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Operating & Maintenance Instructions

Frostbuster F501



It's strictly forbidden to operate the Frostbuster if you haven't read this manual.

Year of construction:
Type: F501
Serial number:

This manual must be used according the European legislation. It must be considered as a part of the machine. The manual must be kept with the machine until the final dismantle as described in the European legislation. The purpose of this manual is to help use and maintain the Frostbuster safely.

The user manual must be kept by the owner or the user on a safe, dry and sun protected place on the working area. It must always be available to consult. When the manual is damaged, the user has to ask Agrofrost for a new one.

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POINTS OF ATTENTION IN THIS MANUAL



Hint: to give suggestions and advice to ease certain tasks

Attention: a remark with extra information to call your attention for possible problems

Warning: to call your attention for avoiding danger

ABOUT THE USERS OF THE FROSTBUSTER

- Required user characteristics.

Persons who are allowed to drive a tractor by law and are familiar with the driving of a tractor may operate the Frostbuster. They have to be at least 18 years old and be able of all their physical and psychical capacities. They must read this manual before using the Frostbuster.



Someone who **has not read** this manual, cannot use the Frostbuster safely.

- The profile of the user.

The user manual is created for two main groups:

- The user / driver: the person who operates the Frostbuster
- The mechanical maintainer: the person who does the assembling, maintenance and repairs

They have to read this manual completely before using the Frostbuster are before doing any repairs or maintenance on the Frostbuster.

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1 Security

1.1 INTRODUCTION

In this chapter, the Frostbusters most important safety aspects will be explained. It is essential that everybody who works with the Frostbuster goes through the contents of this chapter attentively.

The most important safety and health risks related to using the Frostbuster, are listed in paragraph 1.2. The Frostbusters safety equipment is described in paragraph 1.3. The safety precautions to be taken by the Frostbuster user come up in paragraphs 1.4 to 1.6, and the symbols found on the Frostbuster are clarified in paragraph 1.8.

1.2 THE USE IN CLOSED AREAS

It is not allowed to use the Frostbuster in a closed area, because of three reasons:

- 1. The burner consumes a lot of oxygen. So, the supply of fresh air is very important.**
- 2. The engine of the tractor produces carbon monoxide, an odorless, colorless, poisonous gas. Breathing carbon monoxide can cause nausea, fainting or death.**
- 3. If gas would escape because of a gas leak, it would create life threatening situations in a closed area because of the danger of explosions.**



1.3 SAFETY AND HEALTH RISKS

The following safety- and health risks related to using the Frostbuster, have to be given attention:

- Forward tilting during coupling
- Presence of a drive shaft
- Presence of a gas installation
- High temperatures around nozzle and exhausts
- Risk of explosion in closed space
- Lighting the pilot when the gas valve is open
- Uncontrolled use of the Frostbuster

The Frostbuster is designed to reduce these risks as much as possible. The safety equipment used to achieve this are listed in paragraph 1.3, the safety precautions to be observed are listed in paragraph 1.4.

1.4 SAFETY EQUIPMENT

To make the use of the Frostbuster as safe as possible, the following safety equipment is delivered with the machine:

- An electric valve is built in. This valve must be opened manually, and it stays only open automatically as long as the built-in ionisation sensor detects a flame in the burner.
- When the energy supply is cut off, the machine cannot function, because the electric gas valve will close.
- Various safety components are built in the gas installation. These have been inspected by an official inspection service.
- Risk of explosion has been averted completely by the safety components and the explicit ban on indoor use.
- Various lights on the control panels simplify the operation of the Frostbuster.
- All moving parts are screened completely, in order to avoid contact during normal operation.
- A fixed safety zone of 10 meters around the Frostbuster has to be observed: no other people but the user may be in that safety zone.

*Covering the exhaust pipes isn't possible because these exhausts are needed for applying a air flow circulation. Because of this, it is possible a grown up puts his hand in the exhaust and is able to reach the blade wheel of the fan. We can only apply the necessary safety stickers to prevent such an act. Additionally, the user cannot allow any other persons in the safety zone of 10 meters around the machine. Thanks to this manual, he also has to be alerted extra for danger.

**EXTRA WARNINGS:
DO NOT PUT YOUR HANDS IN THE EXHAUST FAN**



1.5 SAFETY PRECAUTIONS BEFORE USE

First read attentively the instructions in the manuals of both the Frostbuster and the tractor. The user has to be acquainted with operating the controls of both.

- The guards must all be in their place. The Frostbuster cannot be used, when one or more of the following guards are missing, loose, damaged or incomplete:
 - the complete drive shaft protection;
 - the guard on the PTO shaft;
 - the tightening belts has to be mounted always so the gas bottles cannot move.
- Furthermore, the following safety equipment must be present: the leak spray
- Check the gas connections for leaks.

1.6 SAFETY PRECAUTIONS DURING USE

- Be extremely careful when there are obstructions blocking your view.
- When the machine is activated, make sure that nobody is within the safety zone, being 30 meters around the machine.
- If you need to leave the tractor for a moment due to unforeseen circumstances, keep the PTO shaft running at a stable pace. When the number of revs lowers, the exhaust temperature will rise sharply. The guards on the exhausts will also heat up enormously, with potential danger of burns.
- Do not stop between the trees.

1.7 SAFETY PRECAUTIONS WHEN CHANGING THE GAS CYLINDERS

- Keep the ventilator running at low speed while you change the bottles.
- Close all the gas cylinders before removing them.
- After connecting the new cylinders, use the leak spray to check the connections for leaks.
- USE OF THE MACHINE WITHOUT THE USE OF TIGHTENING BELT IS STRONGLY PROHIBITED.

1.8 SAFETY PRECAUTIONS WHEN ENDING OPERATION

- Keep the ventilator running for **at least 3 minutes**.
- Always close the gas bottles after use.

1.9 SAFETY ADVICE ON MAINTENANCE, REPAIRS AND STORAGE

- The Frostbuster may not be stored with gas cylinders on it.
- Always use genuine spare parts. Using non genuine spare parts can enhance the chances of damage, even if they fit on the machine.
- Replace damaged warning and instruction stickers.
- Store the Frostbuster horizontally in a dry place
- All the flexible gas hoses have to be replaced every 5 years.

2 Transport and Storage

2.1.1 Transport

- Make sure that the Frostbuster is connected to the tractor in the right way before you move it or start to pull it.
- Make sure that all gas bottles are closed during transport.

2.1.2 Storage

Because the moment the Frostbuster has to be used is never known a long time in advance, the Frostbuster has to be stored as if it's not going to be used for a long time.

Make sure that the Frostbuster is cleaned as described in chapter 6.

Store the Frostbuster on a covered, dry place and preferably horizontally.



The gas cylinders have to be removed every time the machine is put away. The gas cylinders have to be stored outside, according to the prescriptions of the fire insurance company, while the Frostbuster has to be stored indoors.

3 Installation and Start-up.

3.1 INSTALLATION.

Mount all the pieces that are delivered separately. Make sure that you always use the straps to place the bottles into place. If there are not fixed properly, they can start turning around which may cause the breaking of the gas hoses.

3.2 FIRST USE

When the Frostbuster is coupled for the first time, the drive shaft has to get extra attention. Possibly, the accompanying drive shaft is too long or too short for the tractor – Frostbuster combination: the drive shaft still has to be well connected, when the machine is lifted (see the manual of the drive shaft). Should it be too short, it has to be replaced by a longer one. If there is not enough space for the drive shaft to move, the drive shaft has to be shortened. You can do this best by following carefully the instructions in the manual about disassembling and shortening the drive shaft

3.3 BOTTLE SAFETY BELTS

We installed one safety belt on each machine to avoid that the bottles start turning around and would block the propane hoses.

Besides that, there is also the possibility to use 1 safety belt on each bottle.

If you want this option, please contact your dealer.



3.4 PREVIOUS TO THE START PROCEDURE

1. Check if the tractor is completely in working order. In order to obtain optimal results, the tractor cannot be defective. That is why it is important for you to check if there are no clogged filters, that there is enough fuel in the tank, and that the PTO controls work properly.
2. Supply enough spare gas cylinders. Make sure that these are within easy reach, so changing them can be done as quickly as possible. Put the necessary tool out as well: a 28 mm open end spanner. (In some countries, the open end spanner maybe of a different size as 28 mm). Store the gas cylinders vertically.
3. Make sure that all gas hoses are connected to a bottle.
4. Attach the Frostbuster to the tractor as described in chapter 2.
5. Check the gas connections with the leak spray and check the manual main valve at the back of the machine, which should be closed.
6. If the control box is not installed yet, it has to be put on the correct place, and the plug has to be connected to the tractor. The control box must always be in the direct view of the driver, within arm's reach and well fixed.
7. Press the red emergency switch.
8. Make sure that the PTO is ready. It has to be on, but the clutch still has to be in neutral.

Before using the Frostbuster for the first time, you should drive the whole circuit with tractor and machine, without the burner operating. This is necessary, both to check the circuit time and the speed as well as to check the stability of the machine in the field. The machine must not be used on rough uneven terrain.



THE AXLES MUST SET POSITIONED AS WIDE AS POSSIBLE !

3.5 THE CONTROL PANEL



- 1 Main switch = with this switch the Frostbusters electric circuit is switched on
- 2 Red light = **POWER**: if this indicator light is on, the machine's electrical circuit is switched on.
- 3 Yellow light = **FAULT**: if the burner does not ignite or stops for any reason, this light will be on.
- 4 Blue light = **BURNER**: this indicator light will go on when you ignite the burner and stays on as long as the burner is burning.
- 5 Emergency stop = **STOP**: must be pressed in any case of an emergency: the electric valve will close immediately and the burning process will be stopped
- 6 Switch = **BURNER ON/OFF**: to switch the burner "ON" or "OFF".
- 7 Thermometer = indicates the current operating temperature

3.6 THE PRESSURE REGULATORS

- 1. **First Pressure Regulator**: the pressure is set in the factory at 1.4 bar. This pressure must normally not be adjusted. Only at very low temperatures, it might be necessary to raise this pressure a bit.
- 2. **Second Pressure Regulator**: preset in the factory: do not touch.
- 3. **Third Pressure Regulator**: is used to adjust the temperature of the burner.
- 4. **Electric valve**: is activated from the control box in the tractor's cabin.
- 5. **Manometer**: if the pressure on this big green manometer drops below 1.5 bar, the gas bottles need to be changed.



3.7 START PROCEDURE



It is very important that the start procedure is done by just one person. Several persons working together to start up the machine can be extremely dangerous.

1. Open all the gas cylinders.
2. After checking the minimum safety distance of 10 m around the machine for the presence of other people, get on the tractor. Start the tractor. Start the PTO and let it run for idle.



3. Switch the main switch (1) to position “1”, or up. The red check light (2) will light up. If it doesn't, check the plug that connects the control block to the tractor.

4. Put the switch (6) to “ON” to ignite the burner. The burner will ignite and the blue light will turn on. If the burner does not ignite within 8 seconds, the yellow light (3) will turn on. In that case, put the switch (6) back to “OFF”, let the fan run for 30 seconds and try to ignite the burner again.

5. If the burner ignites, the temperature will raise.

When the temperature reaches 50 °C, immediately accelerate gradually the PTO to a maximum of 540 to 600 rpm.

6. The working pressure of the gas must be regulated, with the pressure regulator (3 – picture below) so that the temperature of 80° - 85°C is reached.



7. You must constantly monitor the temperature. **If the temperature exceeds 120 °C, you must push the emergency button (5) immediately to stop the burner.** Let the PTO turn for a few minutes until the machine has cooled down, lower the gas pressure and start again from point 4. **If the temperature exceeds 150 °C, an acoustic alarm will sound.**

8. If the temperature remains stable for a few minutes, you can start driving through the orchard etc.
9. **When the Frostbuster is operational, the speed of the ventilator must not be raised or lowered under any circumstances. This means that the drive shaft must run at stable pace. Every change will have an immediate effect on the temperature.**



There is an emergency stop on the control panel next to the driver. If there is any doubt, this switch has to be pressed. All gas supply will then be cut off immediately.

When the Frostbuster is operational, the speed of the ventilator must not be raised or lowered under any circumstances. This means that the drive shaft must run at stable pace. Every change will have an immediate effect on the temperature.

When disconnecting the gas supply, for any reason, always keep the machine running for another 3 minutes in order to remove any amassed gas and to cool down the machine. Only then, other people may enter the safety zone.

When the Frostbuster is transported, the gas cylinder valves must be closed all the time.

A few more points of interest:



- Start the drive shaft gradually.
- All safety precautions described in chapter 1 have to be observed.
- **When the temperature on the control panel drops 20 degrees in a few minutes, and the pressure on the big green manometer drops below 1.5 bar, the gas cylinders will have to be replaced. In that case, the time schedule can be interrupted for a few minutes without possible damage to the plants. It is of course recommendable to keep the replacing time as short as possible, and below 10 minutes.**

- Avoid changing the gas cylinders at sunrise; this is the coldest moment of the night and it's important that you are not standing still at that point. If you notice that you will have to change the gas cylinders at that time, stop at least 1 hour before sunrise and change the gas cylinders.

3.8 THE IDEAL CIRCUIT

- a. The distance between the rows you drive through must be between 50 and 100 meters. **50 to 80 meters is ideal.**
- b. If possible, drive not always through the same row, but take once the row at the left, once the main row, and next the row at the right, so you have three rows to drive through. This is better for the air distribution, will cause less drying of the flowers and will keep the soil in better condition. If the row distance is more than 4 meters, you can use 2 rows instead of 3.
- c. If possible, make two circuits that you drive alternately. This second circuit has to pass in the middle of first one, or at least 25 meters more to the left or right of the first circuit. Take a look at the example in the next page.
- d. The total distance of the circuit may not be longer than 1300 meters. If you drive two circuits, the total distance of the two must stay under 2600 meters.
- e. The driving speed has to be **between 4 and 8 km/h** and has to be chosen in a way that one circuit lasts between 7 and 10 minutes. **8 to 10 minutes is ideal.** This is because the protection is partly caused by the fluctuations of the temperature. Examples:
 - i. Circuit = 1000 meters, speed = 6 km/H, time = 10 minutes
 - ii. Circuit = 800 meters, speed = 6 km/H, time = 7,5 minutes
 - iii. Circuit = 800 meters, speed = 5 km/H, time = 9,6 minutes
 - iv. Circuit = 1300 meters, speed = 8 km/H, time = 9,8 minutes
- f. Mark the rows where you want to drive through, so it will be easier to follow the circuit in the dark.
- g. Make a test drive with the machine, with the gas bottles mounted, the fan operating and with the burner NOT operating. This is important for two reasons: to check the time of the circuit (see point 1.f), and to check if the Frostbuster stays stable during the complete circuit. Eventually, increase the distance between the wheels, so the stability will improve. **It is extremely important that the Frostbuster cannot turn over, because of uneven, rough ground or because of the inclination of the terrain.**

To calculate the ideal circuit, please send an a-mail to the manufacturer, containing the Google Earth coordinates of your orchard/vineyard: info@agrofrost.be

Give also following information:

- On a slope or not
- Distance between the rows
- Distance between the trees/plants in the row
- Kind of fruit
- For vines: distance between the ground and the lowest wire/buds (in spring)

3.9 DURING OPERATION

During operation the PTO's speed must not be raised or lowered. A change of speed will cause the temperature to rise or fall inversely proportional to the PTO's speed. Consequently, operation will be less efficient.

3.10 REPLACING THE GAS CYLINDERS

1. Turn off the power switch (1) on the control box. The burner stops.
2. Close all the valves of the gas tanks.
3. Let the PTO run idle while you change the bottles.
4. **Replace the empty gas cylinders.**
5. Start up again, following the start procedure.

3.11 ENDING THE OPERATION

1. Turn off the power switch (1) on the control box. The burner stops.
2. Close all the valves of the gas tanks.
3. Close the manual valve on the backside of the machine.
4. **Keep the machine running until the temperatures on the temperature reading on the control box is lower than 40 °C, then switch off the PTO.**
5. **Press the RED EMERGENCY button (5) down.**
6. Disconnect the gas tanks and store these outside.

4 When to start / stop – How does it work – Applications.

4.1 WHEN TO START AND TO STOP.

In case of night frost, you must start operating before the wet temperature drops below 0° C.



The machine has to work for about 30 to 45 minutes before it will create a positive effect on the temperature and the humidity. As soon as the temperature outside the orchard is positive again, you can stop.

Measuring the wet temperature if you do not have a frost alarm with wet sensor: place a plastic foil of 1 square meter on the ground, on the lowest (and coldest) point in the orchard. Place the temperature sensor on the foil. Start as soon as the temperature indicates 0° C.

A good night frost alarm is necessary.

4.2 HOW DOES IT WORK.

The working principle is, unlike all other frost protection systems, not based on raising the temperature above the critical values but on phase transition. Or in this case by controlling the forming of hoarfrost. Where our machines are used, we notice a significantly lower formation of hoarfrost. We all know that hoarfrost is the biggest enemy for the flowers and buds. But there is a way to use the enemy for protection.

The transformation of vapor into hoarfrost is called desublimation or deposition and liberates a lot of energy. This energy is transferred to its surroundings, in this case the surrounding air but above all into the leaves and flowers themselves. We know that it's precisely the hoarfrost that normally causes most damages. This is because the ice crystals extract energy and humidity from the flower. Without protection, the layer of hoarfrost will increase and finally cause damages by dehydration and under-cooling.

But not with our system. Because we pass with a hot air stream, every 7 to 10 minutes, part of the ice evaporates (called sublimation) and the remaining ice gets energy from the passing air. The higher the humidity, the more energy that is transferred. After a few minutes, the air cools down again, the relative humidity increases and some new rime will be formed. This liberates again energy and gives again energy to the flowers. This allows us to create an optimal protection with only a fraction of the energy input that is needed by other systems.

4.3 DIFFERENT APPLICATIONS.

The Frostbuster can be used almost everywhere and for several applications:

- 1) For **frost protection** in orchards for all kind of fruits, in vineyards, in greenhouses and plastic tunnels, for strawberries, raspberries, flowers, vegetables, apples, pears, peaches, plums etc.
- 2) To **improve the fruit set** in low temperature during blossom.
- 3) To **raise the temperature** in plastic tunnels, to bring forward the first harvest date in the beginning of the season, or to pick later at the end of the season

5 Maintenance – Cleaning

5.1 BURNER.

The burner does not require any maintenance.

5.2 GAS HOSES

The gas hoses have to be replaced every 5 years.

5.3 FAN AND TRANSMISSION.

The maintenance of the Frostbuster is very simple: you only have to pay attention to the following points:

- Every 10 working hours, the bearings of the fan, on top and below the machine, has to be greased.
- The drive shaft has to be greased as prescribed in the manual that is delivered with the drive shaft.
- At the beginning of the season, the tyre pressure has to be checked and adjusted when necessary.
- After 200 working hours, or every two years in case less than 200 working hours are performed, the oil of the gearbox has to be changed. Type of oil: 80W90.
- If the Frostbuster is not stored on a dry place, it is recommended to inspect the inside of the machine in the third or fourth season. The glass wool could absorb water from the air and hold it, causing the perforated plate to rust. When this occurs for a long time, the machine could blow out pieces of the perforated plate.
- Check the tension of the belts once a year.

5.4 CLEANING

There are no specific rules for cleaning the Frostbuster. In normal conditions, the functioning of the Frostbuster will not be obstructed by dirt or impurities. Of course, a touch-up is always useful for the Frostbuster. The best time is right before use after a long time.

Do not use a high-pressure cleaner on the outside nor the inside of the fan. The insulation in the interior of the fan might get wet. Never clean the inside of the fan with water.

6 Explanation pictograms



**FLAMMABLE
MATERIALS**



**CAUTION -
DANGER**



HOT SURFACE



**SAFETY GLOVES
MANDATORY**



MOVING PARTS



**FIRE: OPEN
FLAMES
AND SMOKING
PROHIBITED**

7 Warranty - Scrapping – Spare parts list.

7.1 WARRANTY.

The warranty covers the parts that are defective from the start, and that are produced by AGROFROST. This warranty expires when it is a matter of normal wear, when a malfunction is caused by incorrect operation or maintenance of the machine, in case the user has not observed the instructions in the manual, or when non genuine parts, not produced by AGROFROST are used.

We do not accept complaints about changes that will be introduced in the future, in order to improve the machine.

It is important that the document, called “INSTALLATION PROCEDURE” is filled up and send back to the address of the manufacturer:

AGROFROST NV
Kunstlaan 56
1000 Brussels - BELGIUM

If this document is not send back, the manufacturer reserves the right to cancel any warranty.

7.2 SCRAPPING.

The following table gives an overview of the correct way of disposal of the different parts, in case the Frostbuster has to be dismantled.

Part	Way of disposal
Bearings	scrap
Oil from the gearbox	chemical waste
Synthetic guard on the PTO shaft	container for synthetic material
Frame	scrap
Screws, bolts, washers	scrap
Gaskets	container for synthetic material
Insulation	container for synthetic material
Tires	rubber waste

7.3 SPARE PARTS LIST.

If you need a spare parts list, you can ask for it at the manufacturer.

Send an e-mail to: info@agrofrost.be !!

8 EC Declaration of Conformity.

Declaration of Conformity.

We declare under our own responsibility that the machine complies with the safety and health requirements established by the European Directive 2006/42/EG.

EN standard codes:

BS EN 1672-2:2005+A1:2009 ; BS EN ISO 14123-2:2015 ; BS EN ISO 12100:2010 ;
BS EN 1005-1:2001+A1:2008 ; EN 894-1:1997+A1:2008 ; BS EN 1037:1995+A1:2008 ;
BS EN ISO 13857:2008 ; BS EN 60204-1:2006+A1:2009 ; BS EN ISO 13850:2006 ;
BS EN ISO 13850:2015 ; BS EN 61310-1:2008 ; BS EN ISO 14119:2013 ;
BS EN ISO 13732-1:2006

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Machine : Frostbuster Type

Serial number :

Production date :

Year in which CE mark was affixed :

Signature:

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