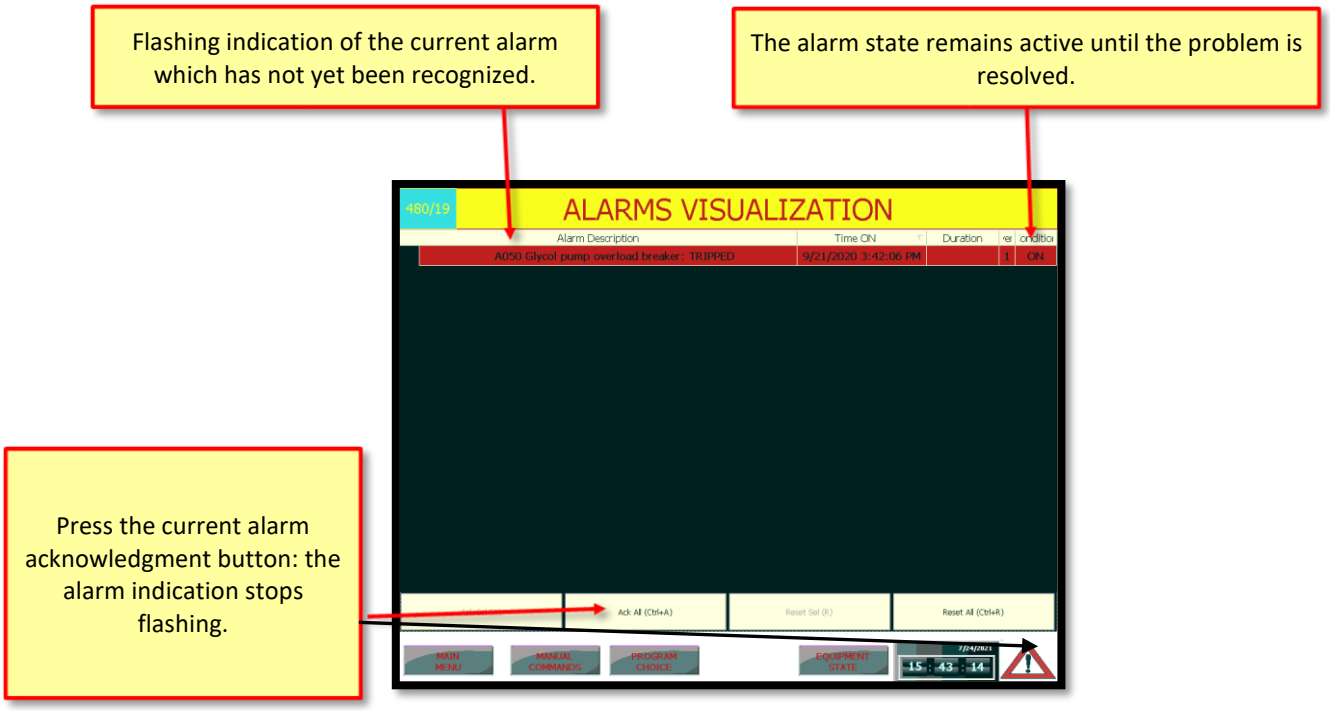


8.8 ALARMS VISUALIZATION

If there is a problem on the dryer, the PLC stops all the equipment and signals this with a flashing indication on the command bar: the cycle is paused.
Press the button of the flashing indication to open the **ALLARMS** page.

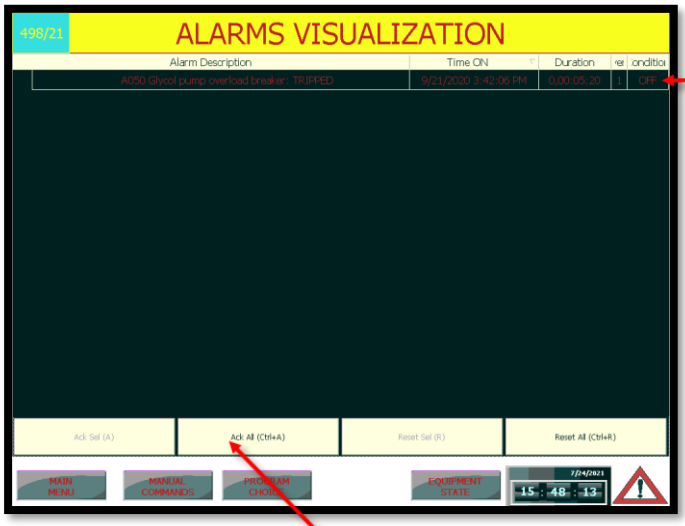


The **ALARMS DISPLAY** page appears.



When the cause of the alarm has been resolved, the alarm state becomes OFF and the PLC automatically restarts the cycle.

The alarm indication on the control bar will continue to flash until the alarm is reset with the RESET ALL button.



The cause of the alarm has been resolved, the alarm state becomes OFF and the PLC automatically restarts the cycle.

The alarm indication on the control bar will continue to flash until the alarm is reset with the RESET ALL button.

Alarm list:

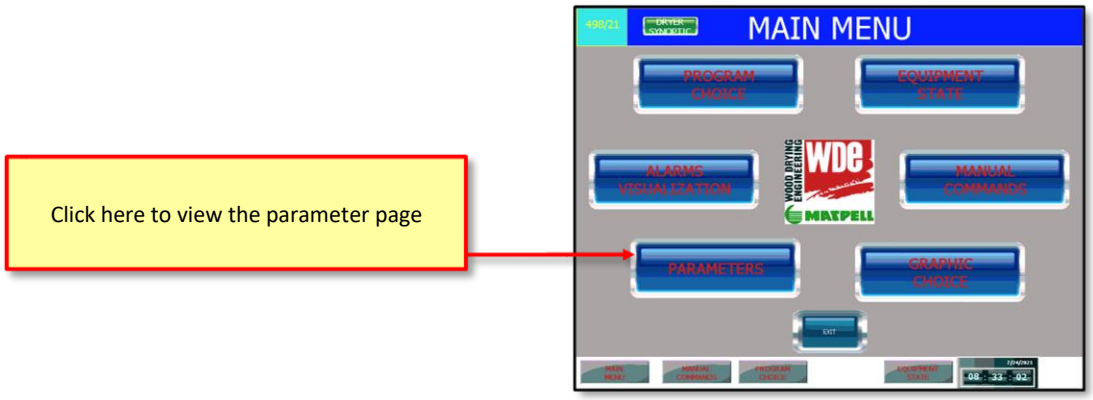
A001 Emergency button switched
A002 Door not closed
A003 In_Out card communication failure
A004 Door right temperature probe failure
A005 Door left temperature probe failure
A006A DoorRightSafeThermostat
A006B DoorLeftSafeThermostat
A007 Door high temperature right probe
A008 Door high temperature left probe
A009 Back right temperature probe failure
A010 Back left temperature probe failure
A011A BackRightSafeThermostat
A011B BackLeftSafeThermostat
A012 Back high temperature right probe
A013 Back high temperature left probe
A014 Dryer door fan inverter failure
A015 Dryer door fan motor overload
A016 Dryer back fan inverter failure
A017 Dryer back fan motor overload

A017A Dryer back fan failure
A020A Condenser fan VC1 motor overload
A020B Condenser fan VC2 motor overload
A022 Cooling tower pump motor overload
A023 Cooling tower fan motor overload
A024 Cooling tower antifreeze heating breaker
A025 Condenser temperature probe failure
A026 Cooling tower temperature probe failure
A028 Cooling tower low level
A040 High temperature in drying cycle
A041 Low pressure in drying cycle
A047 Woodcore temperature probe failure
A050 Glycol pump overload
A051 Glycol fan overload
A052 Vacuum tank pump overload
A053 Vacuum pump fan overload
A054A Dryer cooling fan VRE1 overload
A054B Dryer cooling fan VRE2 overload
A057 Power voltage failure
A058 Command voltage failure
A059A UPS1 failure
A059B UPS2 failure
A060 Electric cabinet high temperature
A061 Glycol temperature probe failure
A062 Vacuum tank temperature probe failure
A063 Door fan shaft temperature probe failure
A064 Back fan shaft temperature probe failure
A065 GlycolTankLowLevel
A066 Glycol TankVeryLowLevel
A067F Glycol Back Low Flow
A067P Glycol Door Low Flow
A068 Nitrogen pressure low
A069 Nitrogen pressure very low
A070 Compressed air pressure low
A071 Vacuum tank refilling time too long
A072 Vacuum tank max level time too long
A073 Condenser air pump emptying time too long
A075 Dryer high pressure
A076 Dryer high pressure inertizing
A077 Dryer high temperature
A078 Dryer high temperature inertizing
A079 Nitrogen pressure transmitter fail
A080 HumidityCardCommFailure
A081A Dryer Z8AI card2 Comm Failure
A081B Dryer Z8AI card3 Comm Failure
A082 VacuumSenecaCardCommFailure

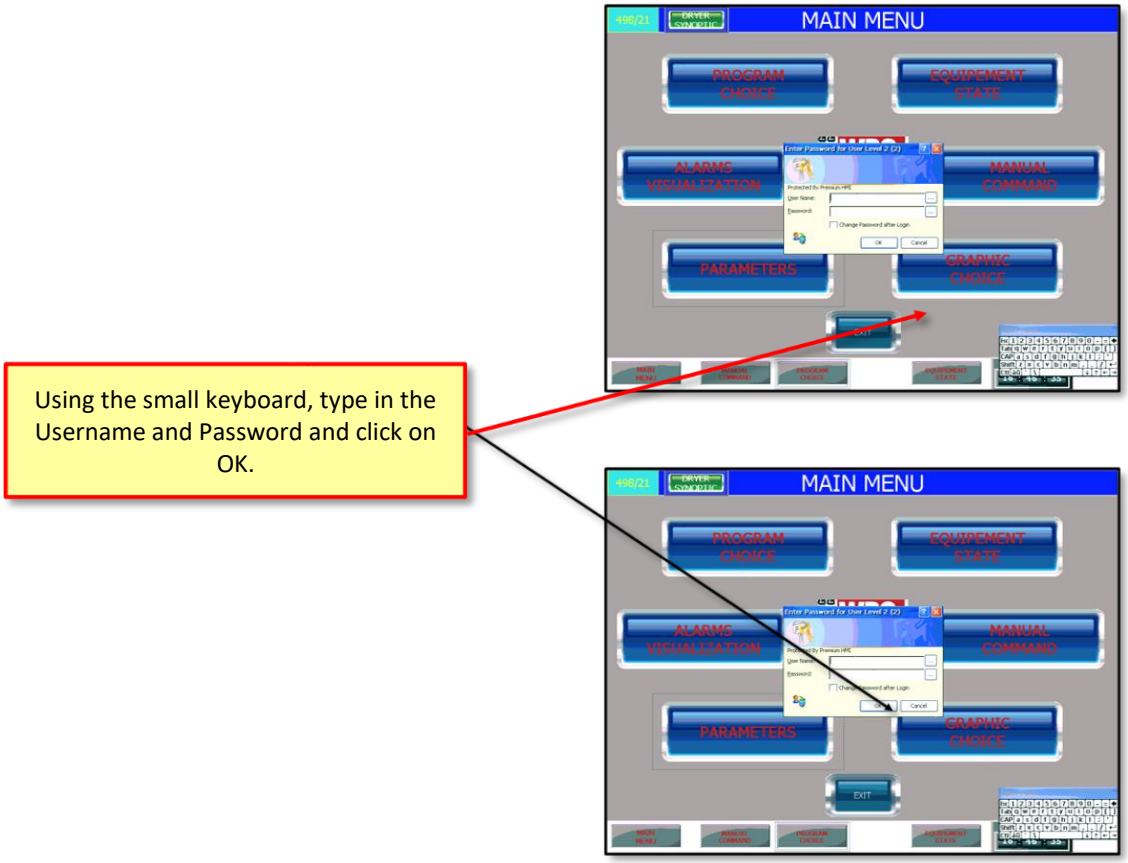
A083 DoorFanInverterCommFailure
A084 BackFanInverterCommFailure
A085 PowerMeterCommFailure
A090A UpsSenCurrentCommFailure
A090B UpsSenVoltCommFailure
A130A1 VSA1 OpenTimeTooLong
A130A2 VSA2 OpenTimeTooLong
A130C1 VSA1 CloseTimeTooLong
A130C2 VSA2 CloseTimeTooLong
A131A VSE OpenTimeTooLong
A131C VSE CloseTimeTooLong
A132A VPV OpenTimeTooLong
A132C VPV CloseTimeTooLong
A133A VPE OpenTimeTooLong
A133C VPE CloseTimeTooLong
A134A VEE OpenTimeTooLong
A134C VEE CloseTimeTooLong
A135A VET OpenTimeTooLong
A135C VET CloseTimeTooLong
A136A VL OpenTimeTooLong
A136C VL CloseTimeTooLong
A137A VWE1 OpenTimeTooLong
A137C VWE1 CloseTimeTooLong
A138A VWE2 OpenTimeTooLong
A138C VWE2 CloseTimeTooLong
A139A VEA OpenTimeTooLong
A139C VEA CloseTimeTooLong
A150A VFCPC OpenTimeTooLong
A150C VFCPC CloseTimeTooLong
A151A VFPC OpenTimeTooLong
A151C VFPC CloseTimeTooLong

8.9 PARAMETERS VISUALIZATION

To display the parameters page, press "**PARAMETERS**":

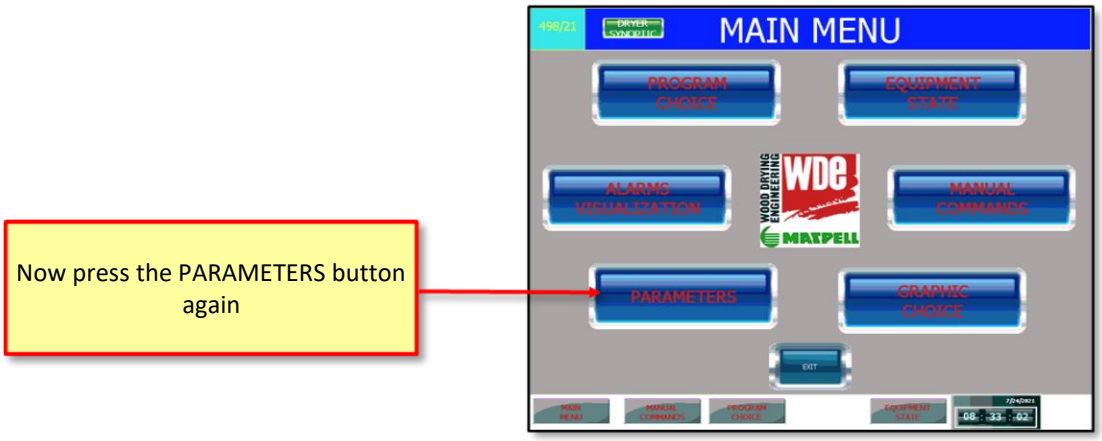


Access to the page is protected by a second level password.
Insert **Username** and **Password**, then press OK.

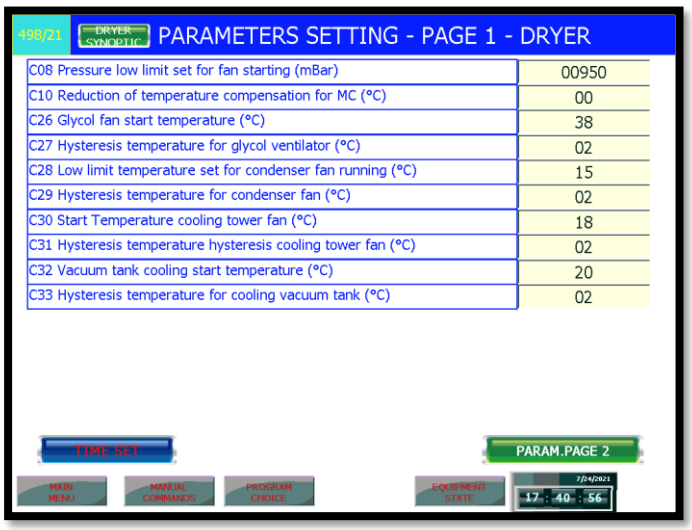


Now press the **PARAMETERS** button again

Warning: the access validity period is only 60 seconds.
After this time, you must reenter USERNAME and PASSWORD.



The following page appears:



8.10 DRYER PARAMETERS DESCRIPTION

C08: Set Pressure Value For Ventilation Starting

This is the pressure threshold value set above which the dryer fans are not enabled to run during
the preheating phase.

- Example: in this case, with C08 = 900, the fan starts when the cell pressure is lower than 900 mbar.

C10: Temperature compensation reduction for MC (° C)

Cell temperature reduction value to calculate the temperature used for humidity probes compensation (MC).

- Example: with C10 = 5 ° C and with an area temperature of the cell of 50 ° C, the compensation temperature will be: t cell - C10 = 50 ° - 5 ° = 45 ° C.

C26: Set Temperature For Glycol Cooling Start.

This parameter specifies the activation of the fan of heat exchanger for the glycol cooling: it is necessary for the cooling of the mechanical seals of the dryer fans.
In our case it is 38°C.

C27: Set Hysteresis for Glycol Cooling On/Off.

This parameter specifies the hysteresis value for the on/off of the fan for glycol cooling: in our case it is 2°C.

- For example: C24 = 38°C; C25 = 2°C: the glycol cooling fan switches-on at a temeprature upper than 40°C and switches-off at a temperature lower than 36°C.

C28: Set temperature for Condenser Cooling Start.

This parameter specifies the low limit of temperature for the condenser fan activation: it is necessary to avoid problems with freezing.
In our case it is 15°C.

C29: Set Hysteresis For Condenser Cooling On/Off.

This parameter specifies the hysteresis temperature for the condenser fan activation.
In our case it is 3°C.

- For example: C26 = 15°C; C27 = 3°C: the condenser fan switches-on at a temperature upper than 18°C and switches-off at a temperature lower than 12°C.

C30: Set Temperature for Cooling Tower Cooling.

The cooling tower is equipped with a fan to increase its cooling power.
This parameter specifies cooling tower water temperature threshold for the activation of the cooling tower fan.
In our case it is 18°C.

C31: Set Hysteresis For Cooling tower Cooling On/Off.

This parameter specifies the hysteresis temperature for activation of the cooling fan of the cooling tower.
In our case it is 2°C.

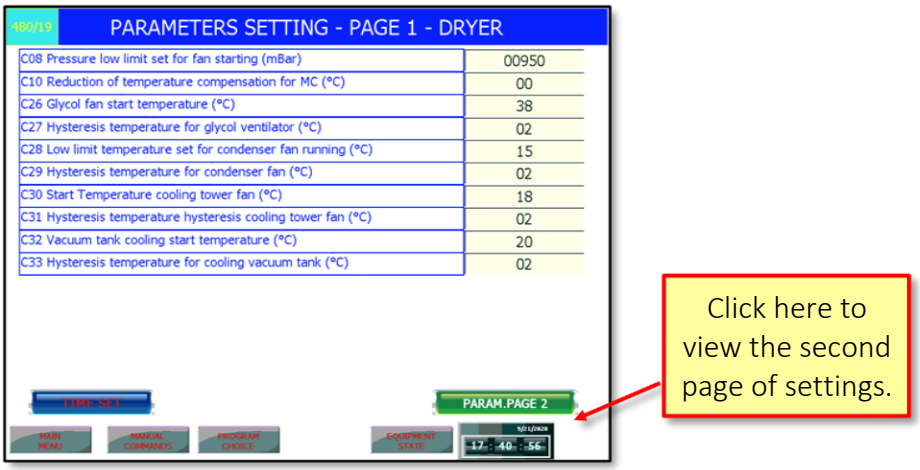
- For example: C30 = 20°C; C31 = 2°C; the cooling tower fan switches-on at a temperature upper than 18° and switches-off at a temperature lower than 16°C.

C32: Set temperature For Vacuum Tank Cooling Start.
This parameter specifies the activation of the cooling of the vacuum tank water.
The cooling of the vacuum tank water is necessary to maintain the efficiency of the vacuum pump.
When the vacuum tank cooling is activated the vacuum tank water is pumped through the primary of the cooling tower heat exchanger and in the same time the cooling tower water is pumped through the secondary of the same heat exchanger to the top of the cooling tower: in this way the vacuum tank water is cooled.
In our case the value of this parameter is 20°C.

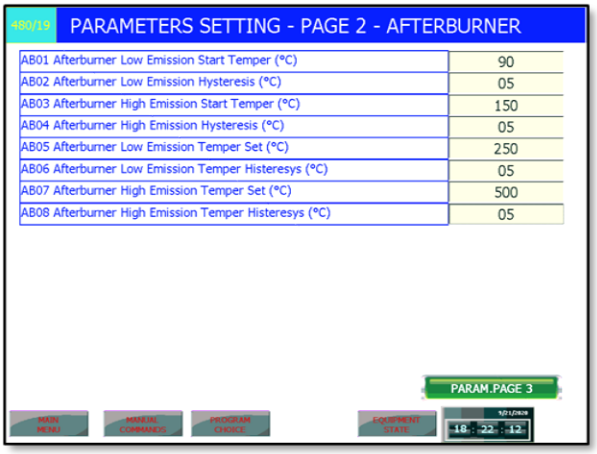
C33: Set Hysteresis For Vacuum Tank Cooling On/Off.
This parameter specifies the hysteresis temperature for activation of the cooling of the vacuum tank water.
In our case it is 2°C.

- For example: C32 = 20°C; C33 = 2°C: the vacuum tank water cooling switches-on at a temperature upper than 22°C and switches-off at a temperature lower than 18°C.

Click on the **PARAM.PAGE 2** button to access at the **AFTERBURNER** temperature set page.



The following page appears:



8.11 AFTERBURNER PARAMETERS DESCRIPTION

AB01: Dryer Set Temperature for afterburner low emissions start.
This parameter specifies the dryer temperature value for the activation of the afterburner in Phase A (low emission).
In our case it is 90°C.

AB02: **Set Hysteresis for afterburner low emissions start.**
This parameter specifies the hysteresis temperature for afterburner low emissions
In our case it is 5°C.

AB03: Dryer Set Temperature for afterburner high emissions start.
Afterburner phase A (low emissions) set temperature.
This parameter specifies the afterburner heating temperature set in high emissions.
In our case it is 150°C.

AB04: **Set Hysteresis for afterburner high emissions start.**
This parameter specifies the hysteresis temperature for afterburner high emissions
In our case it is 5°C.

AB05: Afterburner low emissions set temperature.
This parameter specifies the afterburner heating temperature set in low emissions.
In our case it is 250°C.

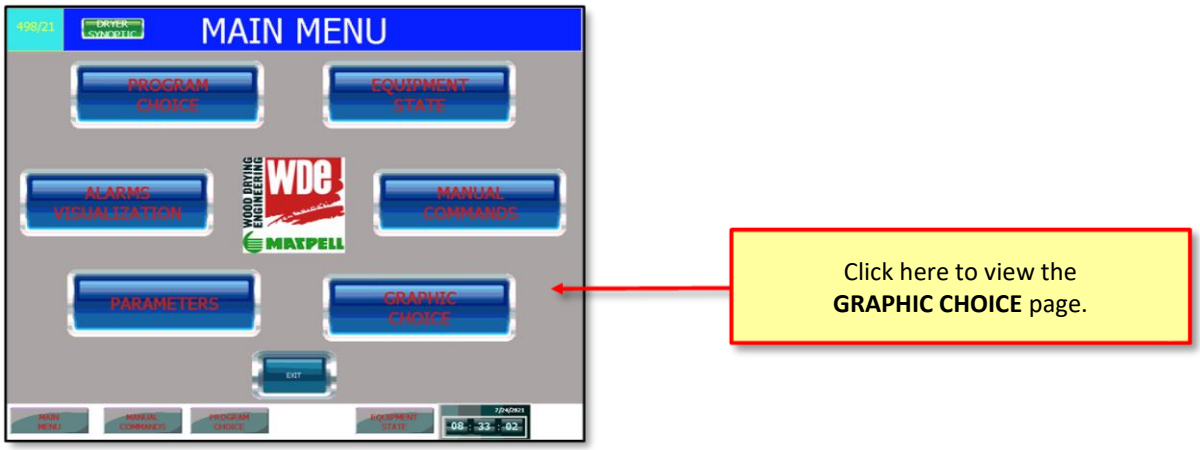
AB06: **Set Hysteresis for afterburner low emissions temperature set.**
This parameter specifies the hysteresis temperature for afterburner low emissions temperature set.
In our case it is 5°C.

AB07: Afterburner high emissions set temperature.
This parameter specifies the afterburner heating temperature set in high emissions.
In our case it is 500°C.

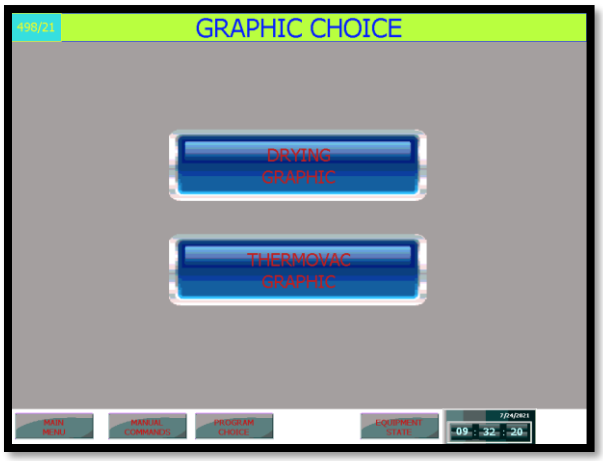
AB08: **Set Hysteresis for afterburner high emissions temperature set.**
This parameter specifies the hysteresis temperature for afterburner high emissions temperature set.
In our case it is 5°C.

8.12 GRAPHICS VISUALIZATION.

To display the graph pages, press “**GRAPHIC CHOICE**” on the **MAIN MENU** page:



La page CHOIX DE GRAPHIQUE apparaît :

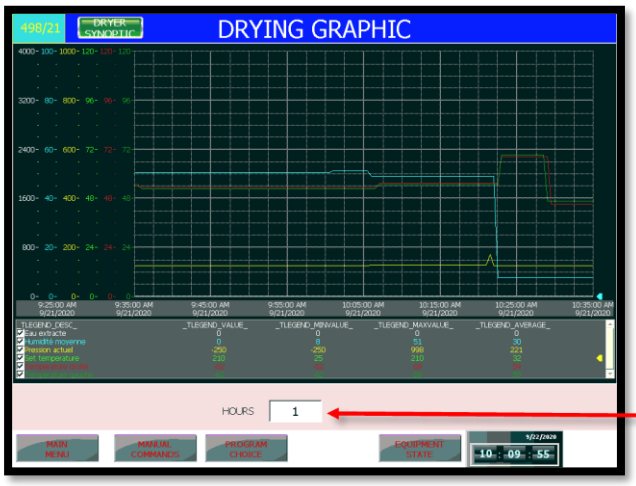


The following page appears:

There are three different graphic that is possible view:

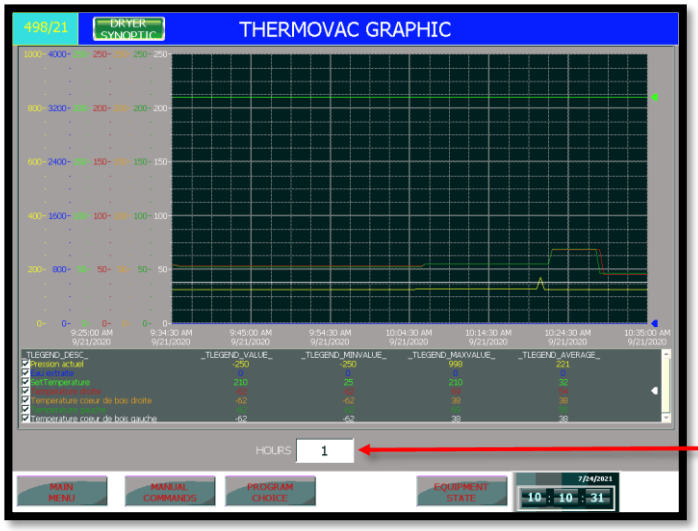
- **DRYING GRAPHIC** page can be opened either from the MAIN MENU or by command bar on all pages. If there is a drying cycle running.
- **THERMOVAC GRAPHIC** page can be opened either from the MAIN MENU or by command bar on all pages if there is a Thermovacuum cycle running.

This is a DRIYNG CYCLE GRAPHIC example:



Time represented in the graph.
After each change, the period in the time axis.

This is a THERMOVAC CYCLE GRAPHIC example:



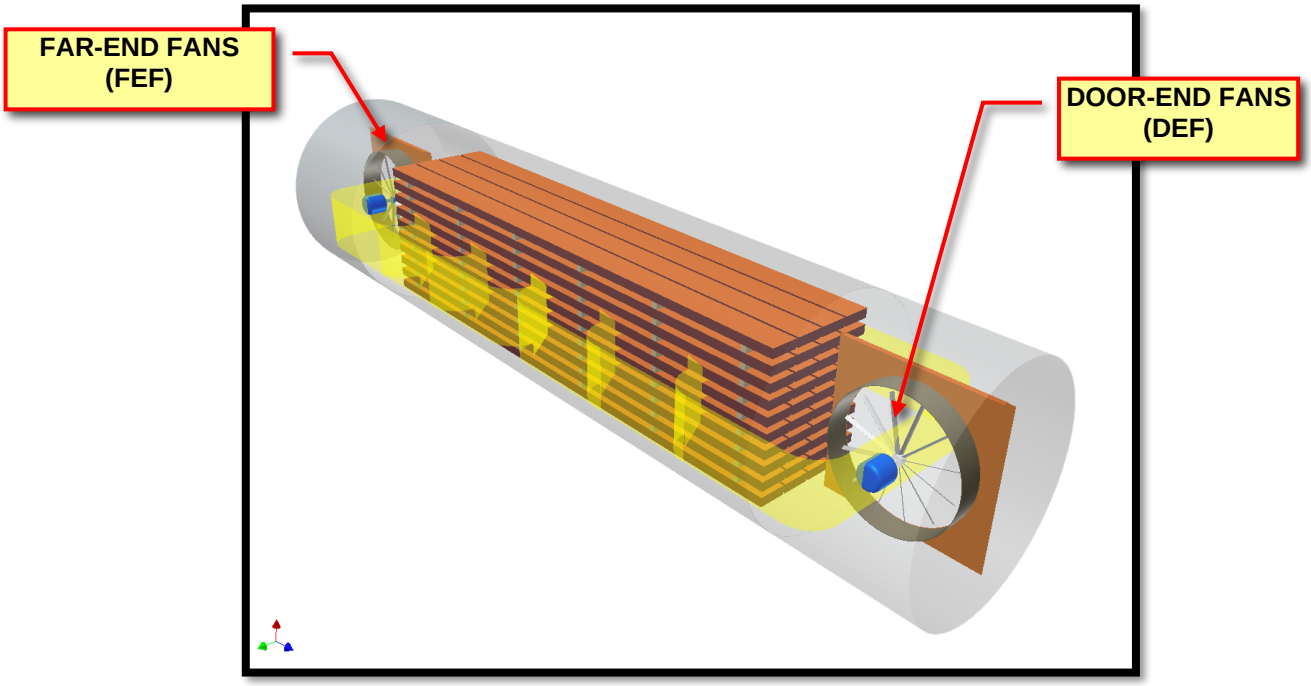
Time represented in the graph.
After each change, the period in the time axis.

CHAPTER 9 **WOOD-HEATING SYSTEM.**

The thermal energy for heating the wood is supplied by two electrical heaters located inside the door and at the far end of the dryer. The heat is transferred to the wood by means of forced hot-air circulation driven by two fans mounted in the cell door (DEF) and at the far end (FEF).

This LO–LA ventilation (longitudinal–lateral type) permits a very even distribution of the flow of air through the wood pile.

LO–LA VENTILATION



FREQUENCY INVERTER: in order to obtain a constant mass flow of air through the wood pile, a frequency inverter increases the rotational speed of the fan proportionally to the value of vacuum.

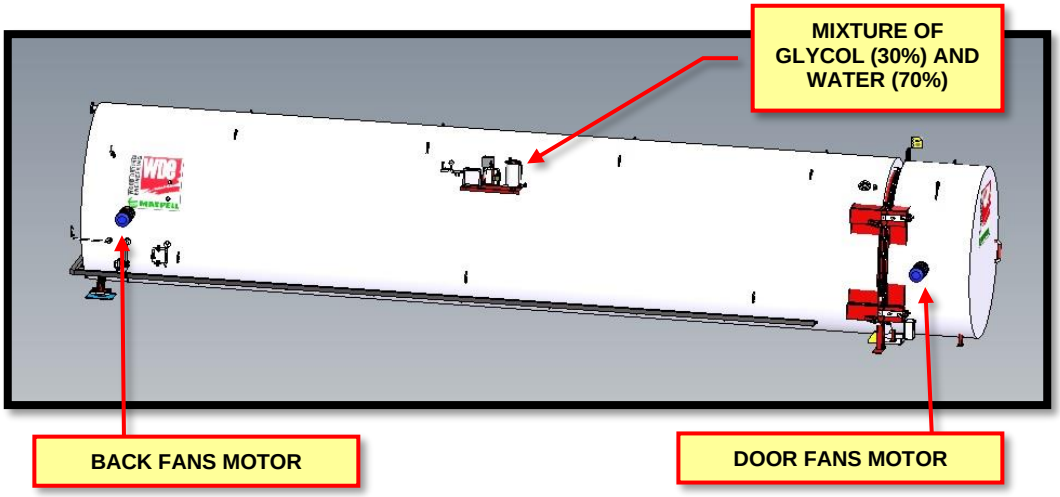
DANGER

Risk of electrocution!
Work on electrical installations should be done by qualified electricians!

Cut off the supply from the main cabinet of the machine before opening the door that covers the electrical connections of the heating elements.

CHAPTER 10 COOLING SYSTEM FOR MECHANICAL SEALS.

The transmission shafts of the fans are equipped with a system of mechanical seals that close the external air input during the vacuum drying. These mechanical seals are lubricated and cooled with a mixture of glycol (40%) and water (60%) by the cooling unit.



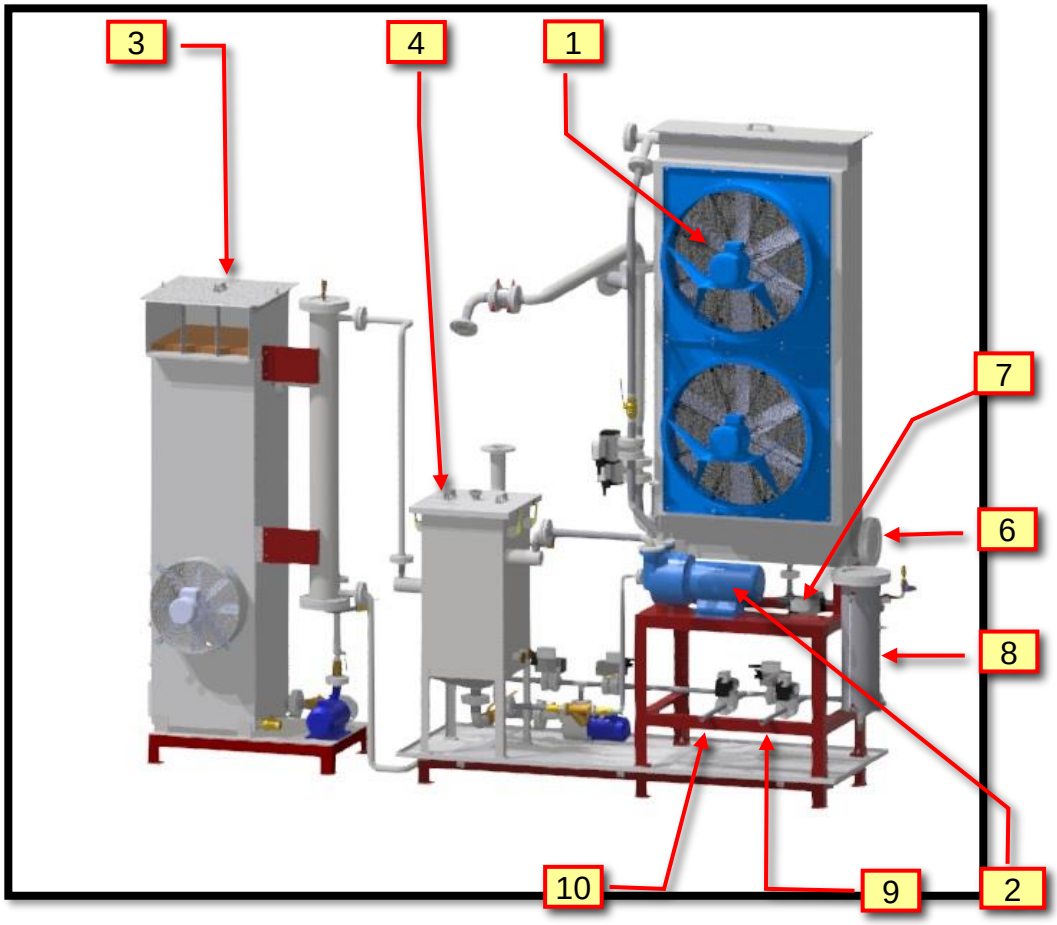
An electric level switch with a double threshold (low and very low level) checks the quantity of mixture glycol in the tank: attention, the low level doesn't allow the start of the cycle, and the very low level stops the cycle and if the dryer temperature is upper 180°C activates the immediately inertization by nitrogen.

CHAPTER 11 VACUUM-PUMPING SYSTEM.

11.1 DESCRIPTION OF THE VACUUM PUMP CIRCUIT

The vacuum pump circuit consists of the following elements:

- A condenser for vapour from the wood (1);
- A liquid-ring vacuum pump (2);
- A water cooling tower (3) for feeding the vacuum pump;
- A tank (4) for discharging condensed vapour from the condenser



WARNING

Risk of pollution.

Depending on the type of wood being treated, the condensate may contain traces of chemicals from the wood. Consequently, this water must be placed in a separate storage tank (supplied by the user) to be chemically analyzed and then disposed of according to the law. Therefore, check with the competent authorities.

11.2 OPERATION OF THE VACUUM-PUMPING SYSTEM:

On starting the drying and/or treatment process, the vacuum pump (2) provides suction:

- of the air inside the dryer through outlet in the top part of the condenser (1), the ball valve and two check valves;

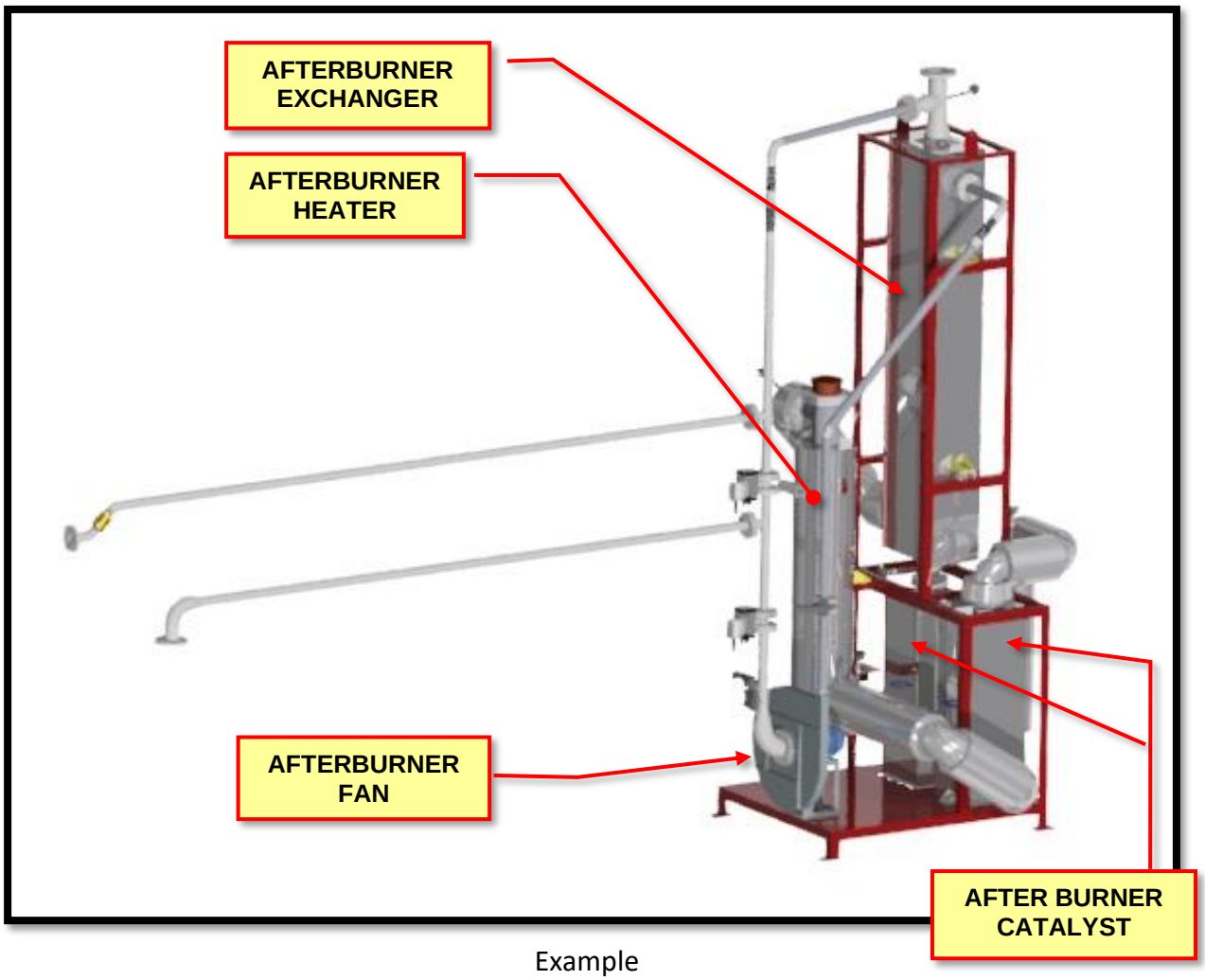
- of water to form the liquid ring necessary for its operation from the reservoir through the pipe and the filter. The used water returns to the reservoirthrough the pipe.

The vacuum pump stops when the desired vacuum is reached. The PLC control system has to ensure the appropriate degree of vacuum in the cell by starting and stopping the vacuum pump.

When the water vapour from the wood aspirated by the vacuum pump passes through the condenser (1), it undergoes cooling that causes its condensation to form water, which flows from the condenser collector (6), through the 3-way valve (7), to the reservoir (8) for evacuation of condensates from compressed air until the maximum level switch which allows compressed air to enter the interior of the tank so as to push water from the tank to the sewer (in the case of clean water) through the pneumatic valve (9) or to the storage tank through the pneumatic valve (10) (if it is water polluted by the heat treatment).

CHAPTER 12 ECOLOGICAL AFTER BURNER

The ecological after burner system to reduce and/or transform the incondensable gases coming out from our equipment ThermoVacuum in other non-irritating and acceptable human sense of smell substances.



Example

OVERVIEW

During thermal modification process, the wood produces many chemicals, as shown in figure below.

The amount of such substances is equal to 4-6% of the weight of the wood not treated. Some of these substances are highly odorous and can cause irritation to the respiratory system of the human being.
For this reason, the thermal modification process under vacuum THERMOVACUUM is considered extremely secure in that, during the process, no gas or vapor can escape from the cell, if not in a controlled manner through the suction of the vacuum pump.

By means of a double condenser system, the gases and the vapors are condensed and collected in liquid form before being emitted into the atmosphere by the vacuum pumping system.
Of course, a small part of non-condensable gas is escaping from the system and goes into the atmosphere.

When the temperatures of the thermal modification process are lower than 210 °C, the amount of non-condensable gases is small, but above this temperature, the amount of gas increases significantly and therefore should be reduced as much as possible and/or otherwise transformed into non-harmful gases.
The task of the post-combustor is precisely to transform the potentially harmful gases into harmless gases and to reduce and/or transform odorous and irritating substances in other non-irritating and acceptable human sense of smell substances.

CHAPTER 13 SAFETY SYSTEM.

As mentioned in the previous chapters, the only real risk during the heating of the wood to temperatures above 160°C is the risk of causing combustion of the wood by air accidentally entering the processing cell.

The cause of such an event may be external to the equipment (stoppage due to a failure of the electricity supply and/or compressed air supply and/or fresh water supply), or it may be caused by the furnace itself (breakdown or malfunction of any component of the device).

The following is an analysis of potential internal and external failures and the technique used by the THERMOVACUUM system.

13.1 MACHINE STOP DUE TO A FAILURE OF THE EXTERNAL POWER SUPPLY.

To overcome this inconvenience, which would cause the stop of all electric components, the THERMOVACUUM is equipped with a safety system that consists of the following elements:

• an uninterruptible power supply (UPS) with additional battery that is able to work without interruption during the absence of a general power supply, and to feed the power-control devices (PLC, HMI control panel, electronic equipment for probes signals etc.) of the machinery and the safety system described below, for a continuous period of at least 6 hours so the engineers have sufficient time to intervene so as to solve the problem and restart the system or if not possible to stop it.

• A telephone dialer that immediately sends voice-message alerts (to up to 4 people) warning of a future crash;

13.2 MACHINE STOP DUE TO THE FAILURE OF A COMPONENT AND/OR COMPRESSED AIR SUPPLY.

To overcome the problem of the possibility of failure of one of the electrical components (motors, valves, sensors, etc.), each component is monitored by a device (for example: thermal thermal protection, auxiliary sensors, etc.) which immediately alerts the PLC to the fault, so that the controller can take the appropriate measures:

1) The immediate shutdown of the component involved and, if necessary, the start-up of other components to maintain the safety of the machine and the load;
2) Send alerts to operators through the telephone combiner;

Once again, the system reacts immediately by guaranteeing the preservation of the wood and allowing engineers to intervene to resolve the problem and restart the system.

13.3 ALARM WITH HIGH RISK OF FIRE.

The THERMOVIDE system is equipped with an emergency system against the possibility of fire in the wood contained in the cell: this device provides inertization inside the cell by the entry of nitrogen.

In the event that the distant ignition event occurs inside the cell, for example for a loss of tightness which causes ambient air to enter the cell causing an increase in the concentration of oxygen and therefore the risk of combustion ignition, pressure and temperature sensors alert the PLC which activates the QUICK INERTISATION process, which consists of the following operations:

1. sends alerts to operators through the telephone combiner;
2. start of the automatic inertization cycle with the introduction of nitrogen into the cell via a special valve in order to saturate the interior volume of the cell with an inert gas, up to 'that the pressure inside the cell is equal to or slightly higher than atmospheric pressure, thus preventing air from entering the cell and in any case stifling the combustion of wood.
3. activation of the cooling system, in order to rapidly lower the cell temperature to values below 90 ° C, far below the combustion temperature (160 ° C)
4. automatic air exchange inside the dryer, before opening the door to avoid any danger to operators

CHAPTER 14 CLASSIFICATION OF WOOD SPECIES

The table below lets you choose the appropriate drying program by the following method:

- Identify the line with the name of the wood to be dried.
- Identify the column corresponding to the thickness of the wood.
- Within the column, choose the program mode:

  - Slow program
  - Medium program
  - Rapid program

With this operation, the operator obtains the PROGRAM NUMBER and the GROUP of the wood (1-4) to select in the PLC.

ATTENTION

The drying programs suggested in this manual are taken from the daily practices of the operators of dryers and are derived from studies performed by the Technical Wood Centers in many countries.

However, due to many factors that can influence the drying process (origin and quality of wood, surface condition of the boards, thickness, quality of stacking, etc.) the reactions of your wood could differ from the average standard considered by the programs.

We therefore recommend that you closely monitor the progress of drying to be able to make corrections where necessary, as under no circumstances can WDE MASPELL SRL be liable for possible accidents arising during the use of the above programs.

CAUTION

If you are in doubt about the choice of the drying program, use a less severe program and/or consult our technical service.

TABLE 14.1 DRYING PROGRAMS

Rev. Del 17/10/2018

		THICKNESS 30 mm			THICKNESS 50 mm			THICKNESS 70 mm		
WOOD SPECIE	**GROUP**	**DRYING PROGRAM - SLOW**	**DRYING PROGRAM - MEDIUM**	**DRYING PROGRAM - FAST**	**PROGRAM DE SECHAGE LENTE**	**DRYING PROGRAM - MEDIUM**	**DRYING PROGRAM - FAST**	**PROGRAM DE SECHAGE LENTE**	**DRYING PROGRAM - MEDIUM**	**DRYING PROGRAM - FAST**
ACACIA	**3**	**32**	**33**	**34**	**22**	**23**	**24**	**12**	**13**	**14**
CHESTNUT	**3**	**32**	**33**	**34**	**22**	**23**	**24**	**12**	**13**	**14**
OAK	**3**	**32**	**33**	**X**	**22**	**23**	**X**	**12**	**13**	**X**
EUCALYPTUS	**3**	**32**	**33**	**X**	**22**	**23**	**X**	**12**	**13**	**X**
OAK	**3**	**32**	**33**	**X**		**23**	**X**	**12**	**13**	**X**
RED OAK	**3**	**32**	**33**	**34**	**22**	**23**	**24**	**12**	**13**	**14**
OAK	**3**	**32**	**33**	**X**	**22**	**23**	**X**	**12**	**13**	**X**
WHITE OAK	**3**	**32**	**33**	**X**	**22**	**23**	**X**	**12**	**13**	**X**
EVINO	**3**	**33**	**34**	**35**	**23**	**24**	**25**	**13**	**14**	**15**
RED LAUAN	**4**	**33**	**34**	**35**	**23**	**24**	**25**	**13**	**14**	**15**
ROSEWOOD	**3**	**33**	**34**	**35**	**23**	**24**	**25**	**13**	**14**	**15**
TEAK	**2**	**33**	**34**	**35**	**23**	**24**	**25**	**13**	**14**	**15**
BILINGA	**3**	**35**	**36**	**37**	**25**	**26**	**27**	**15**	**16**	**17**
CEDAR	**2**	**35**	**36**	**37**	**25**	**26**	**27**	**15**	**16**	**17**
HORNBEAM	**3**	**35**	**36**	**37**	**25**	**26**	**27**	**15**	**16**	**17**
SIPO	**4**	**35**	**36**	**37**	**25**	**26**	**27**	**15**	**16**	**17**
MAPLE	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
ALDER	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
ANIGRE	**4**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
ASH	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
POPLAR	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
BEECH	**2**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
HORNBEAM	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
CHERRY	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
EBONY	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
ELM	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
BEECH	**2**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
FRAKE	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
ASH	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
BEECH	**2**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
KOSSIPO	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**
KOTIBÉ	**3**	**36**	**37**	**38**	**26**	**27**	**28**	**16**	**17**	**18**

LAUAN	4	36	37	38	26	27	28	16	17	18
MAHOGANY	3	36	37	38	26	27	28	16	17	18
MAKORÉ	3	36	37	38	26	27	28	16	17	18
MANSONIA	4	36	37	38	26	27	28	16	17	18
MAPLE	3	36	37	38	26	27	28	16	17	18
MERANTI	4	36	37	38	26	27	28	16	17	18
WILD CHERRY	3	36	37	38	26	27	28	16	17	18
WALNUT	2	36	37	38	26	27	28	16	17	18
ELM	3	36	37	38	26	27	28	16	17	18
RAMIN	3	36	37	38	26	27	28	16	17	18
RED MERANTI	3	36	37	38	26	27	28	16	17	18
SAPELE	3	36	37	38	26	27	28	16	17	18
SYCAMORE	3	36	37	38	26	27	28	16	17	18
TIAMA	2	36	37	38	26	27	28	16	17	18
LINDEN	3	36	37	38	26	27	28	16	17	18
WALNUT	3	36	37	38	26	27	28	16	17	18
WHITE LAUAN	4	36	37	38	26	27	28	16	17	18
WHITE MERANTI	4	36	37	38	26	27	28	16	17	18
YELLOW LAUAN	4	36	37	38	26	27	28	16	17	18
YELLOW MERANTI	4	36	37	38	26	27	28	16	17	18
DOUGLAS	2	37	38	39	27	28	29	17	18	19
IROKO	2	37	38	39	27	28	29	17	18	19
NIANGON	2	37	38	39	27	28	29	17	18	19
PADAUK	3	37	38	39	27	28	29	17	18	19
UTILE	4	37	38	39	27	28	29	17	18	19
ABETE	3	38	39	40	28	29	30	18	19	20
ABURA	3	38	39	40	28	29	30	18	19	20
AFRORMOSIA	2	38	39	40	28	29	30	18	19	20
BIRCH	3	38	39	40	28	29	30	18	19	20
FIR	3	38	39	40	28	29	30	18	19	20
LARCH	3	38	39	40	28	29	30	18	19	20
LIMBA	3	38	39	40	28	29	30	18	19	20
LIME	2	38	39	40	28	29	30	18	19	20
LARCH	3	38	39	40	28	29	30	18	19	20
ABACHI	3	38	39	40	28	29	30	18	19	20
PINE	3	38	39	40	28	29	30	18	19	20
POPLAR	2	38	39	40	28	29	30	18	19	20
RUBBER TREE	1	38	39	40	28	29	30	18	19	20
SAMBA	2	38	39	40	28	29	30	18	19	20
FIR	3	38	39	40	28	29	30	18	19	20
SPRUCE	3	38	39	40	28	29	30	18	19	20

14.1 DRYING PROGRAMS

Rev. del 17/10/2018

PROGRAM 1 (same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 2 (same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 3 (same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 4 (same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 5 (same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 6 (same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 7 (same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 8 (Same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 9 (Same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 10 (Same as program 25, wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 11 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	6									
MC%		50	40	30	25	20	17	14	11	
Pmbar		125	125	125	125	125	125	125	125	
t°C		54	54	54	55	58	61	64	68	
Th	6									7

PROGRAM 12 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		125	125	125	125	125	125	125	125	
t°C		54	54	54	55	58	61	64	68	
Th	6									7

PROGRAM 13 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		150	150	150	150	150	150	150	150	
t°C		58	58	58	60	63	65	69	73	
Th	6									7

PROGRAM 14 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		150	150	150	150	150	150	150	150	
t°C		60	60	60	63	66	69	72	77	
Th	6									7

PROGRAM 15 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	6									7

PROGRAM 16 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		67	67	67	70	74	77	81	86	
Th	6									7

PROGRAM 17 (thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		68	68	68	71	75	78	82	88	
Th	6									7

PROGRAM 18 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		70	70	70	73	77	81	84	90	
Th	6									7

PROGRAM 19 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		200	200	200	200	200	200	200	200	
t°C		72	72	72	75	78	82	86	93	
Th	6									7

PROGRAM 20 (wood thickness 70 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		200	200	200	200	200	200	200	200	
t°C		76	76	76	80	84	88	93	98	
Th	6									7

PROGRAM 21 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	6									
MC%		50	40	30	25	20	17	14	11	
Pmbar		125	125	125	125	125	125	125	125	
t°C		54	54	54	55	58	61	64	68	
Th	4									5

PROGRAM 22 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		125	125	125	125	125	125	125	125	
t°C		54	54	54	55	58	61	64	68	
Th	4									5

PROGRAM 23 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		150	150	150	150	150	150	150	150	
t°C		58	58	58	60	63	65	69	73	
Th	4									5

PROGRAM 24 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		150	150	150	150	150	150	150	150	
t°C		60	60	60	63	66	69	72	77	
Th	4									5

PROGRAM 25 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	4									5

PROGRAM 26 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		67	67	67	70	74	77	81	86	
Th	4									5

PROGRAM 27 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		68	68	68	71	75	78	82	88	
Th	4									5

PROGRAM 28 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		70	70	70	73	77	81	84	90	
Th	4									5

PROGRAM 29 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	X
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		200	200	200	200	200	200	200	200	
t°C		72	72	72	75	78	82	86	93	
Th	4									5

PROGRAM 30 (wood thickness 50 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		200	200	200	200	200	200	200	200	
t°C		76	76	76	80	84	88	93	98	
Th	4									5

PROGRAM 31 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	6									
MC%		50	40	30	25	20	17	14	11	
Pmbar		125	125	125	125	125	125	125	125	
t°C		54	54	54	55	58	61	64	68	
Th	2									3

PROGRAM 32 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		125	125	125	125	125	125	125	125	
t°C		54	54	54	55	58	61	64	68	
Th	2									3

PROGRAM 33 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		150	150	150	150	150	150	150	150	
t°C		58	58	58	60	63	65	69	73	
Th	2									3

PROGRAM 34 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	8									
MC%		50	40	30	25	20	17	14	11	
Pmbar		150	150	150	150	150	150	150	150	
t°C		60	60	60	63	66	69	72	77	
Th	2									3

PROGRAM 35 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		175	175	175	175	175	175	175	175	
t°C		65	65	65	67	71	74	78	83	
Th	2									3

PROGRAM 36 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		67	67	67	70	74	77	81	86	
Th	2									3

PROGRAM 37 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	10									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		68	68	68	71	75	78	82	88	
Th	2									3

PROGRAM 38 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		185	185	185	185	185	185	185	185	
t°C		70	70	70	73	77	81	84	90	
Th	2									3

PROGRAM 39 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	X	x	x	x	x	x	x	x	x
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		200	200	200	200	200	200	200	200	
t°C		72	72	72	75	78	82	86	93	
Th	2									3

PROGRAM 40 (wood thickness 30 mm)

Set/Phase	PH0	PH1	PH2	PH3	PH4	PH5	PH6	PH7	PH8	PH9
Starting phase	x									
Phase included	x	x	x	x	x	x	x	x	x	x
dt°C/h	12									
MC%		50	40	30	25	20	17	14	11	
Pmbar		200	200	200	200	200	200	200	200	
t°C		76	76	76	80	84	88	93	98	
Th	2									3

CHAPTER 15 SUSPENSION OF OPERATIONS AND PROLONGED STOPPAGES.

15.1 TEMPORARY SUSPENSION OF OPERATIONS.

In this case, the risk of freezing must be taken into account and the heating circuit and the vacuum-pumping system drained.

Additionally, the equipment and its components (vacuum-pumping system, electrical cabinet, etc..) must be protected from dust by a non-transparent plastic bag.

15.2 RECOMMISSIONING AFTER PROLONGED STOPPAGES.

Upon startup, use the same procedure as in Section 7 “COMMISSIONING”.

15.3 FINAL DECOMMISSIONING AND DISPOSAL OF WASTE.

When definitively removing the dryer from service, the operator must perform the opposite operations to those of assembly:

- Disassembly of the electric circuit (with recovery of electrical cables, components, pumps and motors).
- Disassembly of the hydraulic heating circuit (after draining the water)
- Dismantling of the various heating and vacuum-pumping systems with segregation of components into homogeneous groups.

The residues from the entire equipment shall be removed by a suitable waste carrier.

No special measures are necessary here.

For more information on the disposal of equipment, check with the service.

CHAPTER 16 INSPECTION AND MAINTENANCE.

WARNING

Improper use of the machine can result in serious injury or death!

Have you read the safety instructions in Section 2, Security?
If not, you are not permitted to work with or on the machine.

WARNING

Improper use of the machine can result in serious injury or death!

These instructions:

- Must have been read and understood before performing any work with or on the machine.
- Must be respected.
- Must be available at the workplace.

DANGER

Inappropriate behavior may cause serious physical injury and material damage.

Before working on components and/or devices installed on the dryer (e.g., vacuum pump, fans, etc.), you must read and understand the manuals of devices and follow the instructions.

DANGER

Risk of electrocution!

Work on electrical installations should be done by qualified electricians!

DANGER

Risk of electrocution!
Before starting work on the machine or installation, the following measures should be implemented:

- Turn power off at the switch.
- Set to the opening position.
- Turn power off at the regulator.
- Connect to earth and short circuit.
- Cover or cordon off adjacent live parts.

CAUTION

Incorrect connection of the dryer can cause serious damage to the machine.

WARNING

Work on the dryer can cause a risk of injury by cutting, crushing and burning, among others!

- First, put on personal protective equipment (helmet and gloves, safety shoes).
- Then work on the system.

The type **TVS** kiln essentially consists of the following elements:

- DRYING CELL AND HEAT TREATMENT
- WOOD HEATING SYSTEM
- AREA CIRCULATION SYSTEM IN THE DRYER
- COOLING SYSTEM OF MECHANICAL FAN SEALS
- WOOD COOLING SYSTEM
- VACUUM PUMP SYSTEM
- WOOD LOADING SYSTEM
- VAPORIZATION SYSTEM (optional accessory)
- ELECTRICAL CABINET
- UPS GROUP FOR EMERGENCY POWER SUPPLY
- WOOD LOADING SYSTEM
- SECURITY SYSTEMS

Periodic maintenance is planned for each element.

16.1 TREATMENT CELL.

1) Door seal

All the end of the cycle The rubber seal on the dryer door must be checked each time it is dried and replaced in the event of damage.

At the end of each drying or heat treatment cycle, after opening the door, the door gasket and the surface on which it is sealed should be cleaned to avoid damage.

2) Periodic cleaning of the bottom of the cell

Every 2 months or more frequently if necessary, a periodic cleaning of the bottom of the tank must be carried out to eliminate the accumulation of dust and wood waste.

3) Visual inspection of the condition of the internal sheets and welds

Every 5 years or more frequently if necessary, a thorough cleaning of the internal sheets of the machine must be carried out in order to check the welds and possible deformations.

4) Fan for circulating the area inside the cell

a) Fan propeller

Before the start of each cycle, check the condition of the fan blades and the fixing the propeller on the shaft

b) Fan shafts

Every 3 years or more frequently if necessary, remove the shafts from the fans and replace the bearings and mechanical seals. This operation has to be done by specialized personnel: see attachment All. h) WDE-Maspell: REPLACEMENT AND MAINTENANCE OF TVS FANS

c) Vibrations of the engine, shaft and propeller system

Every 6 months or more frequently if necessary, measure the vibrations of the motor, shaft and propeller system of each fan.
The measurement should be made when the fan is operating at the maximum rotation frequency.

d) Fan motors

For lubrication and maintenance of the motors, see attachment
All. d) ISGEV MOTORS CAT01R2 USER MANUAL

e) Cooling system and lubrication of the mechanical seals of the fan shafts.

5) Glycol circuit

Before the start of each cycle, check for leaks on the glycol piping and on the fan shafts inside and outside the dryer.
Replace the hoses if glycol leaks from the hoses.
In the event of a glycol leak on the shaft, disassemble the shaft and replace the mechanical seal or the pipe mounted on the shaft: see attachment
All. h) WDE-Maspell: REPLACEMENT AND MAINTENANCE OF TVS FANS

6) Glycol tank

Before the start of each cycle, check by the visual level that the glycol tank is full.
Empty the glycol tank every year, open the lid and clean inside.
After cleaning, fill the tank with a mixture of 75% of water and 25% of glycol.

3) Glycol circuit pressure and flow

At the start of each cycle, check the glycol pressure in the cooling and lubrication circuit on the pressure gauge: it must be greater than 0,5 bar.
At the start of each cycle, check by the visual flowmeter the glycol flow of door and back fans

4) Glycol pump

a) Glycol pump

For maintenance of the glycol pump, see attachment:
All. i) EVOSTA MULTILANGUAGE MANUAL

5) Glycol cooling air heater.

Every 3 months or more frequently if necessary, clean the outside of the fin tubes of the glycol air heater: if found very dirty, increase the cleaning frequency.

6) Fans for cooling the dryer

For maintenance of the fans for cooling the dryer, see attachment All. g) CIESSE-Use-and-Manitenance-Manual.

7) Shutters for cooling the dryer

Every 3 months or more frequently if necessary, check that the shutters completely carry out the opening and closing operations: the visual inspection must be carried out directly on the shutter.

16.2 VACUUM SYSTEM.

1) VACUUM PUMP

For maintenance of the vacuum pump, see attachment
All. e) TRAVAINI VACUUM PUMPS OPERATING MANUAL

2) FILTER ON THE WATER INLET OF THE LIQUID RING OF THE VACUUM PUMP

Before starting each cycle, dismantle and clean the filter on the water inlet of the liquid ring of the vacuum pump to avoid dry running of the vacuum pump.

3) WATER TANK FOR THE VACUUM PUMP

Each number of heat treatment cycles (initially defined in 5 and possibly modified at the request of the customer, if necessary), the PLC will ask to start an automatic cleaning cycle of the vacuum circuit, including the water tank of the vacuum pump.
At the end of each vacuum circuit cleaning cycle, check the condition of the filter inside the vacuum tank: it must be clean and intact.

4) WATER TANK PUMP FOR VACUUM PUMP

For maintenance of the water tank pump for the vacuum pump, see attachment All. f) LOWARA USE AND MAINTENANCE MANUAL

5) VACUUM CIRCUIT VALVES

Remove valves every year and check for cleanliness and tightness

6) CONDENSER

a) Condenser finned tubes

Every 3 months or more frequently if necessary, clean the outside of the condenser fin tubes: if found very dirty, increase the cleaning frequency.

b) Cleaning the interior of the condenser

Each number of heat treatment cycles (initially defined in 5 and possibly modified at the customer's request if necessary), the PLC will ask to start an automatic cleaning cycle for the vacuum circuit, including the interior of the condenser.
Each year or more frequently if necessary, open the inspection nozzle located in the lower condenser collector to check the actual state of the cleanliness: if it is very dirty, inform WDE-Maspell to change the automatic cleaning frequency requested by the PLC.

c) Condenser fan

For maintenance of the condenser fans, see attachment
All. g) CIESSE-Use-and-Manitenance-Manual

7) AIR PUMP FOR CONDENSER CONDENSATE DISCHARGE

Each number of heat treatment cycles (initially defined in 5 and possibly modified at the request of the customer if necessary), the PLC will ask to start an automatic cleaning cycle of the vacuum circuit, including the interior of the air pump for the evacuation of condensate from the condenser.

Open the cover of the air pump for condensate drainage every year of the condenser and check the actual state of the cleanliness: if it is very dirty, inform WDE-Maspell to change the automatic cleaning frequency requested by the PLC.

8) COOLING TOWER

a) Cleaning the tank and the cooling tower filter

Every 3 months or more frequently if necessary, close the valve for filling with water, empty the cooling tower, open the inspection nozzle for cleaning the tank and the filter: if found very dirty, increase the cleaning frequency.

Then proceed as indicated in the following point 16.2.8..b

b) Float level for filling the cooling tower

Every 3 months or more frequently if necessary, after the cleaning mentioned in point 16.2.8.a, reopen the valve for filling the cooling tower: at the end of filling, check the correct operation of the mechanical float level.

c) Water spray from the cooling tower.

Every 3 months or more frequently if necessary, after the cleaning mentioned in point 16.2.8.a, and the filling of the water mentioned in point 16.2.8.b, check that the water spray works properly.

9) COOLING TOWER PUMP

For the maintenance of the cooling tower pump, see attachment All. f) LOWARA USE AND MAINTENANCE MANUAL

10) COOLING TOWER FAN

For maintenance of the cooling tower fan, see attachment All. g) CIESSE-Use-and-Manitenance-Manual

11) WATER-WATER EXCHANGER FOR COOLING THE WATER OF THE VACUUM PUMP TANK.

a) Primary circuit of the water-water exchanger.

Each number of heat treatment cycles (initially defined in 5 and possibly modified at the request of the customer if necessary), the PLC will ask to start an automatic cleaning cycle of the vacuum circuit, including the interior of the tubes of the primary circuit of the exchanger water-water for cooling the water in the vacuum pump reservoir.

Each year or more frequently if necessary, remove the water-water exchanger, open the covers and check the actual state of the cleanliness of the interior of the tubes of the primary circuit: if it is very dirty, clean and inform WDE-Maspell to change the frequency automatic cleaning requested by the PLC.

b) Secondary circuit (mantle) of the water-water exchanger.

Each year or more frequently if necessary, after removing the water-water exchanger mentioned in point 16.2.11.a, clean with a decalcifying liquid: if it is very dirty, increase the cleaning frequency.

16.3 ELECTRICAL CABINET.

1) ELECTRICAL CABINET COOLING FAN

Check the cleanliness and proper functioning of the electrical panel cooling fan every month.

2) FILTERS ON THE AIR INTAKE PORTS FOR THE COOLING OF THE ELECTRICAL CABINET

Every month or more frequently if necessary, carefully remove and clean the filters mounted on the suction vents for the cooling air from the electrical panel.

Every year or more frequently if necessary, replace the filters fitted on the suction outlets for the cooling air from the electrical panel.

3) ELECTRICAL CONNECTIONS OF THE COMPONENTS IN THE ELECTRICAL CABINET.

Every year or more frequently if necessary, check the tightness of the electrical connections of all components in the electrical panel.

4) DRIVE FOR DRIVERS OF AIR FANS IN THE DRYER

For maintenance of the cooling tower fan, see attachment

All. l) INVERTER DELTA CP2000 USER MANUAL

5) FILTER / PRESSURE REGULATOR ON THE COMPRESSED AIR INLET

a) Filter for compressed air

Every month or more frequently if necessary, drain the condensate accumulated in the lower transparent container of the filter: if found full, increase the frequency of discharge.

b) Compressed air pressure regulator

Every month or more frequently if necessary, check that the compressed air pressure is set at 7 bar.

16.4 INVERTER UNIT (UPS) FOR EMERGENCY POWER SUPPLY

1) ELECTRICAL CABINET COOLING FAN

Check the cleanliness and proper functioning of the electrical panel cooling fan every month.

2) FILTERS ON THE AIR INLET PORTS FOR COOLING THE CABINET ELECTRIC

Every month or more frequently if necessary, carefully remove and clean the filters mounted on the suction vents for the cooling air from the electrical panel.

Every year or more frequently if necessary, replace the filters fitted on the suction outlets for the cooling air from the electrical panel.

3) ELECTRICAL CONNECTIONS OF THE COMPONENTS IN THE ELECTRICAL CABINET.

Every year or more frequently if necessary, check the tightness of the electrical connections of all components in the electrical panel.

4) CHECKING THE EFFICIENCY OF THE BATTERIES

Every 6 months or more frequently if necessary, after normal operation of the TVS 24V-DC control circuit (avoiding after a power failure), with the system in manual mode and the TVS empty, open the main switch 400V-ac and start the pump and the glycol fan. Check that after 6h, the output voltage of the inverter is greater than 22V.

Each year or more frequently if necessary, after normal operation of the TVS 24V-DC control circuit (avoiding after a power failure), check each battery individually as follows:

a) open the input disconnectors UPS 240V-AC, output 24V-DC of the UPS ed open the fuse of each branch of batteries

b) replace the battery to be checked with the spare battery

c) close the 240 VAC and 24 VDC input disconnect switches of the UPS.

d) Connect to the battery to check a halogen lamp or a 12V-80W resistance

e) check that after 8h the voltage at the ends of the battery is greater than 11 V-DC

16.5 WOOD LOADING SYSTEM

1) TROLLEY STRUCTURE

Before each load for a drying or heat treatment cycle, check that the structure of the carriage with its welds is intact: before each load for a drying or heat treatment cycle, check that the structure of the carriage with its welds is intact: if there are significant deformations or cracks, do not load the wood before restoring the structure.

2) WHEELS OF THE TROLLEY

At the end of each heat treatment cycle, after the unloading of the wood, check that all the wheels of the trolley rotate regularly: if one or more wheels are locked, they must be unlocked or replaced.

Every 15 days or more frequently if necessary, grease the wheel bearings of the trolley with grease for high temperature for continuous operation at 250 ° C. Suggested: Klüber Barreiertal 55/2 or similar.

16.6 SECURITY SYSTEMS

1) Safety nitrogen against unwanted combustion

Minimum pressure: 170 bar