

DOSHORMAT

“Degassing machine for aluminium casting process based on ultrasound”

D6.6
MANUAL OF USE

Project No. 606090

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1.- INTRODUCTION

Taking advantage of previous results achieved by ULTRAGASSING (FP7-SME-2011-1), DOSHORMAT intends to optimize and develop two ready-to-market ultrasonic degassing machines for aluminium foundries that represent efficient solutions for degassing molten aluminium. The degassing technology is one of the main factors of quality assurance in casting industry. The quality of any as-cast material depends to a great extent on the amount of defects. One of the main defects in near-net shape casting processes is porosity.

Currently used methods of degassing have drawbacks and limitations: involve using mixtures of expensive inert gas, health and environment hazards, strict safety rules, larger investment and maintenance costs, and/or low efficiency. The cavitation melt treatment presents a feasible alternative to current degassing techniques. However, before ULTRAGASSING project, there were not known applications of ultrasound to degas metallic melts on industrial scale and in regular casting processing.

ULTRAGASSING has demonstrated the feasibility of using ultrasonic treatment to degas considerable volumes of melt in batch operations (up to 60 kg). This allowed the development of two conceptual prototypes for degassing aluminium alloys. Even though, there are still relevant points that must be improved in order to successfully introduce the machine in the market and exploit new market niches.

The aim of DOSHORMAT is to improve and optimize the previous prototypes from ULTRAGASSING, adapting them to all the market needs, by developing one equipment specifically designed for HPDC and Gravity Casting and another for degassing much larger volumes, suitable for LPDC and, in general, for any casting activity. DOSHORMAT will improve the melt quality, reducing the gas content and removing the oxides, highly enhancing the quality and mechanical performance of the components produced (e.g. transport applications), while meeting the present and future environment regulations.

1.1.- *Aim of the work*

The aim of the work performed as described in this deliverable is to show a manual of use for the final commercial machine of DOSHORMAT project.

This manual shows us every part of the machine and its function.

It is also presented how to operate the machine done systematically and finally a section describing the possible machine failures and its solution or underlying the cause of the failure.

1.2.- Steps performed

The following steps are performed:

- | | |
|---|-----------------|
| Step 1: Layout Description | (see chapter 3) |
| Step 2: Preparation of ultrasonic equipment | (see chapter 4) |
| Step 3: Explanation of fuction of the DOSHORMAT machine | (see chapter 5) |
| Step 4: Faults and alarms | (see chapter 6) |

2.- LAYOUT DESCRIPTION OF THE DOSHORMAT MACHINE

Characteristic of machine 1:

To better understand the parts of the final machine 1, it is shown below a lay-out plan where you can differentiate various parts of the new machine 1 and are explained one by one.

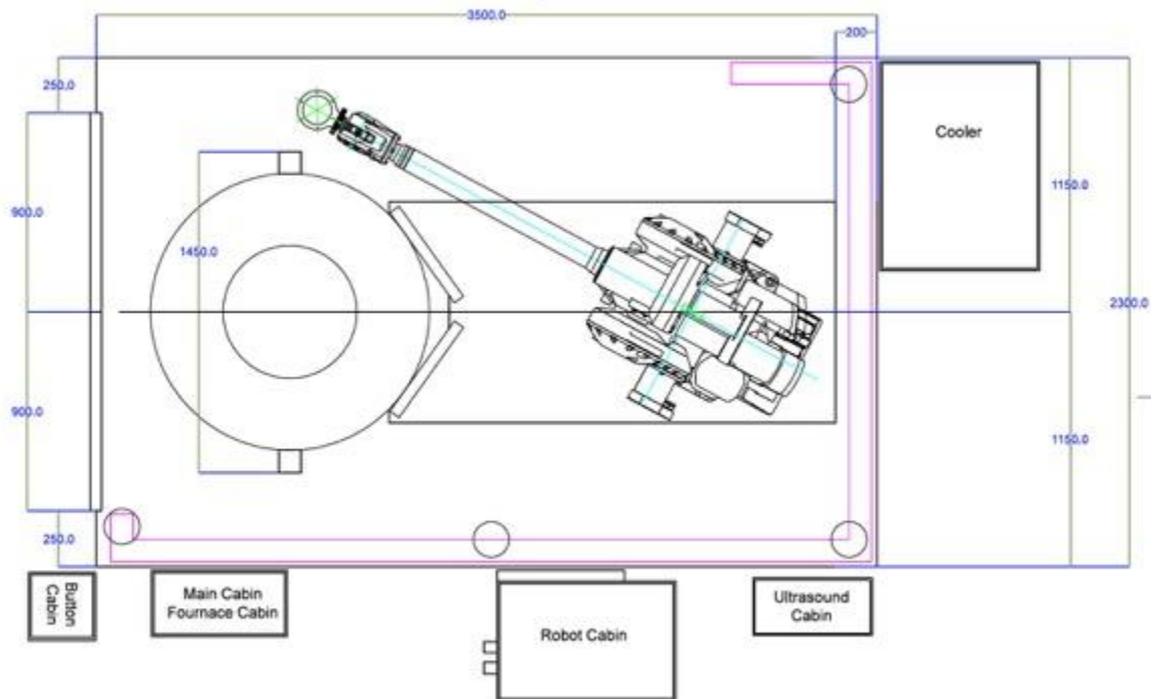


Figure 3.1. Lay-out machine 1

Cooler: Cooler for ultrasound. Its function is to maintain the ultrasound at a temperature of 20°C.

Button Cabin: Keypad for the control of the security fence door. To open or close the door.

Furnace Cabin: Controls the temperature of the crucible by the thyristors.

Robot Cabin: Controls of the robot ABB.

Ultrasound cabin: Controls of ultrasound generator.

Security Fencing: Security fencing to protect the station and prevent movement of the robot when there are people inside.

3.- PREPARATION OF ULTRASONIC EQUIPMENT

In this section it is described the procedure that has to be followed in order to have the ultrasonic equipment ready for its operation.

STEP 1. PREPARING THE WATER FLOW

Before connecting the ultrasonic equipment to the power grid, connect water hoses following the arrows drawn on the transducer (IN and OUT). Finally turn on the water flow and wait a few seconds for a completed water circulation. Adjust water flow to 4-5 l/min and do not exceed 5 l/min limit. Do not use pressurized water.

The final version of Machine 1 is equipped with an internal cooling circuit that fulfils all this requirements. It is only required to connect or verify the connections and check that the water flow is in between the 4-5 l/min range. During its operation open or close the manual valve in order to regulate the water flow.



Figure 4.1. Inlet hose



Figure 4.2. Outlet hose



Figure 4.3. Hoses

STEP 2. TURNING ON THE EQUIPMENT

Connect the ultrasonic equipment to the power grid and turn on the main MCB.

On the new Machine 1 the ultrasonic equipment is connected to the power grid through the main Machine connector. Therefore, it should be connected the whole machine in order to be able to conduct this step.



Figure 4.4. Ultrasonic controller



Figure 4.5. Turning on the main MCB

STEP 3. MOVING THROUGH THE MENUS

Wait a few seconds until the display shows “RUNNING TIME 00:00”. Then, you will be able to navigate for the menus of the equipment. Use the up and down arrows to locate the parameter you want to change, accept it by pressing the right arrow. Change the value using the thumbwheel and save it pressing the left arrow.



Figure 4.6. Ready to surf the menus



Figure 4.7. Up and down arrows



Figure 4.8. Thumbwheel to change parameter values



Figure 4.9. Saving parameter using the left arrow

STEP 4. TUNING THE SONOTRODE IN AIR

Before introducing the sonotrode inside the melt, an air tuning must be done. The equipment should be tuned to the resonance frequency with AFC disabled. Search the “SET MODE OF AFC”. Press right button and use the thumbwheel to disable AFC, then return to the main menu by pressing the left arrow.



Figure 4.10. AFC menu



Figure 4.11. This parameter must be disabled

Even if the original manual from the ultrasonic manufacturer suggest using broadband for the operation of ultrasonic in liquids, for aluminium degassing is convenient to use narrowband instead of broadband. Therefore, always operate the equipment with narrowband.



Figure 4.12. Verifying the type of load

In the “set current” menu select the current 8A.

Move to “OPER FREQ” menu and select the frequency range that the equipment will work, in our case 16-20 kHz.



Figure 4.13. Operation frequency menu

Check that all the wave-guiding parts are tightened strongly and turn on the ultrasonic generator.



Figure 4.14. Turning on the generator



Figure 4.15. Green switch

By changing the frequency value using the thumbwheel, tune the system to get the maximum power output. The frequency at which the power is maximum corresponds to the resonance frequency of the system. Save the frequency by pressing the left arrow and return to the main menu.



Figure 4.16. Operation frequency menu

Enable AFC.



Figure 4.17. AFC menu



Figure 4.18. This parameter must be enabled

Finally go to “SET CUR” menu and increase gradually the value of the polarized current in order to get a power of 4-4.5 kW.



Figure 4.19. Setting current

STEP 5. EQUIPMENT READY TO WORK

Press the “STOP” button to turn off the generator. Now the ultrasonic equipment is ready to operate inside molten aluminium.

4.- EXPLANATION OF FUNCTION OF THE DOSHORMAT MACHINE

In the next section it would explained step by step the sequence of actions to be followed in order to operate the equipment.

STEP 1: PLACE THE CRUCIBLE IN POSITION

Place de crucible in the centre of the robot base by adjusting the position is correct adjusting the position near the wall. There are two sensors that indicate the correct position of the crucible. The position sensors pot must be enabled.



Figure 5.1. Correct situation of the crucible



Figure 5.2. Activated sensors indicate correct position

STEP 2: CLOSE THE SAFETY FENCE

After closing the security fence, press the red button on the keypad. The green light above the electrical cabinet indicates that the system is ready to start.



Figure 5.3. Keypad of security furnace



Green light:
System ready

Figure 5.4. Indicators in electric cabinet

STEP 3: ROBOT IN AUTOMATIC MODE

Activate the automatic mode in the control booth of ABB robot with the key selector.

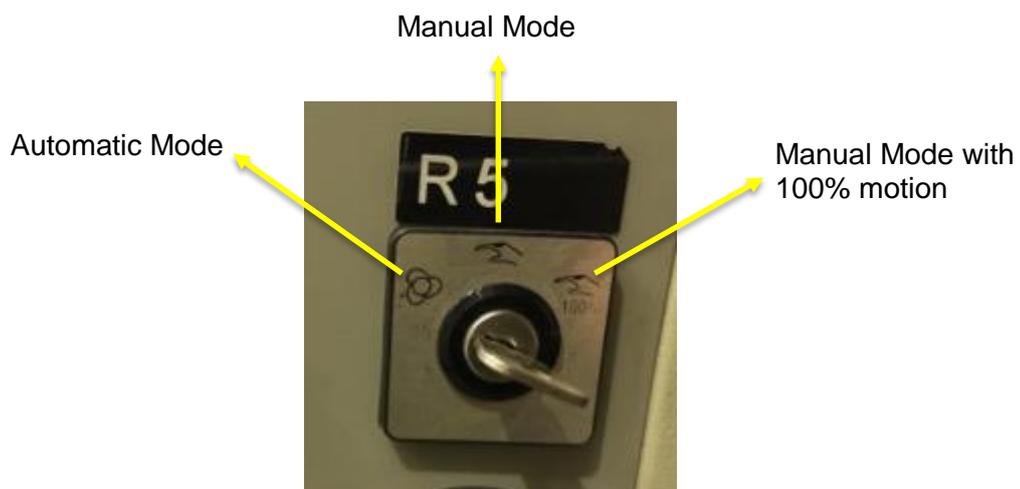
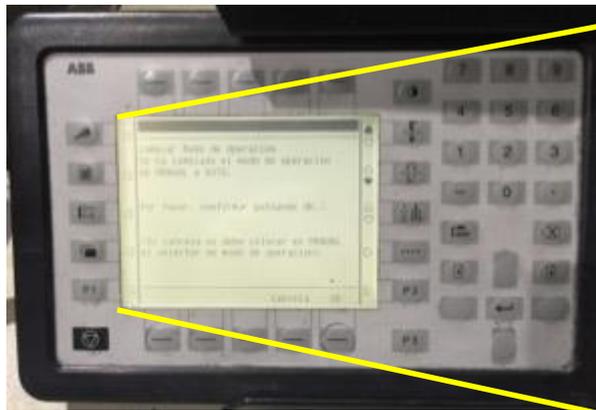


Figure 5.5. Key selector

STEP 4: CONFIRM AUTOMATIC MODE

In the console of the robot a confirmation message that the system is in automatic mode is displayed. Press OK

**Change Mode**

It has changed the mode of operation from MANUAL to AUTOMATIC.

Please confirm by pressing OK.

If canceled should be put in manual mode the key selector

Figure 5.6. Message Automatic Mode OK

STEP 5: START PROGRAM

On the console of the robot, go to the EDIT menu and select item 2: "Start from the beginning"

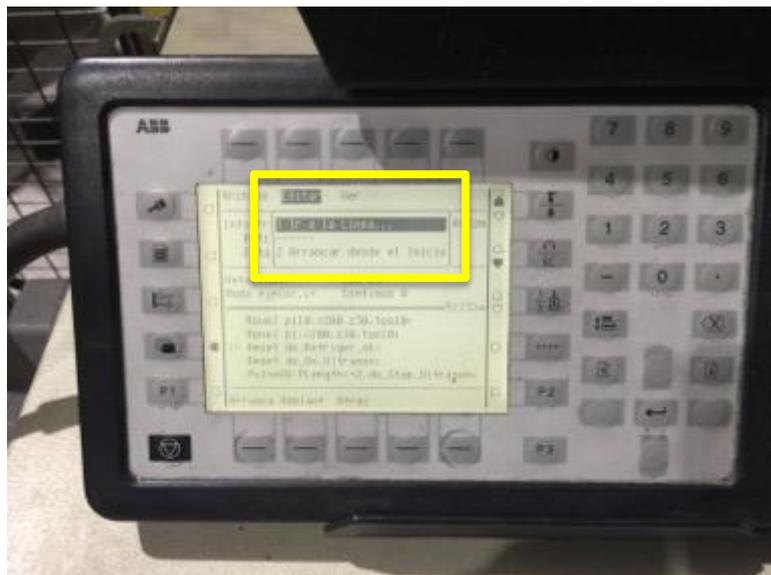


Figure 5.7. EDIT Menu to Start Program

STEP 6: CONFIRM START PROGRAM

Confirm the message to start the program. Press OK

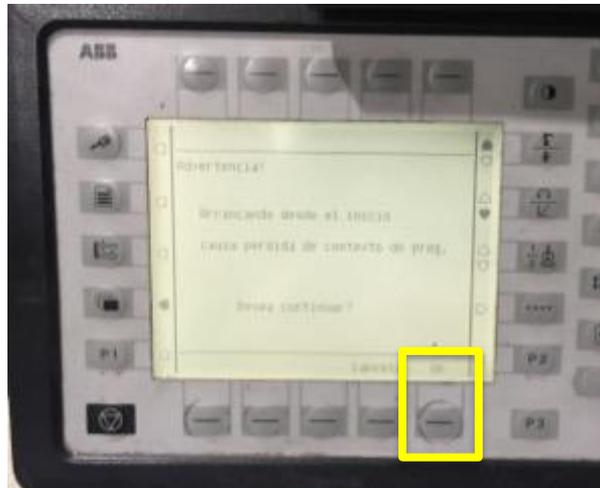


Figure 5.8. Press OK to confirm message

STEP 7: ENABLE ENGINES

Press the white button on the cabin robot until the light comes on permanently to start engines.



Figure 5.9. Button to turn the engines on



Figure 5.10. Engines ready

STEP 8: START

Press the START button to begin the treatment

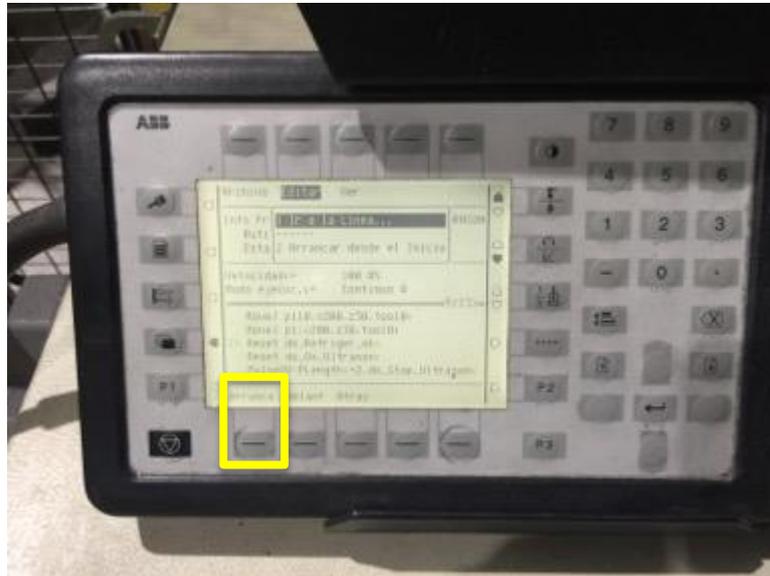


Figure 5.11. START button

STEP 9: TIME OF TREATMENT

A message appears on the screen to select the treatment time. You can select from 5, 10, 15 and 20 minutes.

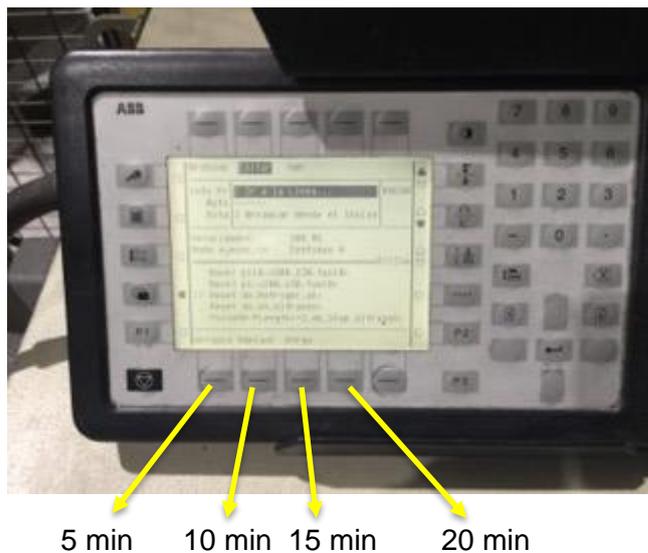


Figure 5.12. Select treatment time

5.- FAULTS AND ALARMS

There are three general alarms, which are:

- Ultrasound cooling alarm
- Position sensors of crucible
- Crucible level sensor

<i>Description</i>	<i>Cause</i>	<i>Solution</i>	<i>Notes</i>
<i>Ultrasound cooling alarm</i>	Excessive temperature in the ultrasonic generator	Check that there is water in the tank Check for leaks Check the correct operation of the cooler	With this fault the cycle does not start If the cycle is undergoing, it stops and the robot returns to the home position.
<i>Position sensors of crucible</i>	The crucible is not well placed	Place the crucible correctly. They should engage the two position sensors	With this fault the cycle does not start
<i>Crucible level sensor</i>	The crucible does not have enough material level.	Fill the crucible with more molten metal	With this fault the cycle does not start