

Autoclave Sterilization Unit



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1ST YEAR POST-GRADUATE

STERILIZATION

- **Sterilization** is a term referring to any process that removes or kills all forms of microbial organisms such as fungi, bacteria, viruses, spore forms, etc. present on a surface, contained in a fluid, or in a compound such as biological culture media.
- Sterilization can be achieved by applying heat, chemicals, irradiation, high pressure, and filtration of them.



Bacterium



Virus



Protozoan



Fungus



Helminth

AUTOCLAVE

- The autoclave is a equipment used to remove microorganisms (Virus, Bacteria, fungus etc.) and spores using high pressure and high temperature steam Sterilization



DEFINITION

Autoclave is a pressurized device designed to heat aqueous solutions above their boiling point at normal atmospheric pressure to achieve sterilization.

Auto → self

Clavis → self locking device



Autoclave Machine

Brief History

- ▶ 1450 B.C.E. Moses
- ▶ 460-377 B.C.E. Hippocrates
- ▶ Lazzaro Spallanzani
- ▶ Pasteur
- ▶ Denis Papin



Papin's steam cooker

20th Century

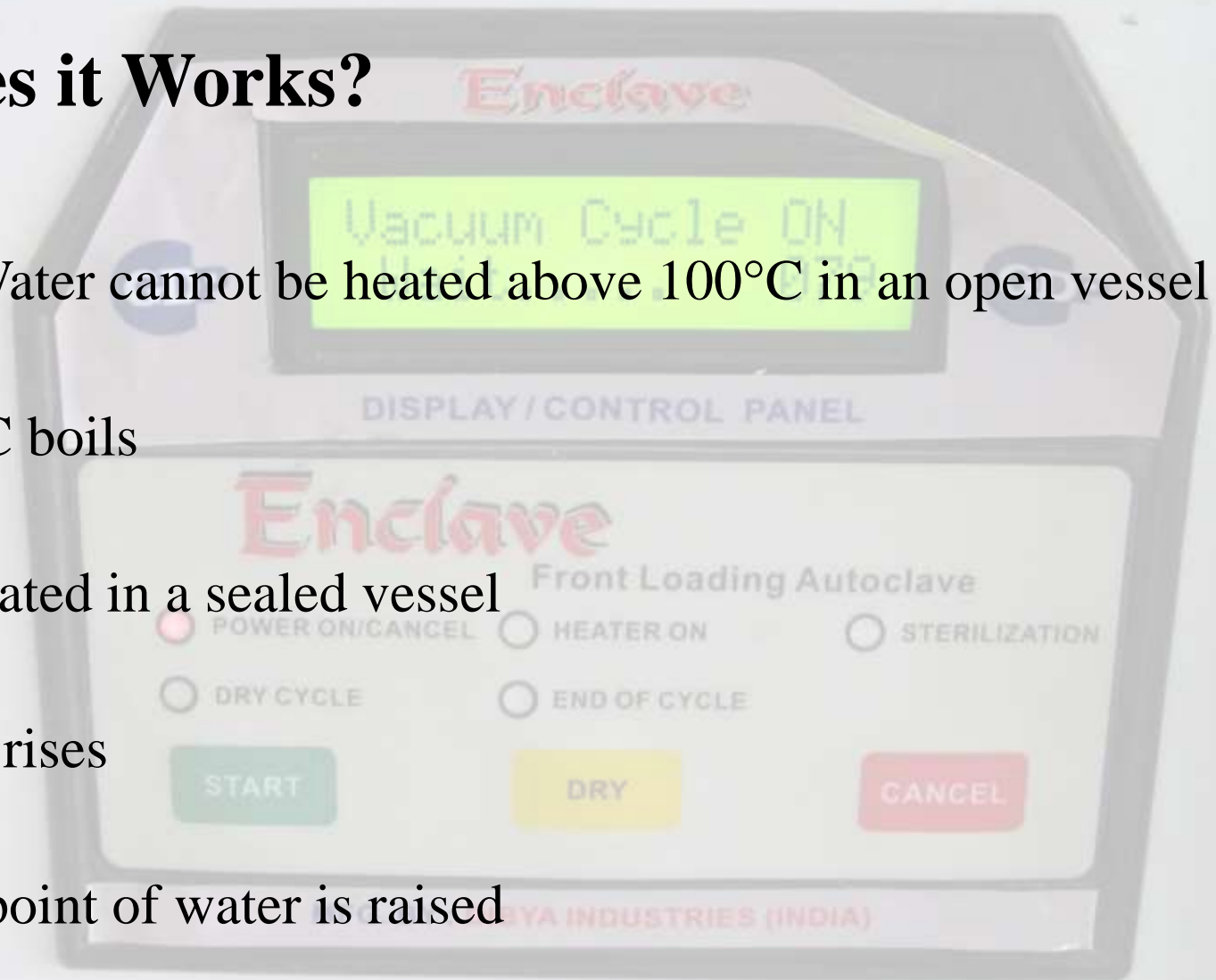
- ▶ It was finalized by Charles Chamberland in 1987
- ▶ Colleague of Pasteur
- ▶ Building up on Papin's marmite
- ▶ From culinary to medicine



Charles Chamberland 1851-1908

How Does it Works?

- ▶ Liquid Water cannot be heated above 100°C in an open vessel
- ▶ At 100°C boils
- ▶ Water heated in a sealed vessel
- ▶ Pressure rises
- ▶ Boiling point of water is raised



Autoclave Usage

- ▶ Microbiology
- ▶ Medicine
- ▶ Veterinary science
- ▶ Dentistry
- ▶ Metallurgy ...



PURPOSE OF THE AUTOCLAVE

1. To prepare materials for bacteriological cell cultures (test tubes, pipettes, Petri dishes, etc.) without contamination.
2. Prepare elements used for taking samples. (needles, tubes, containers).
3. Sterilize contaminated material.

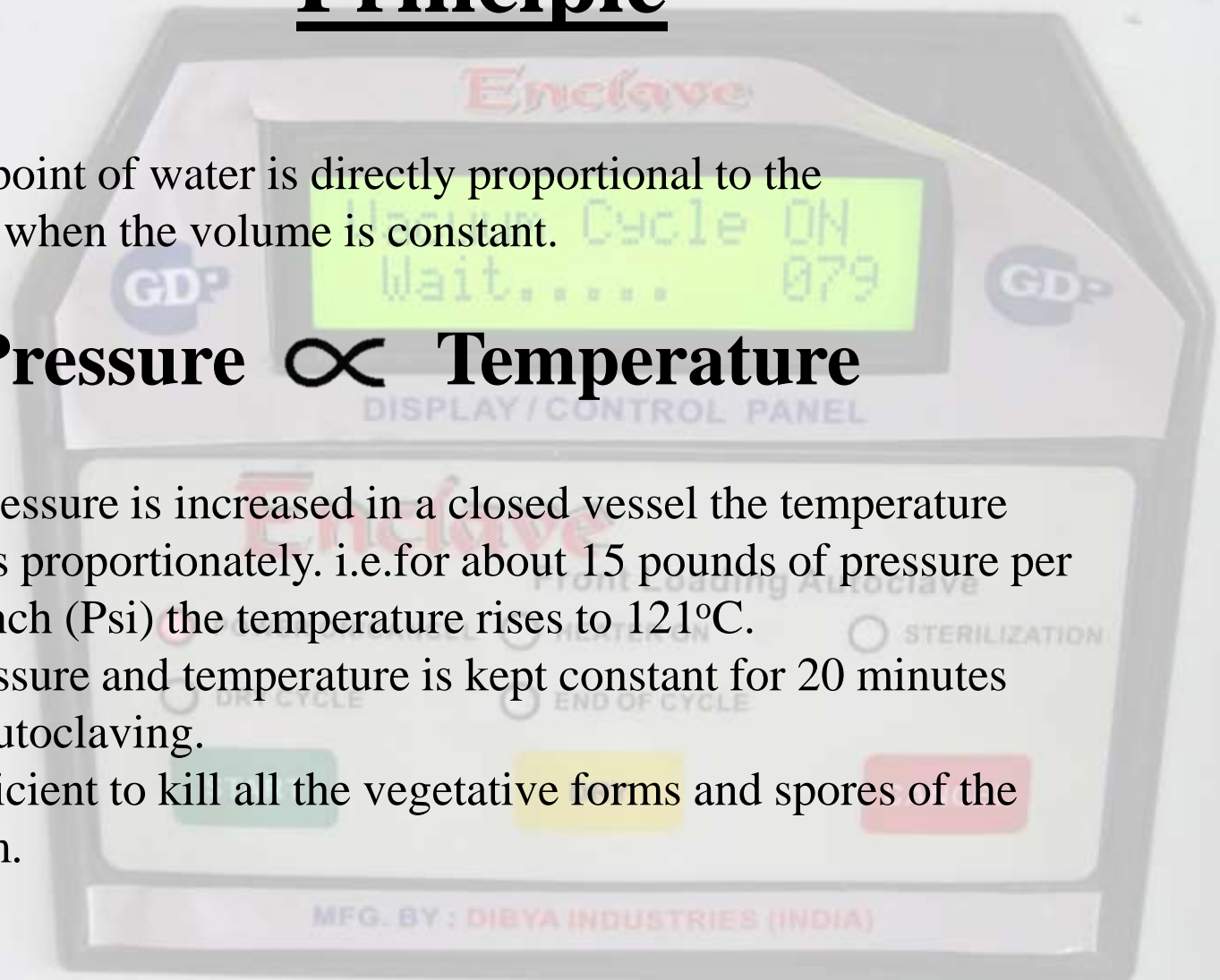


Principle

- ❑ Boiling point of water is directly proportional to the pressure when the volume is constant.

Pressure \propto Temperature

- ❑ When pressure is increased in a closed vessel the temperature increases proportionately. i.e. for about 15 pounds of pressure per square inch (Psi) the temperature rises to 121°C.
- ❑ This pressure and temperature is kept constant for 20 minutes during autoclaving.
- ❑ It is sufficient to kill all the vegetative forms and spores of the organism.



The Relationship Between the Pressure and Temperature of Steam at Sea Level*

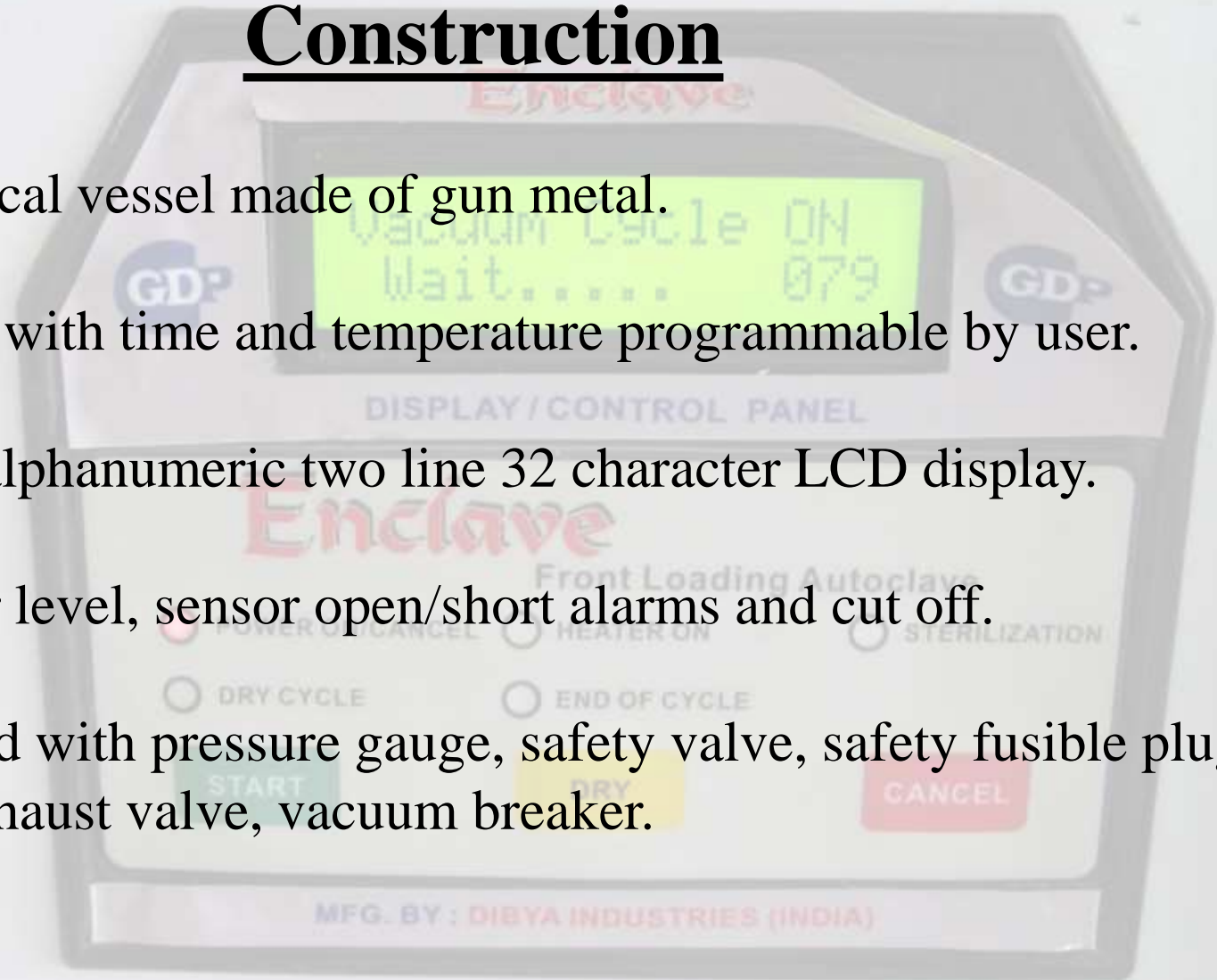
TABLE

Pressure (psi in excess of atm pressure)	Temperature (°C)
0 psi	100
5 psi	110
10 psi	116
15 psi	121
20 psi	126
30 psi	135

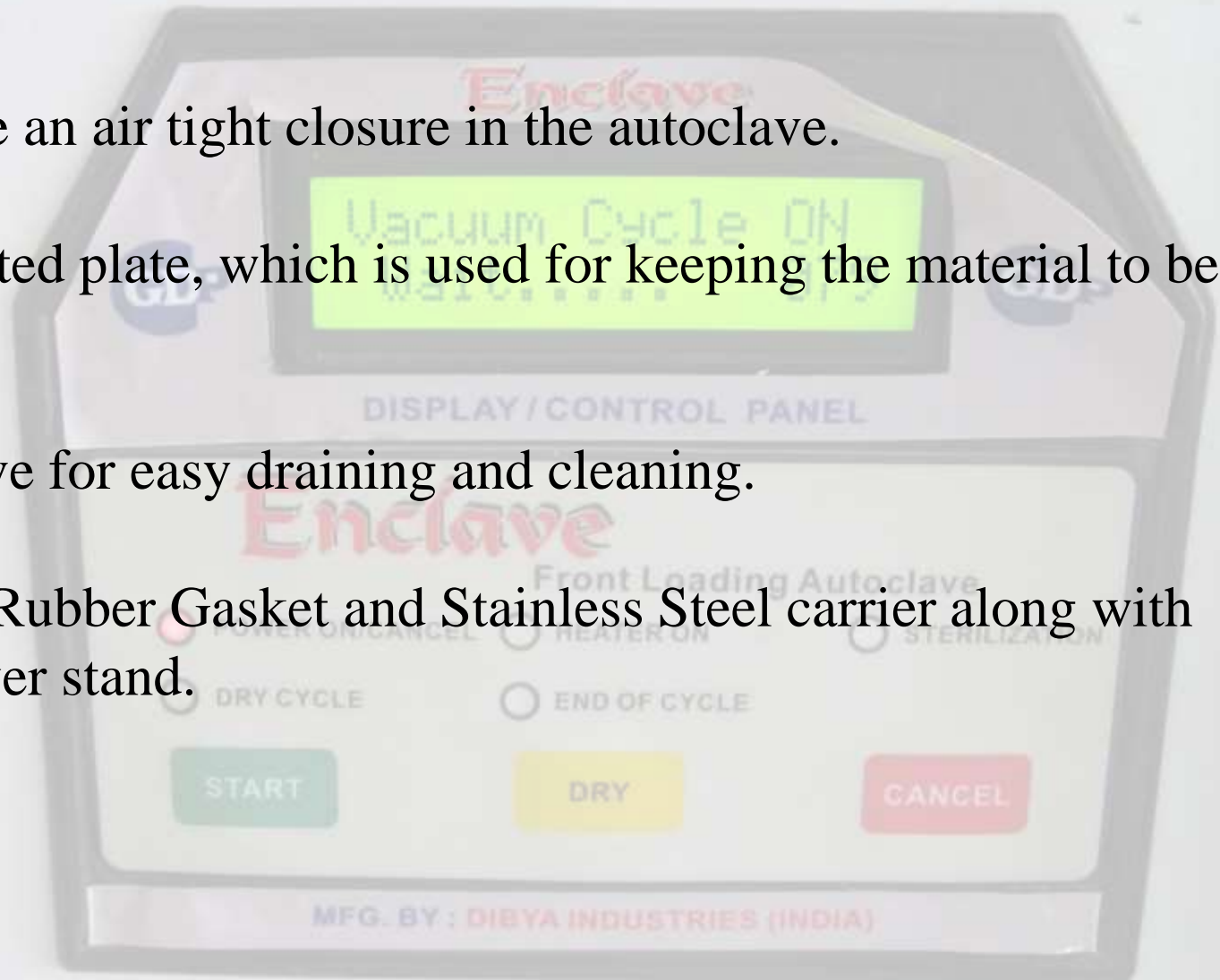
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Construction

- ❑ A cylindrical vessel made of gun metal.
- ❑ Controller with time and temperature programmable by user.
- ❑ A backlit alphanumeric two line 32 character LCD display.
- ❑ Low water level, sensor open/short alarms and cut off.
- ❑ Lid is fitted with pressure gauge, safety valve, safety fusible plug manual exhaust valve, vacuum breaker.

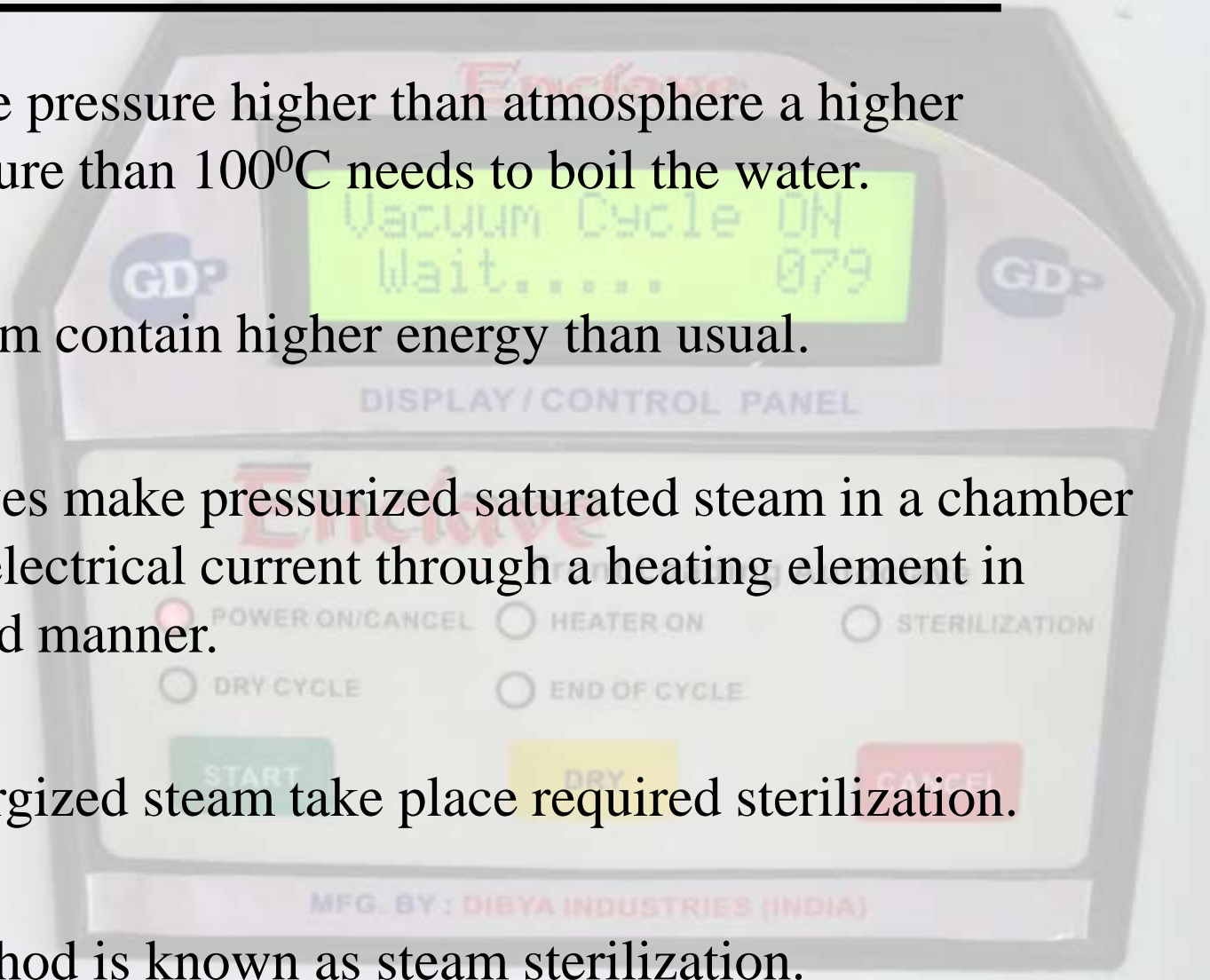


- ❑ Lid ensure an air tight closure in the autoclave.
- ❑ A perforated plate, which is used for keeping the material to be sterilized.
- ❑ Drain valve for easy draining and cleaning.
- ❑ Moulded Rubber Gasket and Stainless Steel carrier along with heater cover stand.



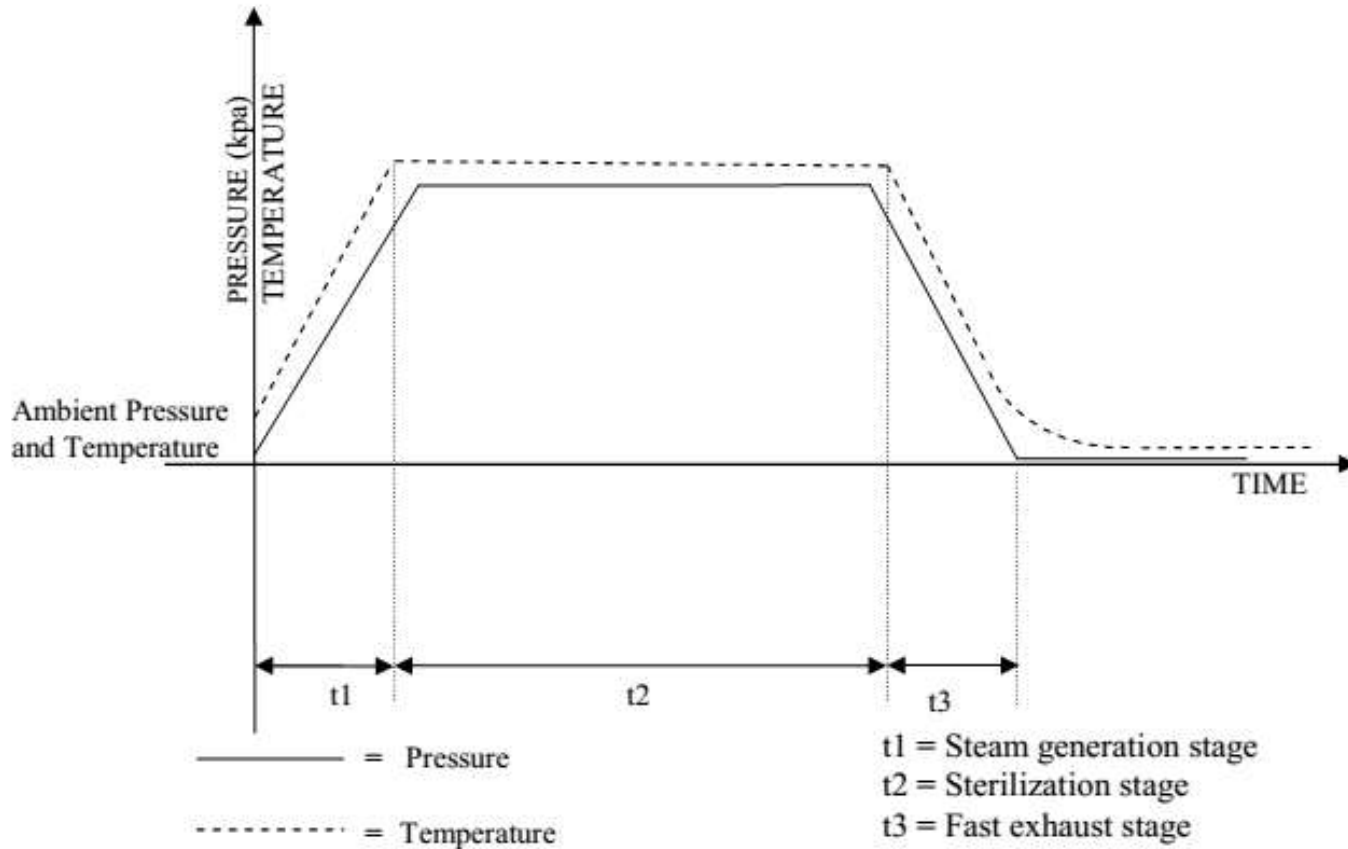
OPERATION PRINCIPLES

- When the pressure higher than atmosphere a higher temperature than 100°C needs to boil the water.
- This steam contain higher energy than usual.
- Autoclaves make pressurized saturated steam in a chamber passing electrical current through a heating element in controlled manner.
- This energized steam take place required sterilization.
- This method is known as steam sterilization.



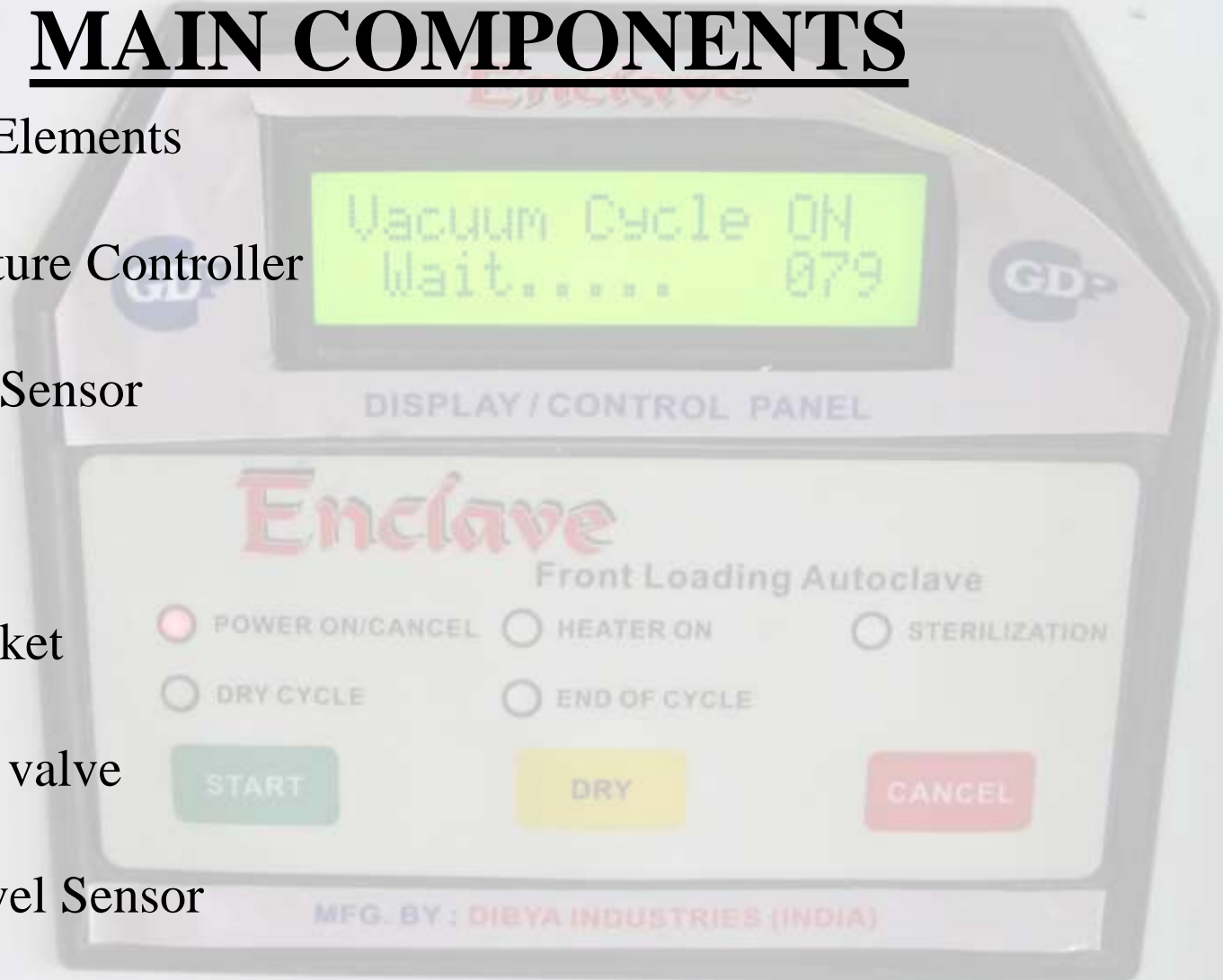
STERILIZATION PROCESS

Enclave



MAIN COMPONENTS

1. Heating Elements
2. Temperature Controller
3. Pressure Sensor
4. Chamber
5. Door gasket
6. Solenoid valve
7. Water level Sensor



Heating Elements



Temperature Controller



Thermostat



Pt 100

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Pressure Sensor



Enclave

Vacuum Cycle ON

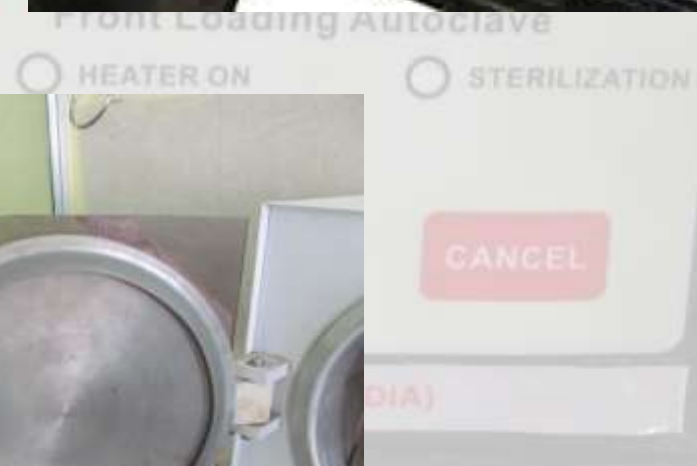
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Chamber

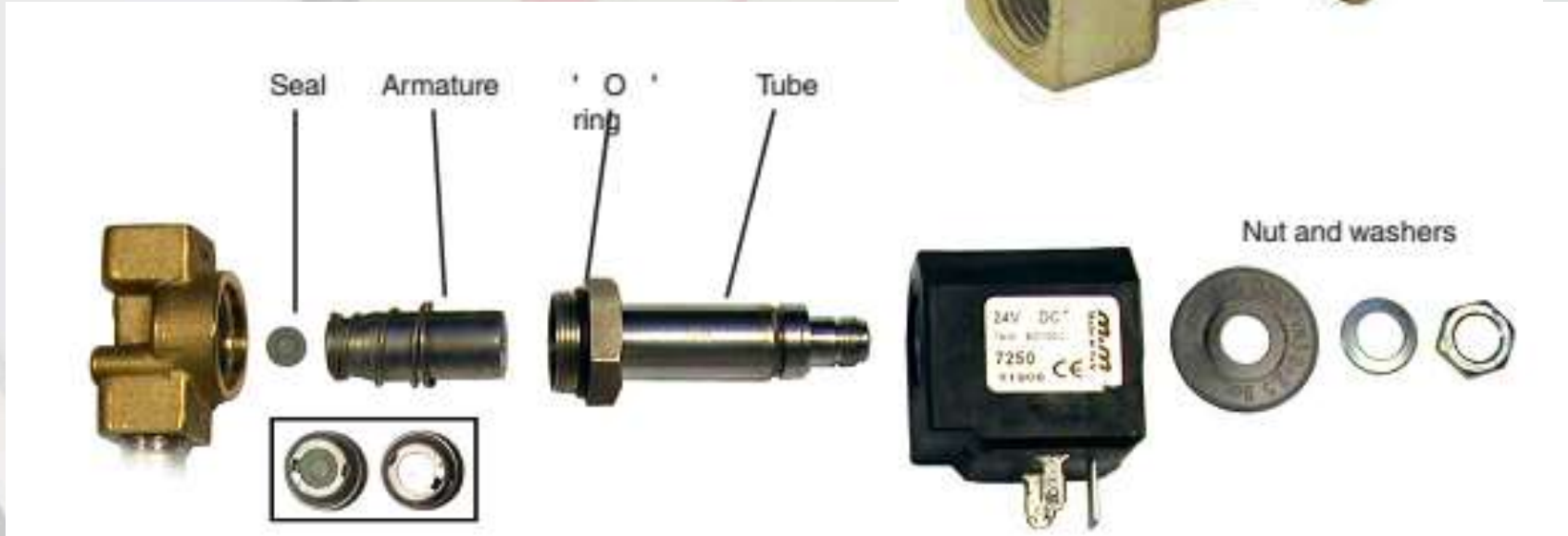


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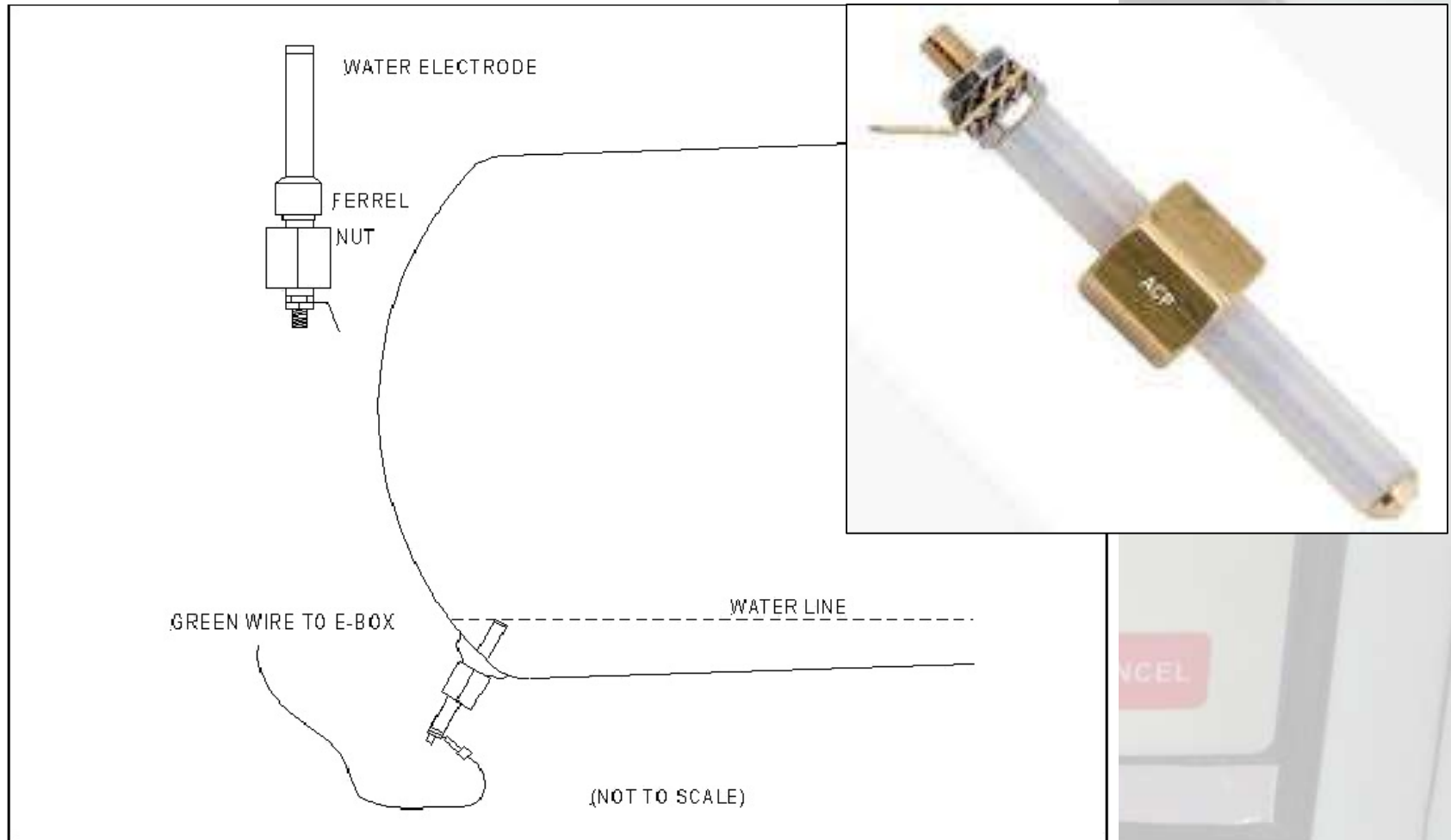
Door Gasket



Solenoid valve

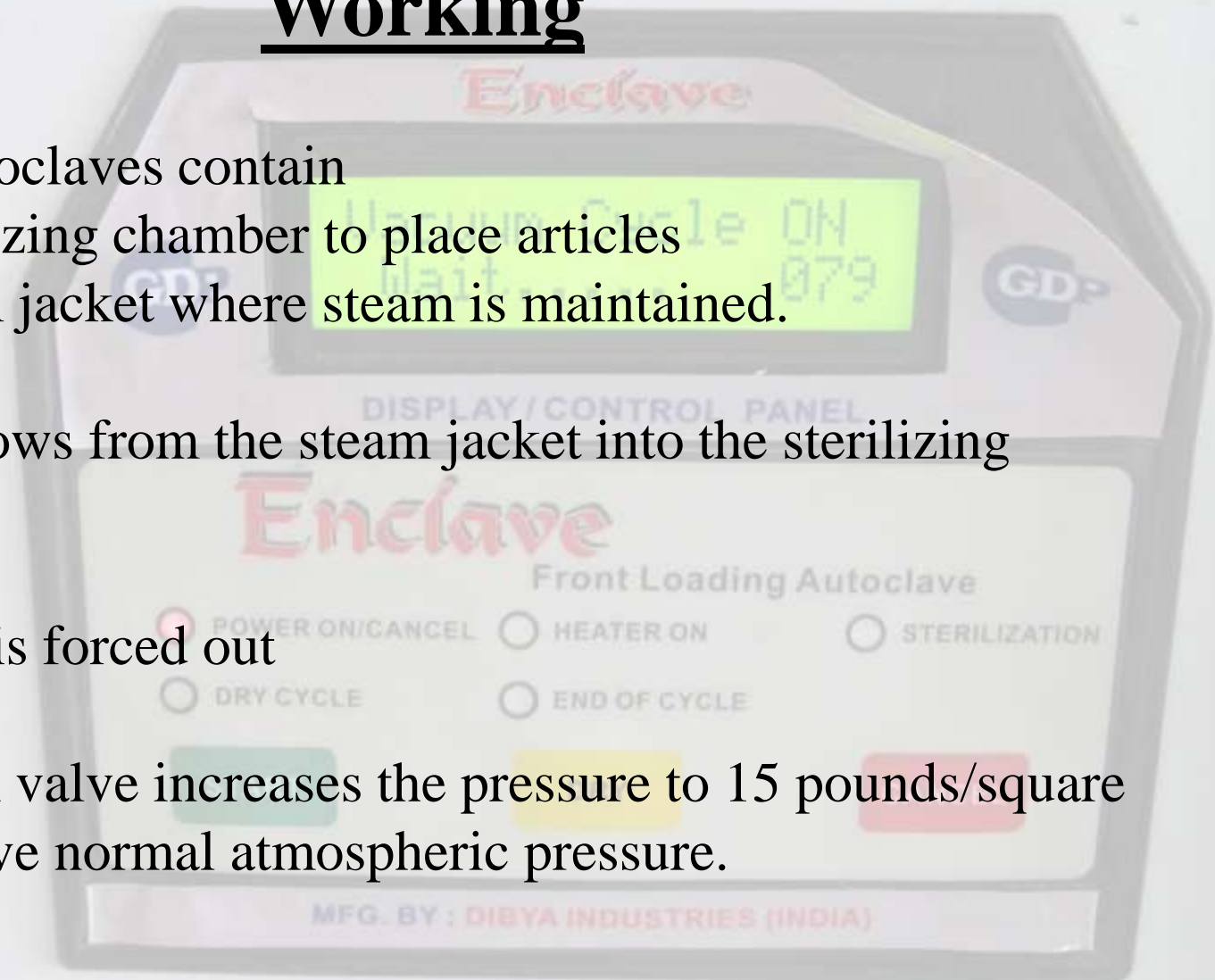


Water level Sensor

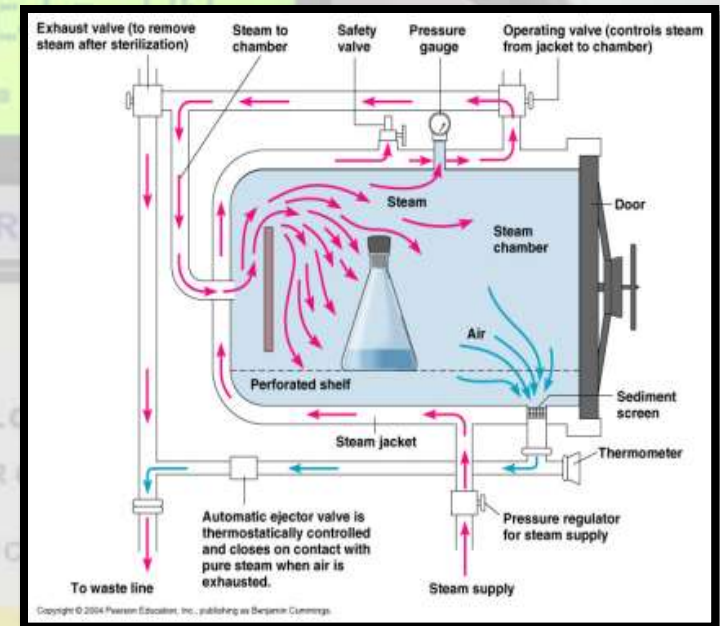


Working

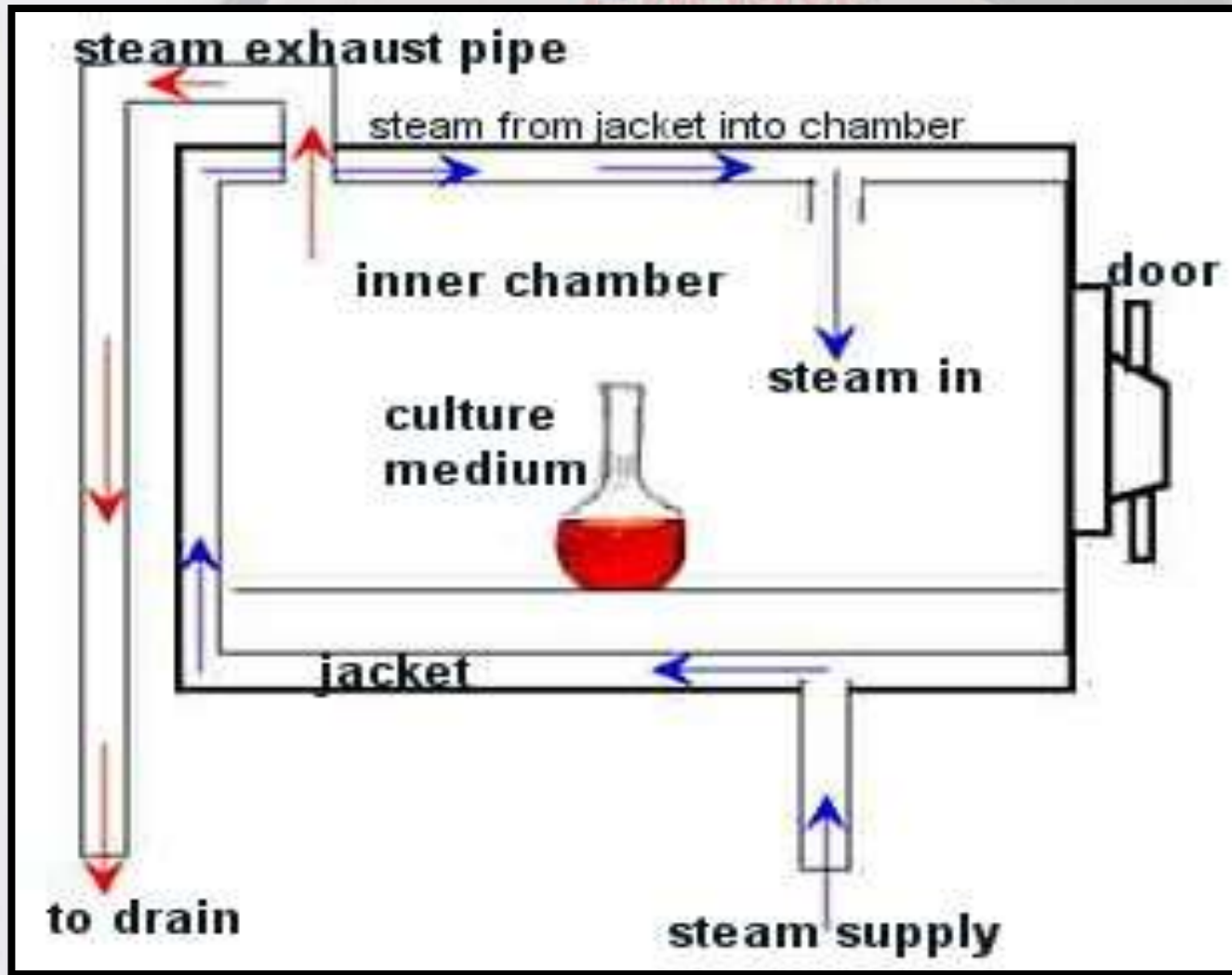
- Most autoclaves contain
 - a sterilizing chamber to place articles
 - a steam jacket where steam is maintained.
- Steam flows from the steam jacket into the sterilizing chamber
- Cool air is forced out
- A special valve increases the pressure to 15 pounds/square inch above normal atmospheric pressure.



- The temperature rises to 121.5°C , and
- The superheated water molecules rapidly conduct heat into microorganisms.
- The time is reduced to 15 minutes to kill bacterial spore
- For denser objects, up to 30 minutes of exposure may be required.



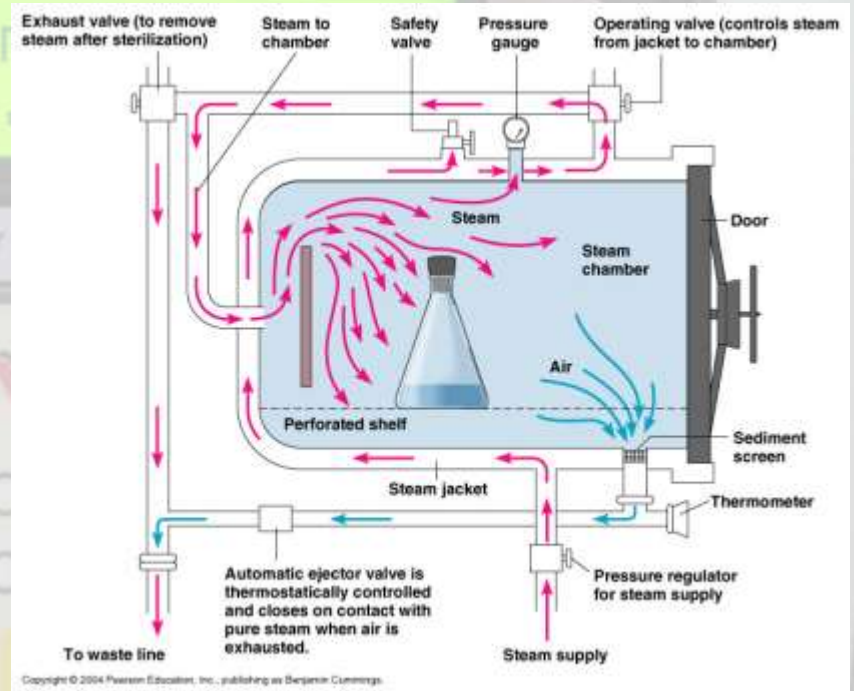
Schematic Diagram Of Autoclave



Air Removal

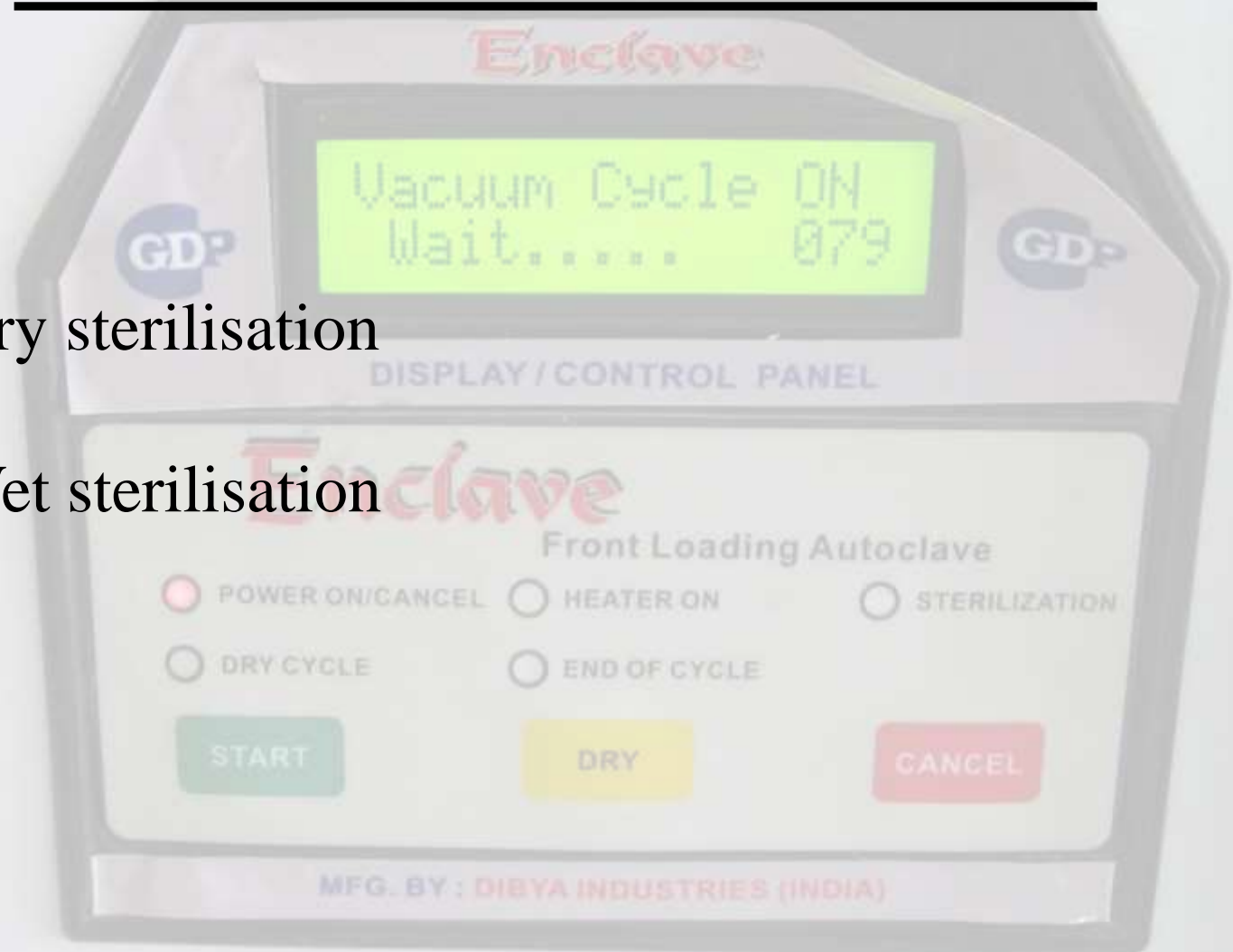
Various methods involved are :

- ▶ Downward displacement
- ▶ Steam pulsing
- ▶ Vacuums pumps
- ▶ Super atmospheric cycles
- ▶ Sub atmospheric cycles



TYPES OF STERILISATION

- Dry sterilisation
- Wet sterilisation



Dry Sterilization

Mechanism:

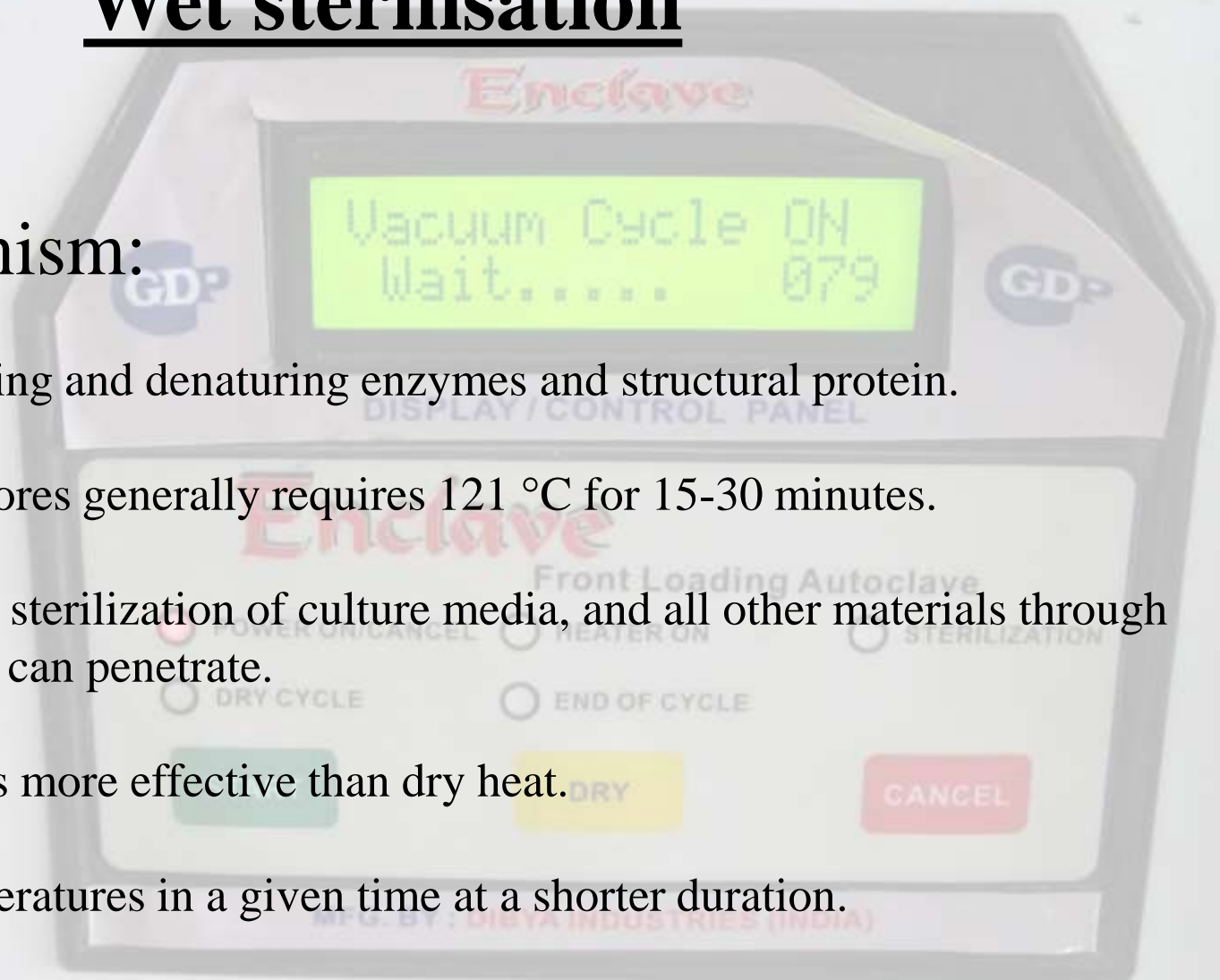
- By destructive oxidation of essential cell constituents.
- Resistant spores requires a temperature of about 160 °C for 60 minutes.
- Employed for glassware; syringes, metal instruments and paper wrapped goods.
- Used for anhydrous fats, oils and powders that are impermeable to moisture.



Wet sterilisation

Mechanism:

- By coagulating and denaturing enzymes and structural protein.
- Resistant spores generally requires 121 °C for 15-30 minutes.
- Used for the sterilization of culture media, and all other materials through which steam can penetrate.
- Moist heat is more effective than dry heat.
- Lower temperatures in a given time at a shorter duration.

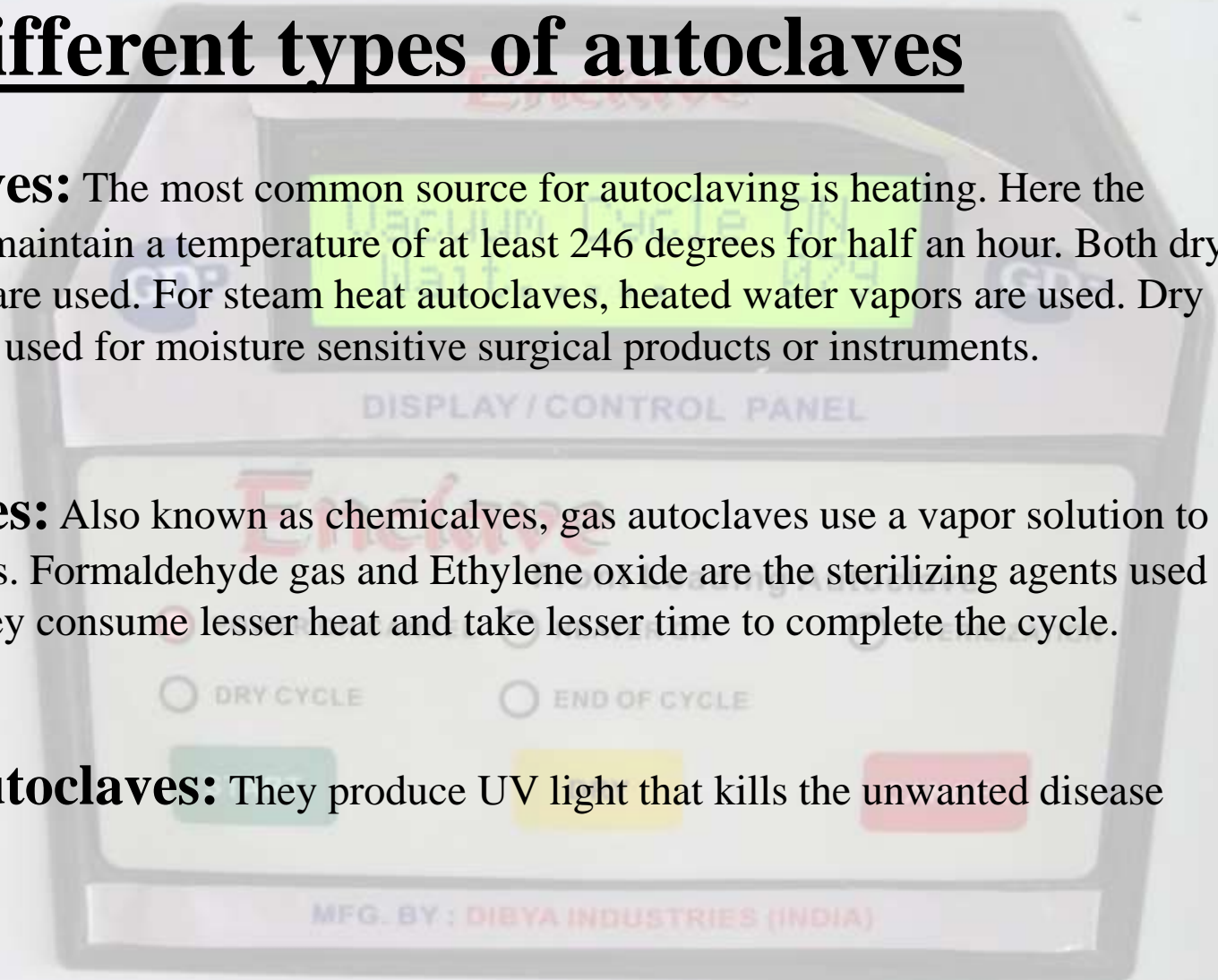


Different types of autoclaves

Heat autoclaves: The most common source for autoclaving is heating. Here the autoclaves should maintain a temperature of at least 246 degrees for half an hour. Both dry heat or steam heat are used. For steam heat autoclaves, heated water vapors are used. Dry heat autoclaves are used for moisture sensitive surgical products or instruments.

Gas autoclaves: Also known as chemicalves, gas autoclaves use a vapor solution to sterilize its contents. Formaldehyde gas and Ethylene oxide are the sterilizing agents used in gas autoclaves. They consume lesser heat and take lesser time to complete the cycle.

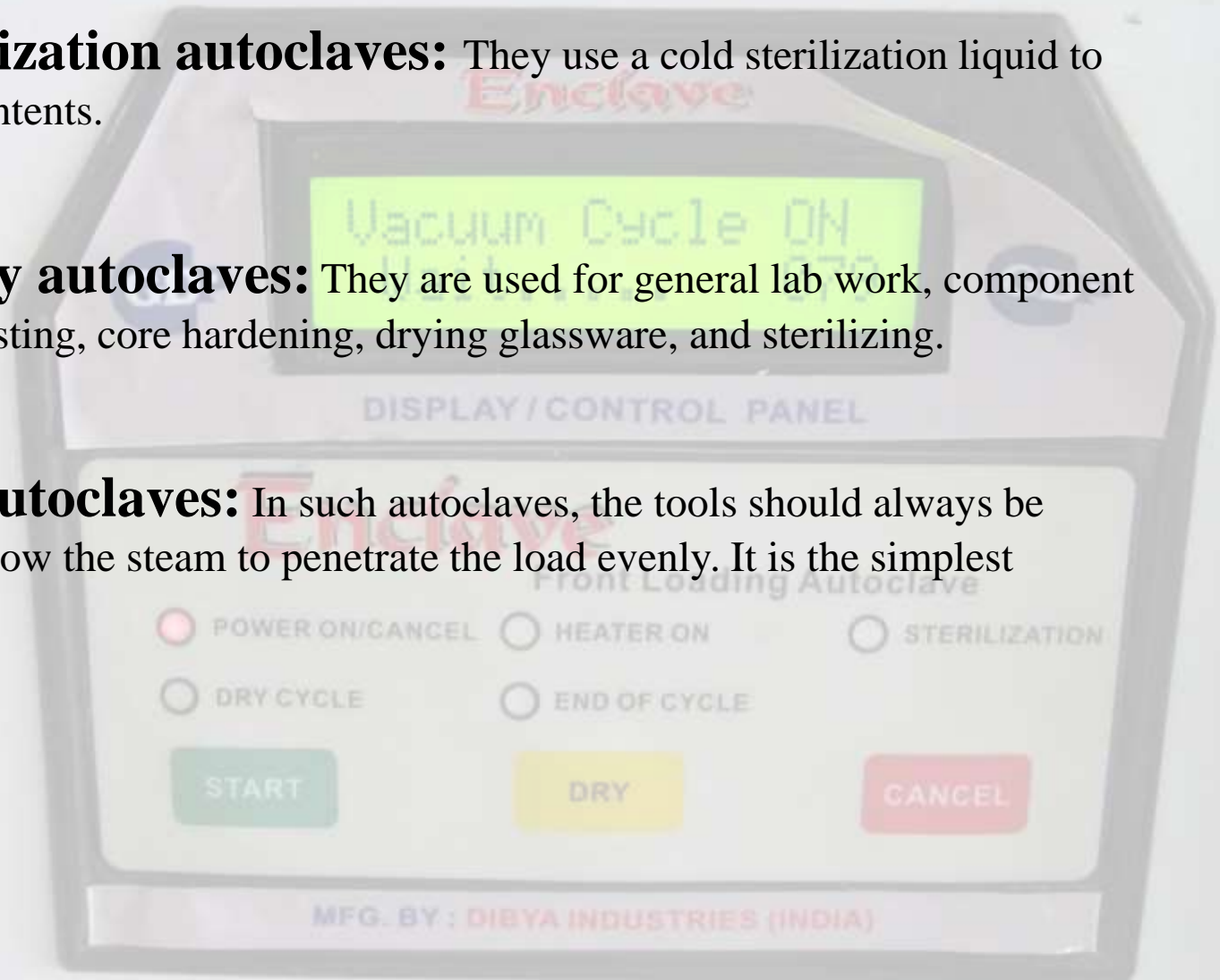
Ultraviolet autoclaves: They produce UV light that kills the unwanted disease causing organisms.



Cold sterilization autoclaves: They use a cold sterilization liquid to sterilize the contents.

Laboratory autoclaves: They are used for general lab work, component and stability testing, core hardening, drying glassware, and sterilizing.

Stovetop autoclaves: In such autoclaves, the tools should always be separated to allow the steam to penetrate the load evenly. It is the simplest autoclave.





Double door autoclave



Lab Autoclave



Portable Autoclave



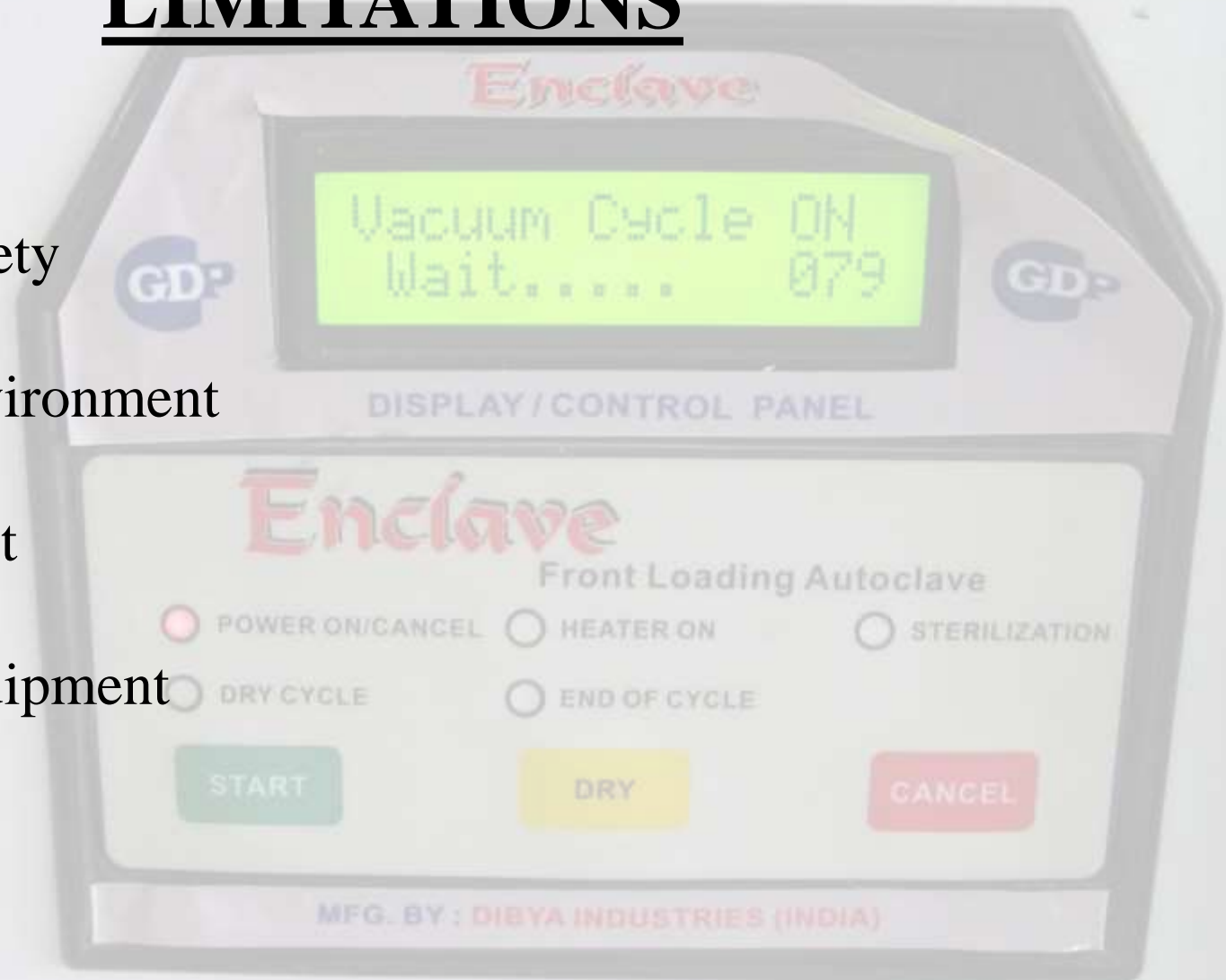
Stovetop autoclave



Horizontal rectangular & cylindrical autoclaves

LIMITATIONS

- Safety
- Environment
- Cost
- Equipment

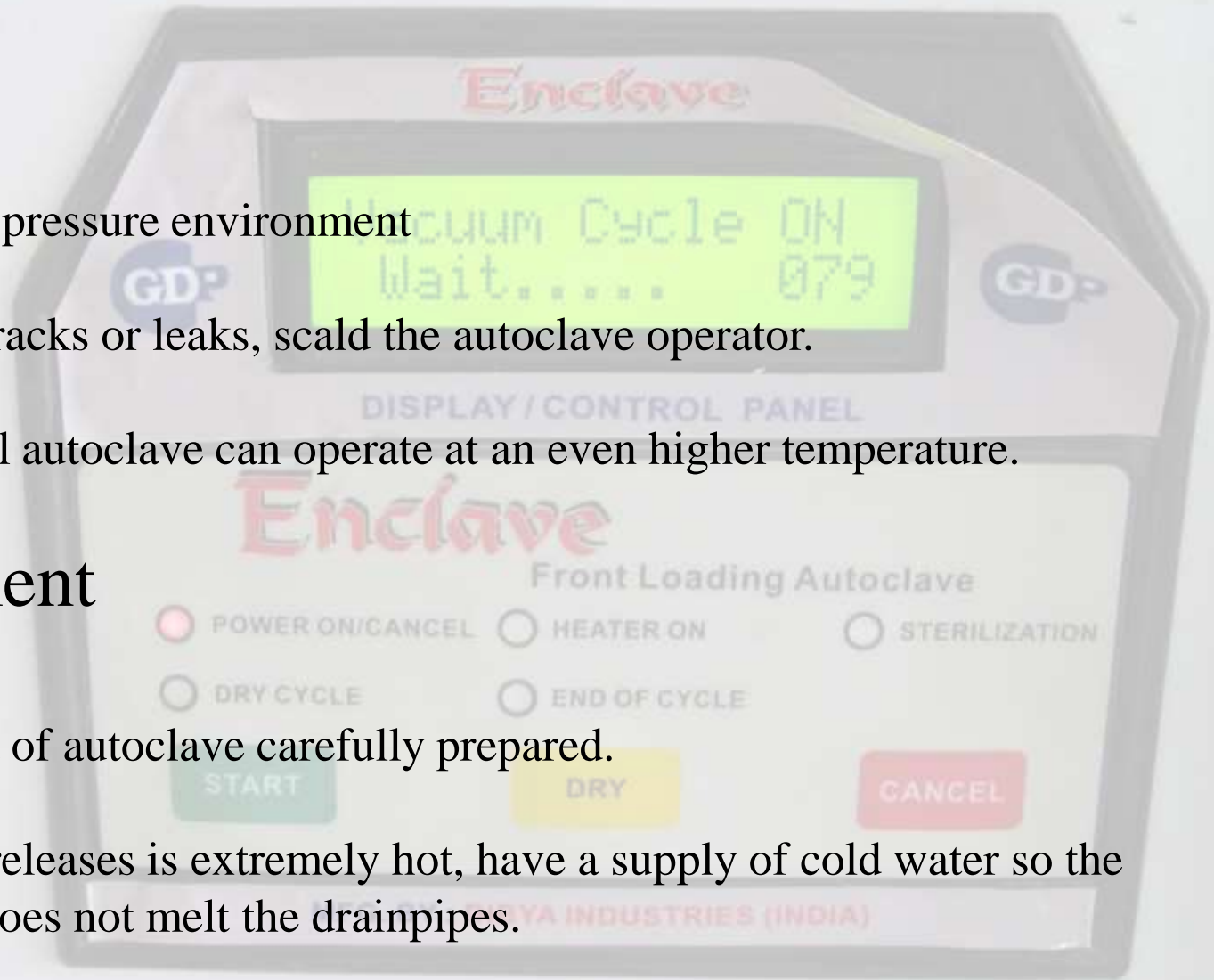


Safety

- A very high-pressure environment
- Autoclave cracks or leaks, scald the autoclave operator.
- An industrial autoclave can operate at an even higher temperature.

Environment

- Environment of autoclave carefully prepared.
- Condensate releases is extremely hot, have a supply of cold water so the condensate does not melt the drainpipes.

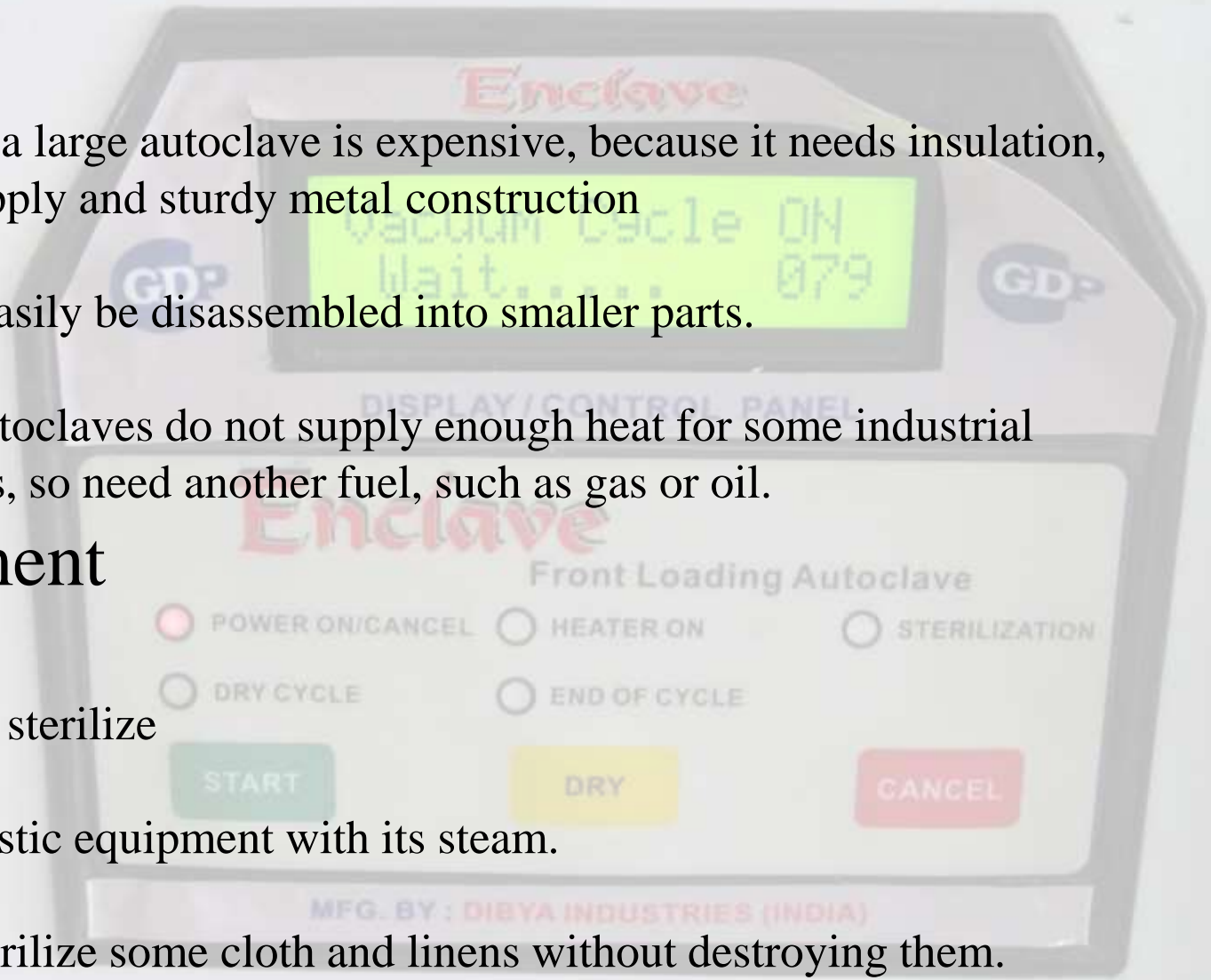


Cost

- Building a large autoclave is expensive, because it needs insulation, water supply and sturdy metal construction
- Cannot easily be disassembled into smaller parts.
- Steam autoclaves do not supply enough heat for some industrial processes, so need another fuel, such as gas or oil.

Equipment

- Reliable sterilize
- Melt plastic equipment with its steam.
- Can't sterilize some cloth and linens without destroying them.

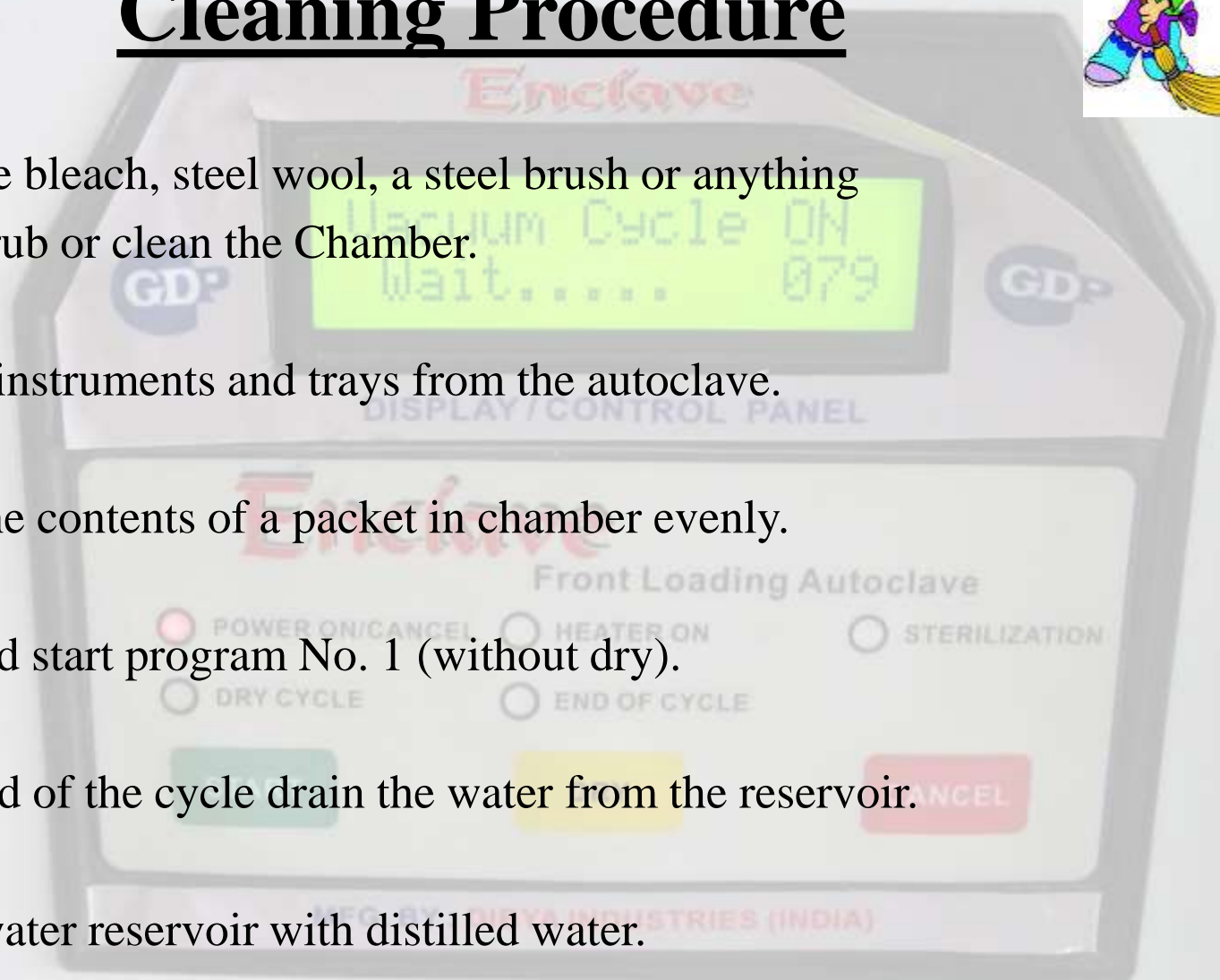


Cleaning Procedure

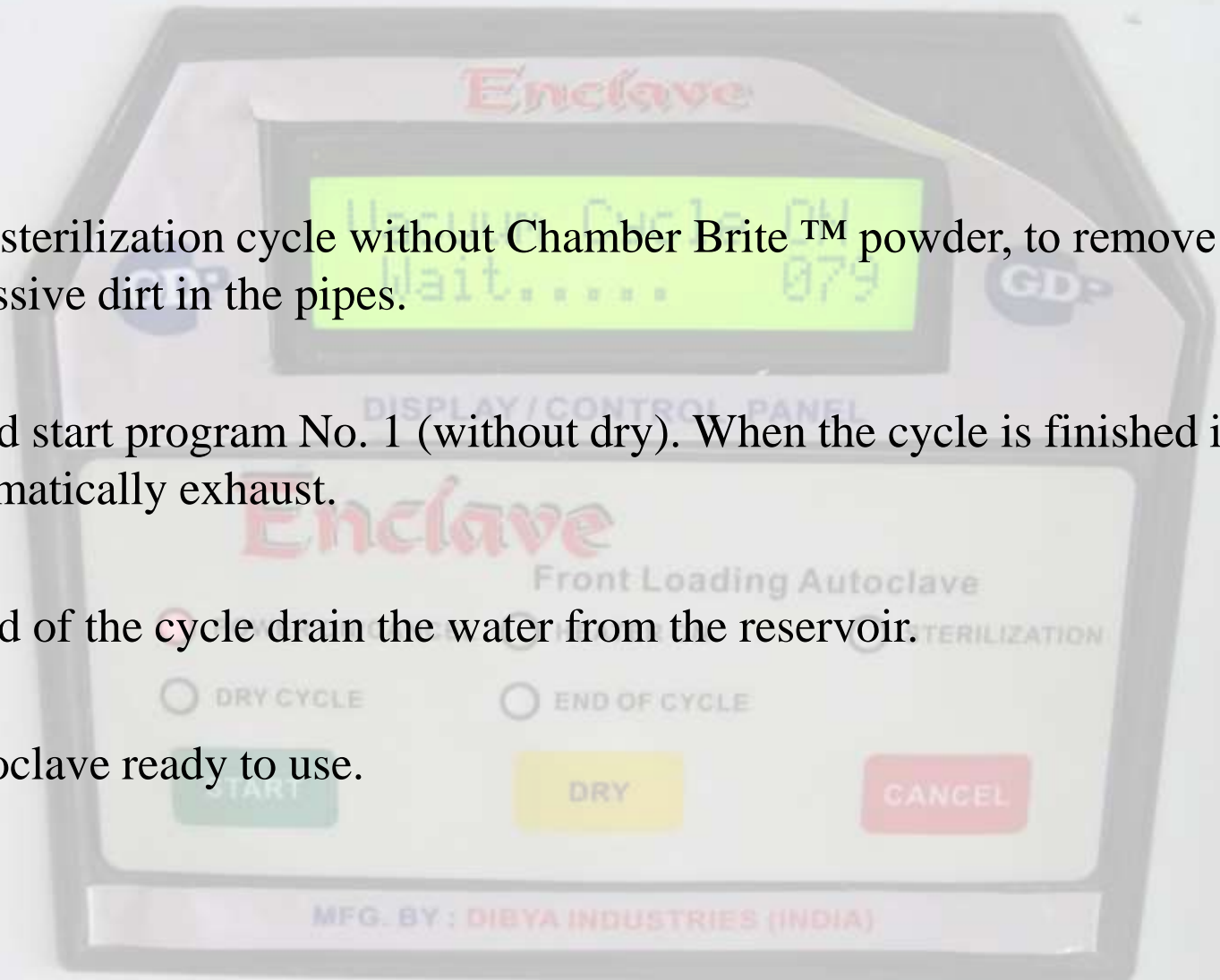


- NEVER use bleach, steel wool, a steel brush or anything abrasive to scrub or clean the Chamber.

1. Remove instruments and trays from the autoclave.
2. Spread the contents of a packet in chamber evenly.
3. Select and start program No. 1 (without dry).
4. At the end of the cycle drain the water from the reservoir.
5. Fill the water reservoir with distilled water.



1. Repeat a sterilization cycle without Chamber Brite™ powder, to remove any excessive dirt in the pipes.
2. Select and start program No. 1 (without dry). When the cycle is finished it will automatically exhaust.
3. At the end of the cycle drain the water from the reservoir.
4. Now autoclave ready to use.





Chamber Brite

Autoclave Cleaner

Cleans:

- ✦ Chamber
- ✦ Reservoir
- ✦ All Internal Tubing

10 single use packets per box

Tuttnauer
Your Sterilization & Infection Control Partners

Use after every 20 cycles

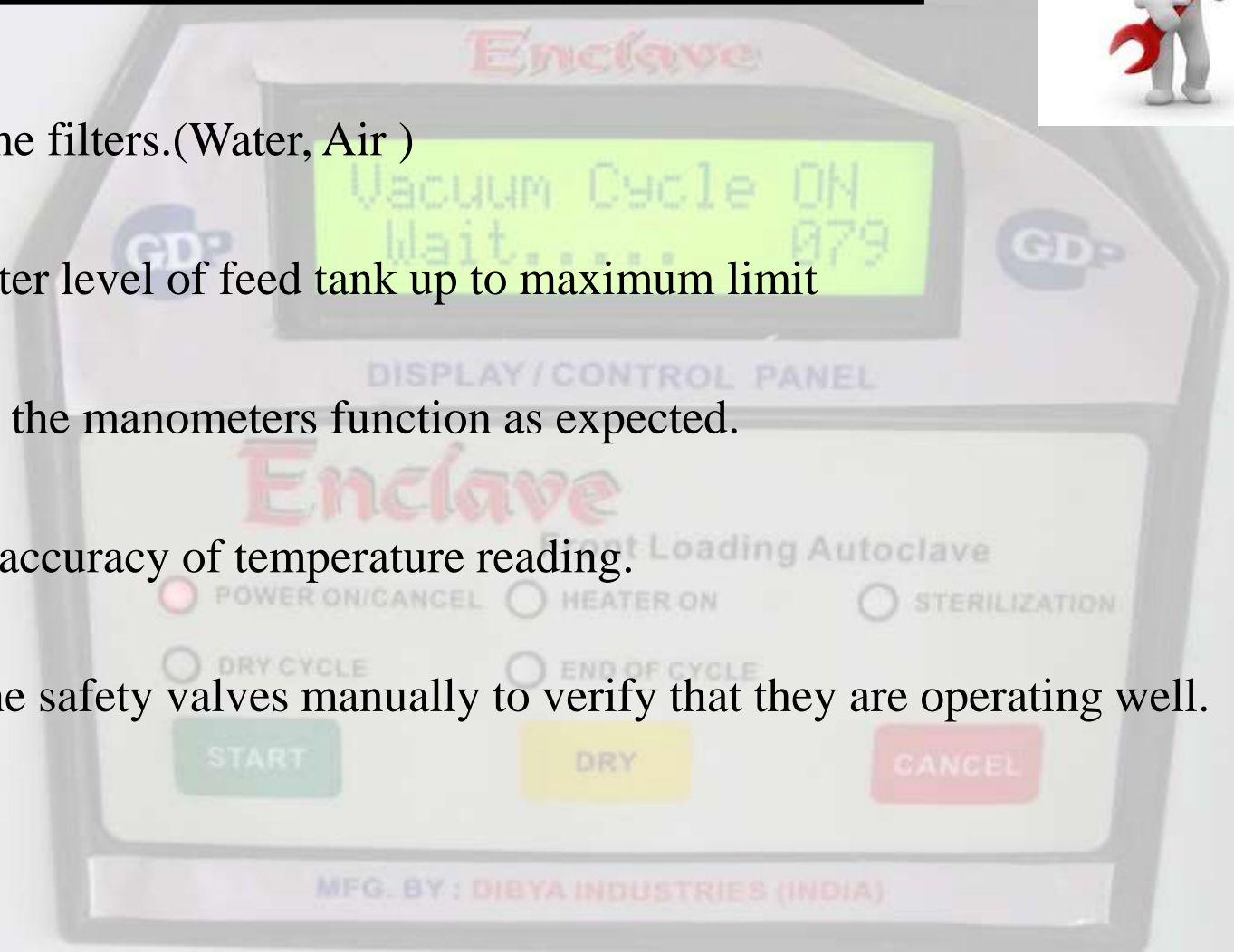
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Preventive Maintenances

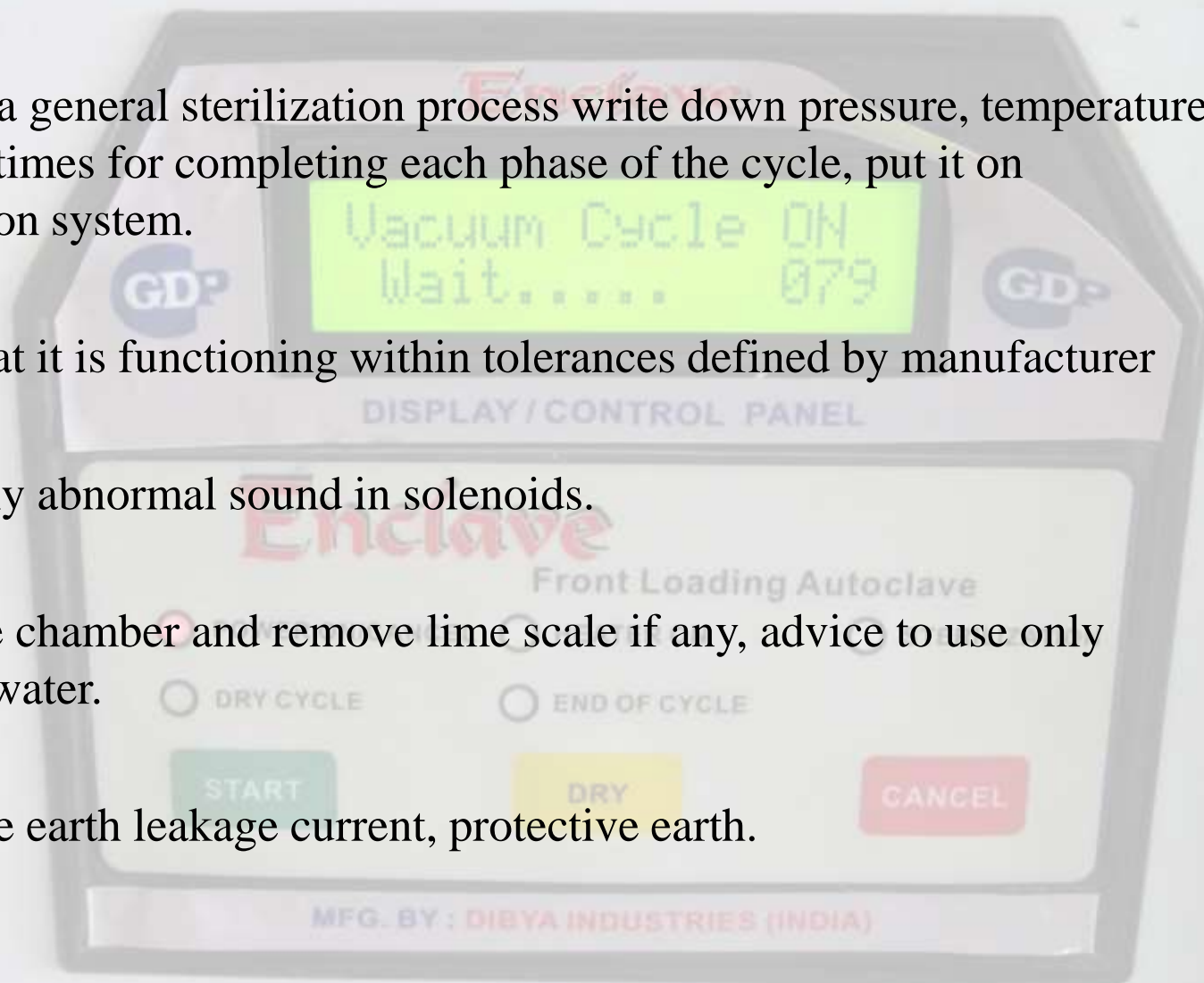


- **Quarterly**

1. Clean all the filters.(Water, Air)
2. Fill the water level of feed tank up to maximum limit
3. Check that the manometers function as expected.
4. Check the accuracy of temperature reading.
5. Activate the safety valves manually to verify that they are operating well.



1. Conduct a general sterilization process write down pressure, temperature, required times for completing each phase of the cycle, put it on registration system.
2. Verify that it is functioning within tolerances defined by manufacturer
3. Check any abnormal sound in solenoids.
4. Clean the chamber and remove lime scale if any, advice to use only distilled water.
5. Check the earth leakage current, protective earth.



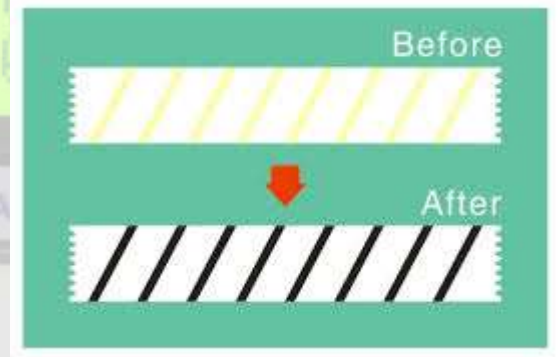
LIMESCALE

- **Limescale** is the hard, off-white, chalky deposit found in kettles, hot-water boilers
- Add little amount of any acid heat the chamber.
- Deposited CaCO_3 will be removed.
- Then rinse off with plenty of water.



Quality of Process

- Sterilization process indicators
- They check instrument's control parameters like temperature, time and pressure.
- Chemical indicators
- Adhesive tapes that go inside a component or on packages.
- Biological indicators
- The spore indicator is placed in the sterilizing load.
- After the process, it is incubated, analyzed and it is determined if the cycle meets with the sterilization requirements.



Symbols need to remind



Caution! Consult accompanying documents.



Caution! Hot surface.



Caution! Hot steam.



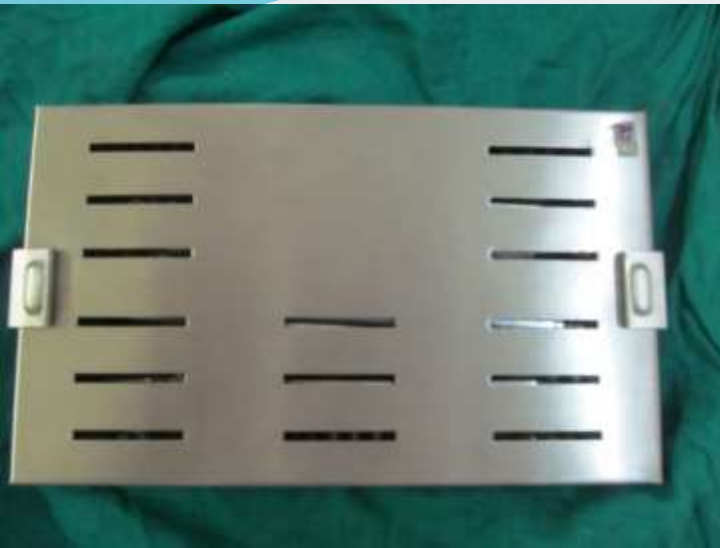
Protective earth (Ground).



Standby

Program selection





1. Sterilization cassette



2. Sterilization cassette with instruments



3. Sterilization cassette with autoclave marker



4. Sterilization cassette in autoclave

Enclave

GD[®]

Vacuum Cycle ON
Wait..... 079

GD[®]

DISPLAY / CONTROL PANEL

THANK YOU

Enclave

Front Loading Autoclave

- POWER ON/CANCEL
- HEATER ON
- STERILIZATION
- DRY CYCLE
- END OF CYCLE

START

DRY

CANCEL

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