
Autoclaves for packaged food

CFS SERIES

Technical information





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CFS SERIES Technical information

General specifications

TERRA Food-Tech® autoclaves are designed to cook, pasteurize* or sterilize food products sealed in containers at temperatures of 90 up to 130°C** using saturated steam produced by heating elements assembled inside the sterilization chamber. Temperature is controlled by chamber temperature or by F_0/P_0 values by means of a flexible temperature probe placed inside a reference sample, leading to an optimal control of the sterilization cycle while meeting the organoleptic and nutritional target values of the finished product. Choose your model from a wide variety of chamber sizes from either vertical or benchtop format. Additionally, all units can be ordered with several accessories to cover specific applications.

TERRA Food-Tech® autoclaves are used in a wide range of applications including commercial production, scientific research, product development within the food industry, quality control within the packaging industry, academia, education, entrepreneurs, farmers, foodservice, restaurants and non-profit organizations.

Features and benefits

Serviceability and simplified maintenance

All TERRA Food-Tech® autoclaves are designed and manufactured in the European Union (Barcelona) with reliable and affordable components to allow quick and cost-effective maintenance. Our network of authorized distributors provide maintenance, assistance and customer service to several countries. In addition, TERRA Food-Tech® maintains a complete spare parts department ready to ship replacement parts to our authorized distributor or technical service center.

Professional technical and consultancy service

With the purchase of the autoclave you will benefit from a professional food consultancy service that will guide you in the setup of the program parameters that best suit your food product. Additionally, our technical service has deep expertise acquired in hundreds of installations that will train you on the operation of the equipment and will be available to solve technical doubts throughout the entire lifespan of the unit.

Process control flexibility

A 5" touchscreen controller offers up to 50 different programs customizable by name, temperature, pressure, time, P_0/F_0 values, microorganism resistance, cooling speed and end of cycle temperature, allowing an excellent flexibility to process all sorts of food recipes in the optimum temperature and time. Moreover, for advanced users and research professionals all units can be programmed with up to 11 temperature segments independently adjustable by temperature, time and pressure.

Cycle performance: basic to advanced

TERRA Food-Tech® autoclaves offer chamber-sensed or load-sensed processing using a built-in flexible temperature probe, pressure support control via an integrated air compressor and fast cooling through water shower. They can also process the cycle using a temperature probe located at the inner side of the pressure vessel wall. They are ideal to process food sealed in containers or to perform stress tests of containers. Compatible containers include glass jars, plastic trays, bottles, sachets, pouches and metal cans among others.

Traceability

All the relevant sterilization parameters are continuously monitored and registered to ensure correct operation of the equipment, including F_0/P_0 values, batch number and the evolution in time of ΣF_0 and ΣP_0 . All process data can be individually exported and analyzed with a dedicated software and exported in .CSV or .PDF format. Cycle data can be further analyzed with charts or detailed logs.

Safety

TERRA Food-Tech® autoclaves are designed and built to ensure the safety of the users. All units include a safety valve, a safety thermostat with manual rearm for the heating elements, a pneumatic door blocking system while positive pressure exists inside the sterilization chamber, an open door sensor, water level detectors, a thermally insulated door, an independent heating elements cover and several visual and acoustic safety alarms.

Model sizes and weights

TERRA Food-Tech® autoclaves are based on seven chamber sizes, all of them either vertical top-loading or benchtop front-loading.



MODELS	USABLE CHAMBER DIMENSIONS Ø x H mm	TOTAL CHAMBER VOLUME L
CFS-28V	300 x 350	33
CFS-50V	300 x 620	55
CFS-75V	400 x 495	79
CFS-110V	400 x 740	115
CFS-150V	500 x 660	175
CFS-21H	210 x 430	22
CFS-50H	400 x 400	55
CFS-75H	400 x 600	79



Understanding TERRA Food-Tech® autoclaves

Cycle phases of a standard sterilization using load-sensed processing

Heating phase

In this initial step, the powerful heating elements assembled at the bottom of the sterilization chamber heat up dramatically, transferring energy to water to produce steam.

Sterilization phase

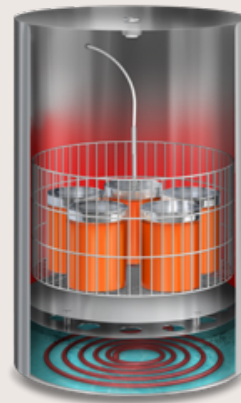
Upon reaching 100°C sterilization begins and the autoclave starts calculating attained F_0 in real time. Upon reaching target processing temperature, the temperature is held throughout the duration of this phase until target F_0 is reached within the reference sample. For some acid products sterilization may be reached at lower temperatures than 100°C.

This crucial step is controlled by two PT-100 Class A temperature probes located within the sterilization chamber wall and within reference sample.

Cooling phase

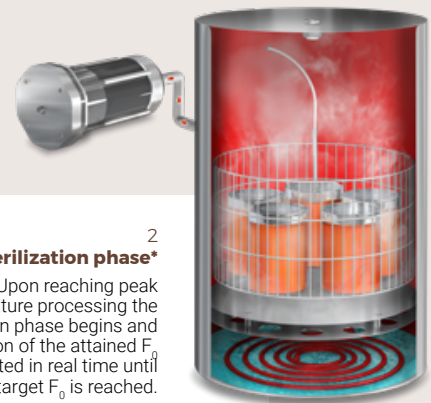
Upon reaching target F_0 value, the fast cooling phase starts, water is rapidly injected inside chamber while active pressure support is applied. Pressure control is critical to avoid container breakage due to pressure changes during thermal shock.

The number and duration of water chamber fillings can be adjusted. The temperature at which the door can be opened can also be adjusted.



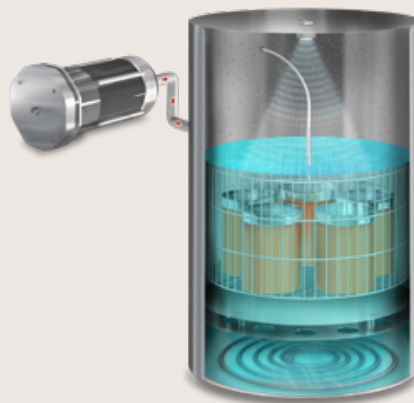
1 Heating phase

The heating elements transform electricity into heat to produce steam and heat up the sterilization chamber.



2 Sterilization phase*

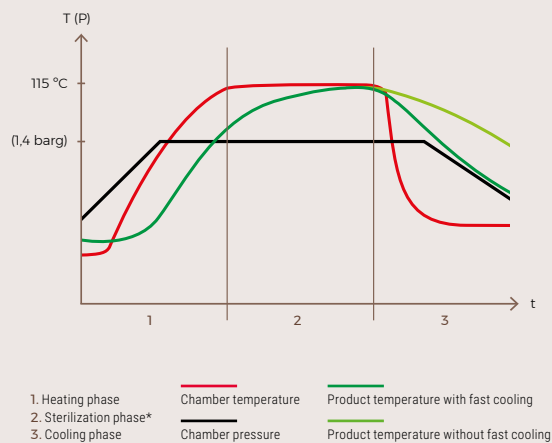
Upon reaching peak temperature processing the sterilization phase begins and the evolution of the attained F_0 is calculated in real time until target F_0 is reached.



3 Cooling phase

After reaching target F_0 water is rapidly injected to cool down the load while active pressure control is performed to prevent container breakage due to thermal shock.

Graph of a standard sterilization cycle



1. Heating phase
2. Sterilization phase*
3. Cooling phase

Chamber temperature
Product temperature with fast cooling
Chamber pressure
Product temperature without fast cooling

*In reality sterilization occurs not only during peak temperature processing.



High performance sterilizations and pasteurizations*

TERRA Food-Tech® autoclaves are used in a wide range of applications including commercial production, research, product development and quality control within the food and packaging industry, academia, education, entrepreneurs, farmers, foodservice, restaurants and non-profit organizations.

TERRA Food-Tech® autoclaves are purpose-built for conventional sterilization or pasteurization of food sealed in containers in a myriad of packaging options. All models are equipped with a flexible core temperature probe, cycle regulation by F_0/P_0 values or chamber temperature, pressure support by an integrated air compressor and fast cooling by water shower. In addition, all units can be customized with accessories according to specific client requirements including custom baskets and frames, additional temperature probes, baskets crane or special drilling kits.

TERRA Food-Tech® uses only high-quality and easily replaceable components in all parts of autoclave design and construction, thereby maximizing productivity and permitting a quick, economical and locally-managed service throughout the life of the product. With maximum uptime engineered into the product, our autoclaves offer a superior return on investment as demonstrated through hundreds of installations worldwide.

Steam source

TERRA Food-Tech® autoclaves operate with saturated steam produced by heating elements assembled inside the sterilization chamber. No external steam source is required. Water immersion of the heating elements is achieved by automatic injection from the water main.

The heating elements are made of Incoloy® 825, a nickel-iron-chromium alloy with additions of molybdenum, copper and titanium. It is an alloy that provides high levels of corrosion resistance to both moderately oxidizing and moderately reducing environments with improved resistance to aqueous corrosion. A protective cover made of stainless steel grade AISI-304 covers the heating elements in all models.

Depending on model, standard voltages available are 230V or 480V with either single-phase or three-phase voltage connections. Specific custom electric outlets and voltages are available for clients overseas. The heating capacity of some models can be customized with overpowered versions to shorten the duration of the heating phase, consult options with our technical team.

Upon starting a cycle, water is injected in the sterilization chamber to cover the heating elements. During heating phase, air is gravimetrically displaced, achieving saturated steam throughout the chamber. A water level buoy (or electrodes in some models) controls the correct coverage of the heating elements with water during equipment operation to prevent overheating.



Water quality compatibility

TERRA Food-Tech® autoclaves require soft water to operate. In facilities with hard water we offer a validated water softener.

- If water supplied has a hardness greater than 30 mg CaCO_3/L , a water decalcification system must be installed.
- If water supplied has a hardness of less than 30 mg CaCO_3/L , a water decalcification system may not be necessary although it could be advantageous to prevent long term build-up of limescale.

WATER TYPE	Mg/L ¹	°fH ²	°dH ³	°eH ⁴
Soft water	≤17	≤1.7	≤0.95	≤1.19
Slightly hard water	≤60	≤6.0	≤3.35	≤4.20
Moderately hard water	≤120	≤12.0	≤6.70	≤8.39
Hard water	≤180	≤18.0	≤10.05	≤12.59
Very hard water	>180	>18.0	>10.05	>12.59

¹ Mg/L: Calcium carbonate (CaCO_3) milligrams per liter of water.

² fH: French hardness (10.0 mg CaCO_3/L).

³ dH: German hardness (17.8 mg CaCO_3/L).

⁴ eH: English hardness (14.3 mg CaCO_3/L).

The water outlet is equipped with a system that automatically mixes the hot water produced during the cooling stage of the chamber load so that no excessively hot water at high temperature is sent to the drain. With this system the drain water temperature is reduced to 60 - 70 °C.

*Pasteurization requirements may vary depending on the acceptance criteria of each country. Check local regulations to determine the suitability of our equipment for your specific application.



Thermal processing of packaged food

Understanding pasteurization and sterilization









Microorganisms are an extremely diverse family of organisms (bacteria, fungi, virus...) and consist of both useful and harmful types in relation to human health. Pasteurization is a process used to considerably reduce the number of microorganisms in food products to a level where it is unlikely that they are able to cause disease in a given time period, while conserving the desired properties of the product. With sterilization, on the other hand, the aim is to kill all microorganisms present in the load, furthermore, due to the high temperatures involved, spores and enzymes are also inactivated.

There are several differences between sterilization and pasteurization, sterilizations are carried out at higher temperatures than pasteurizations and the organoleptic properties of the processed product are altered more significantly than with pasteurizations. Conversely, sterilization is the only way to be able to conserve food for a number of years with room temperature storage. In contrast, pasteurized products best before dates is often a brief number of weeks and require refrigeration at all times.

Below you can find a practical comparison between both methods while working with an autoclave:



Practical comparison between pasteurization and sterilization

MAIN DIFFERENCES		STERILIZATION	PASTEURIZATION
	TYPES OF FOOD*	All kinds of meat, fish, vegetables, fruits and legumes. In addition to jams, syrups, patés (spreads), vegan spreads, pet food, sauces, marinades, broths, creams and soups.	All sorts of food, although certain juices, vegetable milks or dairy products may not taste good enough after autoclave pasteurization. Other technological approaches might be more appropriate for these cases.
	FOOD SAFETY	Best before date applies to all cases since sterilization destroys all microorganisms, including spores and also enzymes.	Mostly we will talk about best before date, although there are exceptions, since microorganisms and enzymes partially survive.
	TYPE OF THERMAL PROCESSING	Application of moist heat to food packaged in hermetic containers.	
	STORAGE AND DISTRIBUTION TEMPERATURE	Room temperature.	Always with refrigeration, they require a refrigerator in its storage and distribution with refrigerated trucks.
	BEST BEFORE DATE**	From 12 months to 5 years depending on the physical and chemical stability of the product. At a microbiological level, the product will always remain safe for human consumption if container integrity is protected.	Very variable. From weeks to 3 months in the best cases. After this date it is dangerous to ingest the product.
	ORGANOLEPTIC PROPERTIES	They may suffer alterations in organoleptic properties.	The organoleptic and nutritional properties are better maintained.
	pH AND ACIDITY OF FOOD	In general they are processed at more than 100°C. Some food products with acidic pH (<4.5) can be sterilized with sterilization temperatures from 85°C to 99°C.	Processed between 60°C and 100°C. The higher the combination of temperature and time, the bigger the best before date.
	F ₀ /P ₀ THERMAL VALUES	F ₀ values are used in thermal processes with temperatures higher than 100°C and P ₀ in thermal processes with temperature lower than 100°C. The autoclave calculates and registers both automatically.	P ₀ values are always used. The autoclave calculates and registers it automatically.

*In reality, all food products can be pasteurized or sterilized with an autoclave, the decision of whether to carry out one method or the other will depend on the preferences of the manufacturer and the specific nature of the processed product, some food products may not taste good enough after undergoing sterilization.

**Combining techniques that impact acidity, osmotic pressure or water activity may drastically enhance best before dates while reducing required processing temperature and processing time.



Thermal processing of packaged food with F_0 or P_0 control

Understanding commercial pasteurizations and sterilizations

Quantifying the attained degree of microorganism destruction with a given thermal process is not simple. Each microorganism has a different thermal resistance and each product load has different physical features that affect its thermal conductivity (size of containers, form of the containers, quantity of containers, liquid medium, etc.). Moreover, depending on the nature of the processed product, the pH and other variables, causes that equivalent degree of microorganism destruction between different products is attained using different combinations of temperature and exposure time.

Another key aspect to consider is that there is a significant lag between the evolution of chamber temperature and the evolution of sample temperature, and therefore, load-sensed processing is required to correctly process a load. With chamber temperature control alone you could not know how has your sample been processed and if it has been processed correctly. Furthermore, not all points of the chamber heat up in the same way, that is why the flexible core probe is inserted in a reference sample located at the center of the top basket, because it is one of the coldest spots of the autoclave and also enables temperature readings within the load.

Because with thermal processing we are dealing with human health, the food industry and microbiologists developed a method to accurately quantify the attained degree of microorganism destruction within a processed load. Food processing operators are interested in exposing the product to a precise amount of heat to attain a precise degree of microorganism destruction, but doing so to the minimum necessary, exposing the product to unnecessary amounts of heat causes unwanted organoleptic changes. In practice, what operators do is add significant safety margins to take into account all the involved variables that we have detailed previously.

To understand how TERRA Food-Tech® autoclaves do this, which is the standard of the food industry, we must understand the concepts of D-value, Z-value, F-value and P-value.

The D-Value

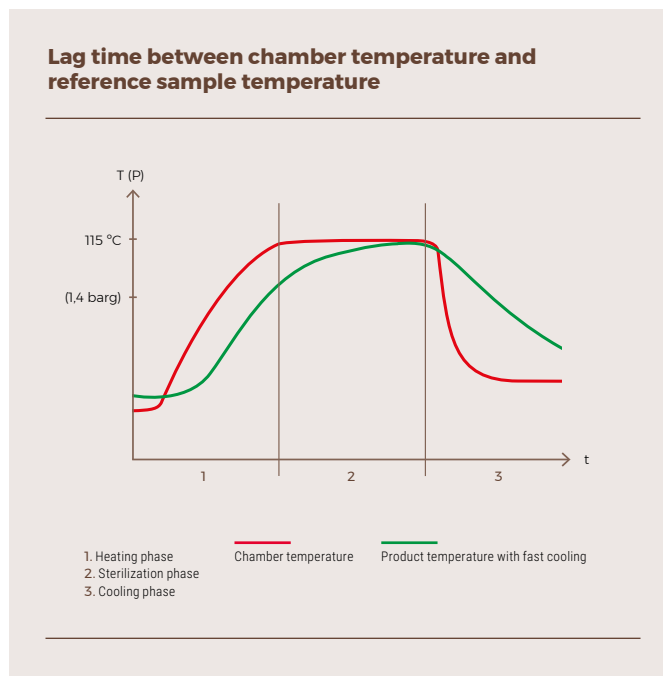
The D-Value refers to the decimal reduction time, and is defined as the time required at a given temperature to reduce the number of microorganisms to one tenth of their initial value. This means that 90% of the microorganisms would have been killed.

Numerous microorganisms may be present in a given sample prior to carrying out sterilization or pasteurization. So numerous, in fact, that their number is normally expressed in powers of base ten (1.000 is written as 10 to the power of 3 or 10^3 and 10.000.000 is written as 10 to the power of 7 or 10^7), to avoid writing down a large number of zeros.

The process of destroying microorganisms starts at particularly low temperatures: consider, for example, 65°C. To reduce the initial number by one decimal place, one would have to expose the food sample to a temperature of 65°C for a certain time, say 20 minutes.

If, initially, the sample contained 10^6 microorganisms (1.000.000), after 20 minutes their number would have reduced by 10 times, down to 100.000 or 10^5 . If the process is repeated, therefore exposing the sample for another 20 minutes, the number of microorganisms would have again been reduced by 10 times, down to 10.000 or 10^4 . This means their number is now 100 times less than that at the beginning.

To continue with our explanation, we introduce the Z-Value.





The Z-Value

One may wonder then, what would happen if the temperature is increased? In this case, the number of microorganisms destroyed per minute will drastically increase. Furthermore, depending on the species of microorganism which we are targeting it is possible to determine, experimentally, the increase in temperature required to reduce the value of D by a factor of 10 (in our example, from 20 minutes to just 2 minutes): this increase in temperature is represented by the Z-Value and is expressed in °C.

The Z-Value is the temperature change that will bring about a 10-fold change in the D-Value.

In other words, the D-value is the time (t) required at a specified temperature (T) to reduce the microbial population from 100% to 10% (1 log reduction). The Z-value is the number of degrees the temperature requires to increase to cause a 90% reduction of the D-value.

Typically, in steam sterilization Z-values range from 6 and 13 for sterilization temperatures in the range of 100 to 130°C. In this temperature range a change of 1°C entails a variation of ~26% in the D-value. This is a substantial percentage which illustrates the impact generated when the sterilization temperature is only a few degrees lower than the expected value, perhaps only at some point of the load. This effect of sterilization temperature variation decreases considerably both as the temperature rises and if the sterilization method is changed: the Z-value for dry sterilization at approximately 200°C is 20. Therefore, small temperature differences can be dramatic in steam sterilization and much less impactful in dry sterilization.

The following table lists average D-values and Z-values for some "typical" microorganisms; in fact, the actual D-values and Z-values depend to a large extent on the medium which contains the microorganism and on their history.

AVERAGE VALUE OF D AND Z FOR SOME TYPICAL MICROORGANISMS

MICROORGANISM	D _{121,1°C} (minutes)	Z (°C)
<i>Clostridium botulinum</i>	0.2	10
<i>Geobacillus stearothermophilus</i>	2.0	6
<i>Bacillus subtilis</i>	0.5	10
<i>Bacillus megaterium</i>	0.04	7
<i>Clostridium sporogenes</i>	0.8 - 1.4	13
<i>Clostridium histolyticum</i>	0.01	10

In TERRA Food-Tech® autoclaves the Z-value is predetermined as 10°C and can be changed on demand for each program. The D-value is predetermined at 1 min and cannot be changed as it's the standard value used in the industry. The combination of both predetermined values offers ample margin of safety for the microorganisms which are commonly dealt with.

F-value and P-value. The values that quantify pasteurization and sterilization

The need for safe but not excessive heat sterilization requires a practical method for the exact measurement of the amount of heat transmitted. In general, process operators are simply interested in the following information: at what temperature and for how long should the process be carried out?

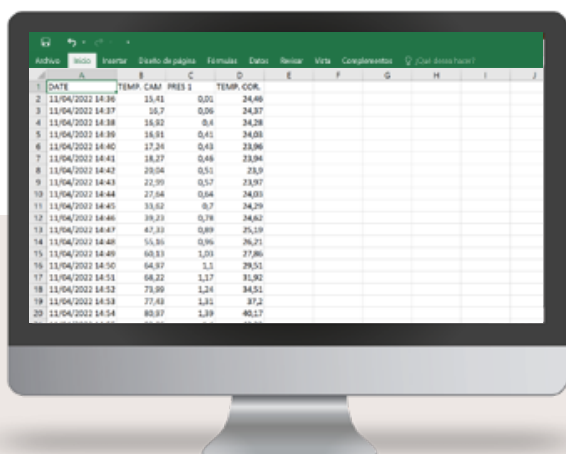
In industry one would commonly ask for the F- or P-value at a certain temperature. In sterilization processes we frequently encounter a specific value of F, known as F₀. This is the number of minutes of equivalent sterilization at 121.1°C. If another temperature is used this is normally stated after the symbol F. For example, we could have F₁₁₀ or F₁₃₅ and so on. For pasteurization processes, technically one should refer to the P-value, however F is commonly used instead. Therefore, F₀ is the number of minutes of equivalent sterilization at 121,1°C.

The F-Value (or P-Value) is therefore the duration (in minutes) of the entire sterilization or pasteurization process, at a defined temperature.

As we have already explained, an increase in temperature changes lethality and therefore, each minute at each temperature attains different F-values. The lethality attained processing a load during 5 minutes at 105°C is quite different than that of processing the same load during 5 minutes at 121°C. For reference, the following table shows different F-values per minute of thermal processing exposure for a load using a Z-value of 10.

ATTAINED F_{121,1} -VALUES PER MINUTE FOR TEMPERATURES RANGING FROM 100 °C TO 130 °C USING A Z-VALUE OF 10

TEMPERATURE °C	EQUIVALENT F _{121,1} PER MINUTE	TEMPERATURE °C	EQUIVALENT F _{121,1} PER MINUTE
100	0,008	116	0,316
101	0,010	117	0,398
102	0,013	118	0,501
103	0,016	119	0,631
104	0,020	120	0,794
105	0,025	121	1,000
106	0,032	122	1,259
107	0,040	123	1,585
108	0,050	124	1,995
109	0,063	125	2,512
110	0,079	126	3,162
111	0,100	127	3,981
112	0,126	128	5,012
113	0,158	129	6,310
114	0,200	130	7,943
115	0,251		



Here is an example of the evolution of reference sample temperature during a thermal process. Below a detailed log of attained F-values during the process.

Date and time	Sum of attained % of target F ₀ -value	Sample Temperature °C
11/04/22 15:10:36	0	91,55
11/04/22 15:11:36	0	94,15
11/04/22 15:12:36	0	96,41
11/04/22 15:13:36	0	98,33
11/04/22 15:14:36	0	100,15
11/04/22 15:15:36	0,1	101,86
11/04/22 15:16:36	0,3	103,27
11/04/22 15:17:36	0,6	104,76
11/04/22 15:18:36	1	105,81
11/04/22 15:19:36	1,4	107,07
11/04/22 15:20:36	2	108,04
11/04/22 15:21:36	2,8	108,91
11/04/22 15:22:36	3,7	109,81
11/04/22 15:23:36	4,8	110,52
11/04/22 15:24:36	6,1	111,28
11/04/22 15:25:36	7,6	111,91
11/04/22 15:26:36	9,3	112,51
11/04/22 15:27:36	11,2	113,02
11/04/22 15:28:36	13,4	113,59
11/04/22 15:29:36	15,8	114,04
11/04/22 15:30:36	18,5	114,39
11/04/22 15:31:36	21,4	114,78
11/04/22 15:32:36	24,5	115,17
11/04/22 15:33:36	27,9	115,52
11/04/22 15:34:36	31,6	115,77
11/04/22 15:35:36	35,5	116,08
11/04/22 15:36:36	39,7	116,30
11/04/22 15:37:36	44,1	116,62
11/04/22 15:38:36	48,8	116,90
11/04/22 15:39:36	53,9	117,11
11/04/22 15:40:36	59,1	117,31
11/04/22 15:41:36	64,6	117,53
11/04/22 15:42:36	70,2	117,71
11/04/22 15:43:36	76,1	117,80
11/04/22 15:44:36	82,3	118,02
11/04/22 15:45:36	88,6	118,08
11/04/22 15:46:36	95	118,23
11/04/22 15:47:36	101,6	118,38
11/04/22 15:48:36	108,2	118,30

However, in practice such processes will not be identical to the theoretical ones: in fact, the temperature will not rise immediately to the target value, it will not remain perfectly constant over time and it will not drop to the ambient temperature in an instant. Therefore, we need to calculate the sum of attained F-values (or P-values) within the entire process. Consider the results shown on this page after processing a load.

As can be observed, F₀ starts to change when the temperature rises to about 100°C and will remain constant after it drops below 100°C. Also note that we attain a value for F₀ even though the process never actually reaches 121.1°C. This is possible thanks to the effect of the Z-value, which allows for the calculation of equivalent thermal processes at different temperatures.

Software programs that automatically analyses data from sterilization and pasteurization processes require that a few parameters to be set up:

- The reference temperature T (in general this is set to 121.1°C for sterilizations and 60°C for pasteurizations).
- The Z-Value (in °C, that corresponds to the change in temperature required to change the decimal reduction time by a factor of 10) which is necessary to cater for the fact that the process is not carried out at a single constant temperature.
- The target F-value (or P-value).
- The processing sterilization temperature (or pasteurization temperature).

The program will automatically calculate the value for F (or P for pasteurization) that has been defined for the temperature T.

If necessary, one may also introduce a threshold value for temperature below which any contribution to the F (or P) value is ignored. In TERRA Food-Tech® autoclaves this value is set for 100 °C for sterilization processes and 60 °C for pasteurization processes.

Sterilizations and pasteurizations without load-sensing

After understanding the importance of F₀/P₀ values it becomes clear why it is always preferred to regulate each cycle with F₀/P₀ control while using a flexible core temperature probe inserted in a reference sample. Load-sensed processing is the most robust and correct way to ensure that we always produce products safely and with the best before date requirements that we have set as our goal. Furthermore, should any variable change (e.g. we load the product at a different temperature or less containers than usual are loaded), the attained microorganism destruction will be the same as the F-value output won't fluctuate, the target F-value will take into account the environmental and product characteristics variability that changes between batches.

However, some clients produce the same product over and over in exactly the same manner. They load the equipment with the same product recipe, the product is loaded at the same temperature, the same quantity of product units, using the same container, using the



same number of baskets and the ambient conditions also remain constant throughout the year (temperature of the main water with which the autoclave is cooled and room temperature). In this scenario, where the process is first studied, optimized and empirically validated using a reference sample with F_0/P_0 regulation, it may be possible to then use only chamber temperature regulation as it is faster and requires less cleaning.

Bear in mind that using chamber temperature probe regulation only and changing any of the process characteristics (total units, disposition of the units within the sterilization chamber, product temperature while loading, recipe formula, container size or ambient conditions) will potentially cause changes in attained F_0/P_0 values. Therefore, we strongly recommend to always use core probe control and F_0 regulation except for very advanced users that produce the same products several times a day.

Pressure support

All TERRA Food-Tech® autoclaves are built with an integrated air pressure pump that automatically injects additional pressure on demand to avoid containers breakage or spilling during sample thermal expansion while sterilization phase occurs and during cooling phase due to the drastic and sudden temperature reduction inside the chamber. Without this feature the sudden change in chamber pressure and internal pressure of the load could damage the containers.

Pressure value is displayed on the manometer and on the screen in blue, it can be adjusted in each cycle between 0,1 Bargs up to 2,1 Bargs.

Furthermore, pressure support plays a key role on container characteristics output while performing sterilizations:



Glass jars with metallic lid

Avoids lid opening during processing and creates the vacuum. The vacuum effect created can be customized and is directly correlated with the necessary strength required to open the jar. Processing jars with pressure support also enables easy visual inspection of correct processing by checking the curvature of the caps.



Pouches and plastic containers

Avoids container breakage or deformation during thermal expansion during processing at peak temperatures. For these container programs with ramps are recommended.



Cans

Avoids container breakage during peak temperatures.

In pasteurizations, the samples do not experiment a significant expansion and thus require a lower pressure support value while processing them.

Pressure support can be controlled in 3 different ways in TERRA Food-Tech® autoclaves:

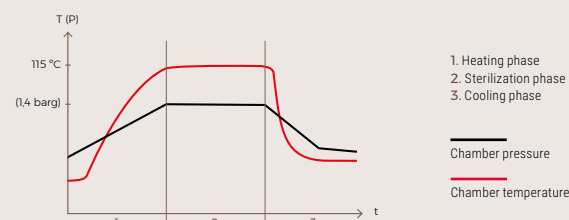
Constant pressure

Recommended for processes where temperature is regulated by flexible core temperature probe. The chamber pressure until reaching a sample temperature of 100°C remains constant.



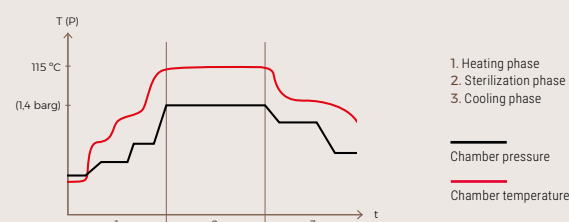
Single cooling ramp

Recommended for processes where temperature is regulated by chamber temperature probe, specially indicated for processing pouches. The decrease speed of chamber pressure until reaching a chamber pressure of 1 barg can be adjusted.



Multiple ramps

Recommended for experienced users that perform processes with integrated cooking segments prior to peak temperature processing and for processing plastic trays. Segments can be programmed by time, pressure and temperature. These segments can be inserted both before or after sterilization phase. Multiple ramps mode is hidden by default to simplify equipment operation, nevertheless it can be easily activated upon request.





Fast cooling

After reaching the target P_0 , F_0 or combination of time and temperature, the equipment initiates the cooling phase with an intense water shower that causes full immersion of the load with cold water. This is crucial to avoid unnecessary heat exposure to the processed products. With pasteurizations and sterilizations we want to expose the product to a precise amount of heat, controlled to the minimum necessary.

During the cooling phase pressure support is active to prevent containers breakage or deformations in the packaging due to the drastic and sudden temperature reduction inside the chamber.

While processing thermolabile or delicate samples the process can be sped up by adjusting the number and duration of chamber fillings according to client preferences. Furthermore, the temperature at which the sterilization chamber is unlocked, and thus be opened, can be set between 30-100°C.

The water injected into the chamber generally does not require active refrigeration, but in locations with extreme hot weather where the main water may exceed 35°C, such as in Middle Eastern or African countries, or where pronounced fluctuations in temperature occur between seasons, it may be advisable to use a dedicated water circuit or water tank in conjunction with a water chiller and thus shorten the duration of the cooling phase and also minimize fluctuations in processing times with seasonal changes. The cooler the water used for the fast cooling the shorter this phase will be.

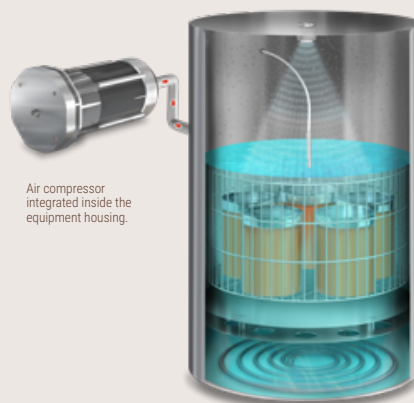
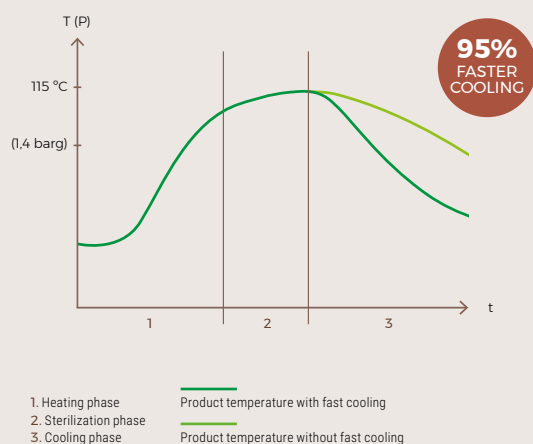
The cooling stage will finish after reaching the programmed final temperature which can range from 30-100°C. If the program is regulated by flexible core temperature probe the end of cycle temperature corresponds to the sample temperature. If we are regulating the process by the chamber temperature probe the end of cycle temperature corresponds to chamber temperature instead.



Upon finishing the chamber door can be opened. Depending on the selected end of cycle temperature the manipulation of the samples require that operators wear special gloves.

Depending on the nature of the processed product, a posterior storage with a blast chiller may be most optimal. Blast chillers are specialized cooled refrigerators that cool down loads very fast, which is advantageous both for sanitary purposes and to prevent product overcooking.

Impact of fast cooling



Cooling phase

After reaching target F_0 water is rapidly injected to cool down the load while active pressure control is performed to prevent container breakage due to thermal shock.



Autoclave construction

Pressure vessel

TERRA Food-Tech® autoclaves are manufactured with a pressure vessel built in high quality stainless steel-grade AISI-316L, a steel grade extremely resistant to corrosion. All pressure vessels are electropolished to a high luster finish to maximize equipment lifespan. Autoclaves are equipped with standard external port access within the pressure vessel wall for use with validation or process measurements. Additional port accesses can be ordered. All sterilization chambers are welded and built in compliance with European Union's Pressure Equipment Directive (PED) 2014/68/EU and AD 2000 Merkblatt Design Codes.

Sterilization chamber lid and gasket

TERRA Food-Tech® autoclaves are designed with redundant and independent mechanical and software features to ensure maximum safety for the user. Door design specifications meet European Union's Pressure Equipment Directive (PED) 2014/68/EU and AD 2000 Merkblatt Design Codes requirements:

- All autoclaves use solid silicone gaskets that do not require high pressure air, steam or vacuum to operate. Instead, the act of closing the door compresses the silicone gasket to create a secure and reliable seal. In the event that the gasket fails, the door can still be easily opened and the gasket quickly replaced.
- The lid is operated by a manual wheel assuring that, in the rare event of a failure, the door will continue to support the load within performance specifications.
- The lid is covered by a thermo-resistant insulating plastic that remains at a safe temperature.
- Complete door engagement is achieved by manual rotation of the wheel until a beep sound is heard.
- Door engagement is clearly visible by a screen message that confirms closure and with a beep sound.
- An electrical door switch ensures that the door is fully closed and locked prior to the start of the cycle. If the signal is lost during a sterilizing cycle, the cycle is automatically aborted.
- The security piston is activated by chamber pressure to lock the door. Chamber pressure forces a cylinder against the clutch plate, engaging the lock and not permitting loosening of the door.
- The flexible core probe is reinforced with a cover made of stainless steel-grade AISI-316L.
- The baskets, tray frames and trays are made of stainless steel-grade AISI-304.

Components

- Piping, fittings and valves are available in PTFE and silicone. All parts and components subject to wear and repair are stocked in our facilities for fast delivery upon request.
- Safety relief and drains are integral to the plumbing configuration.
- Sterilization chamber door cover offers heat insulation against thermal shock.
- Easy-to-read pressure gauges ensure simple and safe operation.

Autoclave Mounting

TERRA Food-Tech® autoclaves are available for installation as both top-loading floor-standing or front-loading benchtop cabinet-enclosed units. To conceal plumbing and wiring vertical models are built with a stainless-steel grade AISI-304 superstructure. Benchtop models are built with an external metallic frame with epoxy resin coating.

On top of the cabinet in top-loading units or at the front of the cabinet in front-loading units, isolated from temperature, a plastic worktop encloses the microprocessor, manometer, power button, Ethernet and USB ports and the touchscreen of the unit.





Controller and monitoring system

TERRA Food-Tech® offers a state-of-the-art control system built from industry standard components, with proven reliability, based on a 5" TFT platform programmed specifically for TERRA Food-Tech® autoclaves, complete with a touchscreen display and an intuitive user interface.

Permits industry standard and custom programs. The adjustable parameters depend whether cycle is governed by chamber temperature probe or flexible core temperature probe.

Adjustable parameters

If cycle is governed by chamber probe the following parameters can be adjusted:

- Chamber temperature of sterilization phase: 50-130°C.*
- Duration of sterilization phase: 1-250min.
- Pressure support:
 - Constant pressure: 0,1-2,1 Barg
 - Constant slope: 0,1-2,1 Barg/minute
 - Multiple ramps: 0-10 segments
- Number of chamber fillings during cooling phase.
- Duration of chamber fillings during cooling phase.
- Chamber temperature at which cycle finishes and door can be opened: 60-80°C.
- Cycle start time delay: Infinite (minute, hour, date).

If cycle is governed by core probe the following parameters can be adjusted:

- Target F_0 value for sterilizations or target P_0 value in pasteurizations: 0,1-1000.
- Microorganism resistance (Z-value): 0,1-100.
- Reference temperature: 50-130°C.*
- Sample temperature during sterilization phase: 50-130°C.*
- Duration of sterilization phase: 1-250min.
- Pressure support:
 - Constant pressure: 0,1-2,1 Barg
 - Constant slope: 0,1-2,1 Barg/minute
 - Multiple ramps: 0-10 segments
- Number of chamber fillings during cooling phase.
- Duration of chamber fillings during cooling phase.
- Sample temperature at which cycle finishes and door can be opened: 30-100°C.
- Cycle start time delay: Infinite (minute, hour, date).

Simplifies operation with intuitive operator interfaces. Optional advanced features allow the operator to add up to 10 additional cycle segments with specific temperature, pressure and time. Traceability of each batch with custom identifier assures product traceability. User hierarchy with admin control assures quality control and process integrity. Internal battery retains all data in memory of the latest 200



cycles. Features autoclave cycles quality reporting and optional printed documentation and data export. Check Data management paragraph for a detailed explanation of reported data.

Alarms

TERRA Food-Tech® autoclaves continuously monitor components and process integrity, in the event that an error is detected visual and acoustic alarms will appear on the screen. The detailed list of alarm messages, descriptions of each error and actions to take for each message is included in the manual. Some of the alarms include faults on temperature probes, door closure, pressure and temperature, calibration data integrity, microprocessor control, air compressor, water quantity or quality, process integrity, cooling pressure or cooling temperature.

Cycle safeguards

The following cycle safeguards help assure safe operation.

- No cycle can start unless the door is properly closed and locked.
- Control inputs automatically reject incorrect cycle parameters.
- Chamber gauges are installed on the operating end of the sterilizer to display pressure in barg.
- Water inlet pressure is continuously monitored to guarantee an optimal cooling performance.
- Water discharge is automatically cooled to a safe drainage temperature.
- Emergency Stop via the Power bush-button cuts power to all outputs and stops all processes.
- In case of overvoltage, the fuses ensure the protection of the equipment's electrical panel.
- In case of overtemperature, the safety thermostat cuts equipment's electrical supply.
- In case of overpressure, the equipment's safety valve will safely discharge excess pressure.

Calibration

All temperature and pressure sensors on the autoclave can be calibrated using the microprocessor screen. Access to these settings is password protected and only available for authorized technicians. Timely calibration of the temperature probes, specifically the flexible core probe, is required on an annual basis (or biannual depending on use).

Updates

The system is designed to be capable of being updated via a USB stick, allowing end user access to future equipment improvements on demand.

*For pasteurization at temperatures below 90 °C, please contact us to verify the technical feasibility of the application.



Data management

Printer

An impact printer is optionally integrated into the main control panel. Printout includes all important information regarding the cycle recorded at user-defined intervals. Information includes: equipment identifier, serial number, program name, operator identification, container identification, batch number, date and time, cycle counter, cycle parameters, cycle phases, time, chamber pressure, chamber temperature, core temperature probe 1, attained F_0/P_0 values, final ΣF_0 and ΣP_0 attained, alarms, messages and cycle completion status.

Upon installation of this accessory a window appears in the equipment microprocessor screen where data capture cadence can be selected between 1 and 255 seconds and also printing mode (live or upon finishing the entire cycle).



Automatic USB back-up

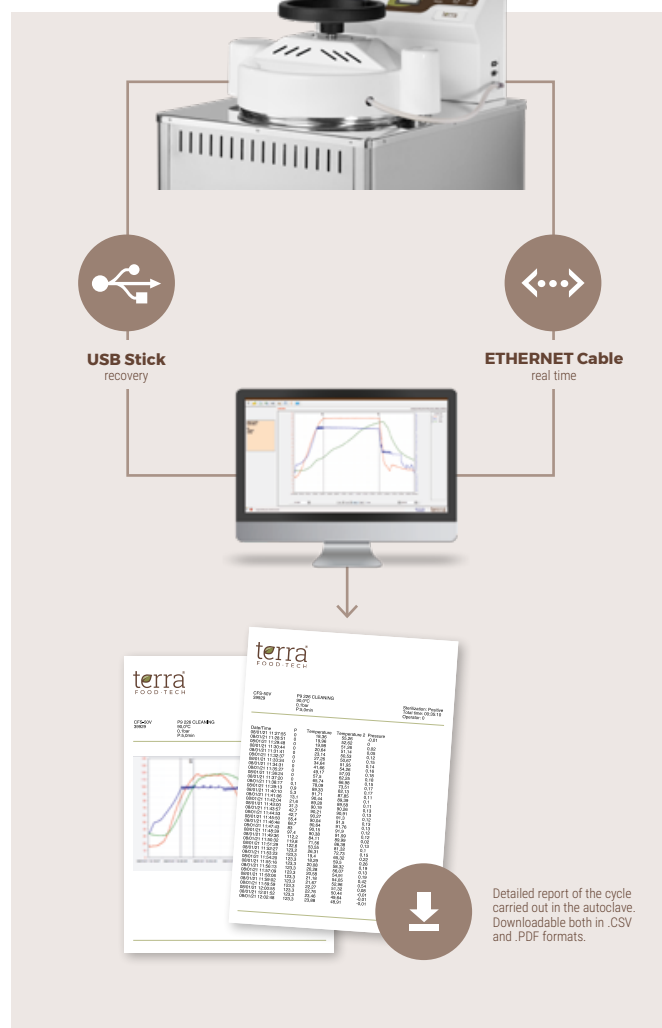
Up to 200 process records are automatically stored on the internal flash drive of the autoclave to which if a USB stick is connected to the equipment, backups will be saved into the USB stick on demand.



Software SWTERRA

TERRA Food-Tech® offers an optional software that can be purchased to analyze and register each cycle data. Upon installation the software allows real-time visualization and posterior registry of each cycle data. Cycles can also be exported in .CSV and .PDF reports. Data from the autoclave is exported via USB stick. Connection to PC via Ethernet is only used for live display of cycle data evolution.

Each report displays in graphic format and in numbers the evolution in time of chamber temperature, core temperature probe 1, core temperature probe 2 and attained F_0/P_0 values. Additionally, information such as equipment identifier, serial number and batch number is displayed. The time cadence of data capture of each report can be customized by the user to a minimum of 1 second, later on the displayed time scale of each report can be customized aswell. Access to the software is protected by username and password. Available languages include English, Spanish, French and Italian.





Strategies to increase productivity

There are several strategies to produce more product units with less time, which is a priority for any commercial organization. Some of the strategies that can be used will be listed here but after having sold hundreds of units worldwide we have come across a myriad of strategies that clients use on their routines.

Optimizing productive capacity

The productive capacity of our process is the maximum number of product units that can be processed within a single cycle. To keep things simple, we will use as an example a vertical autoclave that uses baskets. However, the same principles apply for vertical models using tray supports or benchtop models using trays or baskets.

After having chosen an autoclave model, the available sterilization chamber volume is fixed and therefore there are only 2 ways of producing more units per cycle: either changing container size or changing basket's height.

With a given autoclave model and container size, we can change basket height so that more baskets can be placed within the autoclave or more layers of product can be placed within each basket. The standard basket sizes are as follows:

BASKET MODEL	VERTICAL AUTOCLAVE MODEL				
	CFS-28V (300x350)	CFS-50V (300x620)	CFS-75V (400x495)	CFS-110V (400x740)	CFS-150V (500x675)
CVT-300-S (240x95)	3	-	-	-	-
CVT-300-M (240x140)	2	4	-	-	-
CVT-300-L (240x185)	-	3	-	-	-
CVT-400-S (340x150)	-	-	3	-	-
CVT-400-L (340x225)	-	-	2	3	-
CVT-400-M (340x170)	-	-	-	4	-
CVT-500-S (440x120)	-	-	-	-	5
CVT-500-M (440x155)	-	-	-	-	4
CVT-500-L (440x210)	-	-	-	-	3

*All measurements of the size of the baskets and sterilization chamber expressed in millimeters: Ø x height.

As part of our standard assessment of each project, we study thoroughly this aspect so that each client receives the best solution for their application.

Dedicated productivity study

The information obtained in these studies is extremely useful to guide decision-making while deciding which autoclave model is the most suitable for a project. Furthermore, after equipment acquisition these studies will predict how productive capacity fluctuates when changing container size.



For clients that want to produce their products in **cylindrical containers** we have developed an **online calculator** tool to automatically calculate your productive capacity as many times as you want.
www.terrafoodtech.com/en/productive-capacity/

Productivity studies for cylindrical containers



For clients that want to produce their products in **non-cylindrical containers** our engineers perform **specific productivity studies** according to container type and size. Please contact our team to receive a detailed productivity study of your application for free.
foodconsultancy@terrafoodtech.com

Productivity studies for non-cylindrical containers





Time delay function

It is obvious that the more work shifts per day and more work days per week that the autoclave is running, the more product output will be produced. So there is not much to discuss in front of this obviousness. However, depending on the specific nature of the product to process and the ambient conditions where the autoclave operates, the delay function might be available to perform a cycle by night and thus gain an extra production cycle per day.



To do this, our clients prepare an excess of product during the day, they fill in the containers of an extra batch and store it on a fridge throughout the day. Before finishing their shift at noon or night, they load the autoclave with the refrigerated excess ready-to-process product and program the equipment to start a cycle in the middle of the night so that when they return to work the next day, the autoclave has just or is about to finish processing this extra batch of product. Because the delay function is dependent on program number, the operator simply has to start the already predefined program and the autoclave takes care of the rest.

This optimization can only be performed if the combination of product to process and the chosen thermal processing method is compatible and several factors come into play to determine this. Generally speaking, acid products submitted to sterilization will perform the best. Room temperature also is crucial, very hot ambient temperatures will excessively expose the samples to heat prior to the program starting and thus cause an undesired incubation prior to processing. But in any case, a detailed study of the specific application and characteristics of the products is necessary prior to doing this, we recommend empirical microbiological testing with real before and after product samples obtained on night shifts using the delay function to be performed to validate the adequacy of this tactic.

Processing temperature and time

Essentially, what TERRA Food-Tech® autoclaves do is heating packaged food in a very precise, traceable and safe way. But unlike a conventional oven, when we process products with the autoclave, we seek to meet a microbiological quality objective besides cooking the product. In the case of sterilization the objective is a complete destruction of all microorganisms, and in pasteurizations, the objective is a very substantial reduction in the amount of microorganisms present in the product.

To achieve these goals, we can always process at high temperatures and short times or long times at lower temperatures. And therein lies the optimization, in achieving the shortest possible cycle without compromising the microbiological objective that we pursue while respecting the organoleptic qualities of the product. And this is not an easy task, for each product, recipe, container and microbiological objective, the optimal combination of time and temperature will be different. That is why we always tell our clients that finding this balance is a learning curve, just like cooking the perfect stew requires some tests and practice. Do not be discouraged though, since as you know we offer a food consulting service so that you start your project knowing where to start and the possibilities offered by your recipe. Those who manage to optimize this balance are much more productive and efficient in their productions.





End of cycle temperature

Mastering this process is the most impactful optimization strategy we can implement in our productive process. Defining which will be our method to cool down the load is crucial.

TERRA Food-Tech® autoclaves use water immersion to cool down the sample once they have been processed. The cooling phase can be customized with the following parameters:

1. The target temperature at which the cooling phase ends, the consequent unlocking of the door takes place and products can be extracted. If we are processing using core probe regulation the cooling target temperature will be measured directly inside the sample, if we are processing by chamber-regulation, the cooling target temperature will correspond to chamber temperature instead.
2. The number of water fillings.
3. The duration of each water filling.

Factory settings include a duration of 5 minutes for each immersion and there will be as many immersions as necessary until 60°C is reached within the sample.

Additionally, the cooling phase can also be sped up by changing the number and duration of the chamber fillings with cooling water. Furthermore, some clients located in tropical areas where the water temperature is quite high use a water chiller so that the injected water into the autoclave remains low and thus speeds up the cooling stage. Other strategies include ending the sterilization cycle at high temperatures and immediately placing the processed product into a blast chiller to cool down the product as fast as possible.

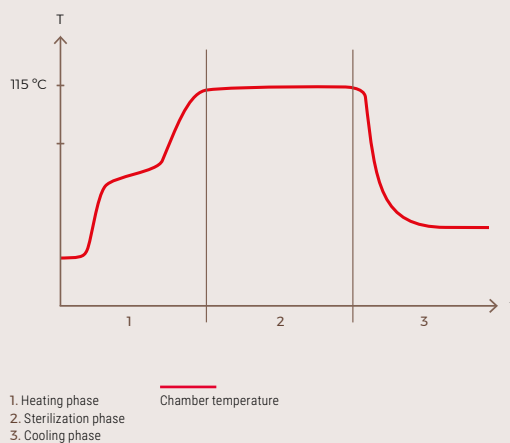
By speeding up the cooling down we reduce the total duration of each cycle and thus produce more product.

Programs with integrated cooking segments

Some clients introduce raw or semi-raw foodstuff within the container and then submit the product to thermal processing, finishing the cooking process with the heat of the autoclave. More experienced users use programs that include a time segment where the product is cooked followed by a sterilization segment. Furthermore, clients that use this method save up kitchen time and energy as they take advantage of the heat generated by the autoclave.

This feature is especially suitable for applications where traditional cooking of the product involves large periods of time on the stove, such as sauces, stews, meat and vegetables.

Evolution of chamber temperature





Cycles without load-sensed processing

We strongly recommend to always use load-sensed processing with F_0/P_0 regulation except for very experienced users.

For these advanced users that produce the same product over and over in exactly the same conditions, processing based on only chamber temperature may be possible. These clients load the equipment with the same product recipe, the temperature of the products when loaded into the autoclave is the same, the same container, the same filling of product per each container, the same quantity of product units and product layers per basket, the same number of baskets and the ambient conditions also remain constant (temperature of the mains water with which the autoclave cools down the load and room temperature). In this scenario where the process is first studied, optimized and empirically validated by several cycles it may be possible to then use only chamber temperature regulation as it is faster, doesn't require a reference sample and requires less cleaning.

Bear in mind that using chamber temperature probe regulation only and changing any of the process characteristics mentioned above will cause a change in outcomes and a change in the attained F_0/P_0 value.

We recommend that only users with a minimum one year of experience using the autoclave should evaluate implementing this strategy. To calculate the equivalent processing parameters between core temperature probe regulation and chamber temperature probe regulation we recommend studying the last 10-12 cycles where core temperature regulation is used, identify the worst-case scenario, extrapolate a pattern, add a safety margin and then validate the conversion with a pilot batch where samples are submitted to laboratory analysis after the first trial chamber-sensed processing.



Overpowered versions

This option only applies if you have not yet purchased your autoclave. For users that will produce a lot of product with several cycles per day we offer the possibility of increasing the power of the models in order to shorten the duration of the heating phase. The exact savings in time that can be achieved by equipping the unit with more powerful heating elements varies depending on model but it can range from a 20% to 50% decrease in time of the heating phase. Bear in mind that increasing the power of the unit may cause changes in the electric outlet and installation requirements.



Extra sets of baskets

Loading and unloading the product from the autoclave is time consuming, especially in larger models that produce hundreds of individual product units per cycle and require a crane to operate the heavy baskets. In these circumstances, extra sets of already loaded baskets may be very useful.

The typical cycle for these bigger models involves extracting hot, heavy and fully loaded baskets from the equipment using a crane, unloading the product from each basket and loading the autoclave again. Clients that have extra sets of baskets unload the autoclave baskets and then place in new ready-to-process and fully-loaded baskets into the autoclave and start a new cycle. Once the autoclave is starting the cycle they then unload the previous baskets, gaining precious extra time per each rotation.



Accessories for both vertical and benchtop models

Water decalcification system

WATERSOFT-11

Soft water is required to feed the autoclave as using water with a high calcium content causes the appearance of lime deposits in the sterilization chamber and in the equipment's pipes. A validated water softener is available for facilities that do not meet the minimum water purity requirements specified in the water quality requirements within this document.

The water softener operates with ion-exchange resins, has a digital display with smart programming, electronic regeneration with up to 23 regenerations per each salt refilling, a 11L decalcified water tank and a maximum flow rate of 550L/hour.

The accessory includes the water softener with all the necessary hoses, a sediment filter and a water hardness test kit.

The installation of this accessory requires an electric connection, a threaded water connection inlet and a water drain outlet. Check the specific installation requirements in the dedicated technical data sheet of this accessory.



Download WATERSOFT-11
technical data sheet

Integrated thermal printer

IT/TERRA

An integrated thermal printer can be mounted on the cabinet. Tickets can be printed automatically after the end of each cycle or in real-time. Prints program number, cycle number, temperature, pressure, date and hour of the run and error messages. Selectable printing cadence ranges from 1 to 255 seconds.

For a detailed explanation of the technical data that can be printed please refer to the dedicated technical data sheet of this accessory.



Download IT/TERRA
technical data sheet

Software for packaged food autoclaves

SWTERRA

The software SWTERRA allows viewing, registry, analysis and printing of each individual cycle data that occurs within TERRA Food-Tech® autoclaves. It is also capable of real-time process monitoring. The software is supplied with a USB stick, an Ethernet cable and an Ethernet-USB adapter.

The Ethernet cable measures 1m and allows real-time display of cycle parameters. The USB stick extracts cycle data from the autoclave and through the use of the software on an external computer both .PDF and .CSV reports can be obtained.

For a detailed explanation of the technical data that can be printed please refer to the dedicated technical data sheet of this accessory.



Download SWTERRA
technical data sheet



Additional flexible core temperature probe PT-2-CFS

All TERRA Food-Tech® autoclaves include an already installed flexible core temperature probe within the sterilization chamber. However, for certain applications, especially in research environments, an additional flexible core temperature probe can be installed.

The additional flexible temperature probe does not govern in normal circumstances, its readings only impact cycle governance if values between probes differ excessively. The data captured by the second flexible core temperature probe can be later analyzed in the software SWTERRA.

Cycle data reports of autoclaves with this accessory will have the registry of 3 temperatures: the sterilization chamber temperature probe, the main flexible core temperature probe and the secondary flexible core temperature probe.

This accessory must be installed in our facilities and can only be installed while manufacturing the unit.



Download PT-2-CFS
technical data sheet

Temperature data logger with connection base and software BDL-DISK3618

This accessory is used to control processes of pasteurization and sterilization, as well as other applications involving high temperatures, where the access of the autoclave's flexible temperature probe using a drilling kit into the container is not possible and therefore load-sensed cycles cannot be performed.

We recommend the acquisition of this accessory for clients working with doypacks, pouches, plastic trays or other plastic bags. In these circumstances, a disk datalogger can be placed inside the container and the registry and analysis of temperature evolution within the sample can be retrieved after processing.

The data logger is IP-68 resistant, pressure resistant, can measure temperatures ranging from 20 to 140°C and has a replaceable battery life of two years. Temperature capture delay can be set down to 1 second and all data can be analyzed with a software and exported into .CSV files.

The data logger operates with a dedicated software which is included with the purchase of the accessory. Data is retrieved by placing the disk within the docking station and connecting the docking station with an external computer via a cable USB.

The included components in this accessory include a USB stick with the software, the docking station, the data logger (disk) and a 2m USB cable.



Download BDL-DISK3618
technical data sheet



Drilling kits

KIT-CFS-V, KIT-CFS-H, KIT-CFS-PG-V & KIT-CFS-PG-H

TERRA Food-Tech® autoclaves programs can be controlled by F_0 & P_0 values inserting a flexible temperature probe within a sample. To achieve a proper flexible temperature probe insertion into the sample a drilling kit and a probe adapter is used. Depending on the type of container we offer specific sets.

- A.** For containers with a rigid lid the kits KIT-CFS-T-V for vertical autoclaves and KIT-CFS-T-H for benchtop models are available. These kits include an awl, joints, packing rings and 16 plastic separators ranging from 20 to 90 mm to accommodate to all sorts of container sizes.



Included components.

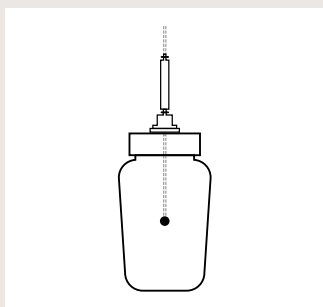
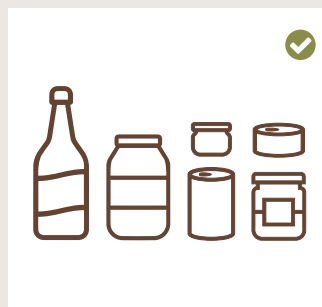


Diagram of the core probe placed in the container.



Compatible containers.

- B.** For flexible containers with walls such as plastic trays the kits KIT-CFS-PG-V for vertical autoclaves and KIT-CFS-PG-H for benchtop models are available. These kits include an awl, joints, packing rings and special sheaths of either 60 or 120mm to accommodate the flexible probe thermowell into the sample.



Included components.

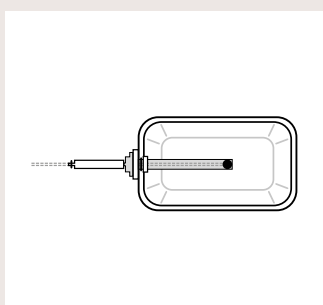
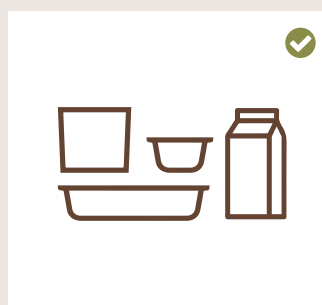


Diagram of the core probe placed in the container.



Compatible containers.

For containers where the placement of the core probe is not viable, such as thin doypacks, we recommend the accessory BDL-DISK3618.

All models include one unit of the KIT-CFS-T-V or KIT-CFS-T-H kits. Additionally, consumables or other drilling kits can be purchased while ordering or after the sale.



Download DRILLING KITS
technical data sheet

Warranty extension

WE-CFS

TERRA Food-Tech® autoclaves are industrial machinery and come with a standard 1-year equipment warranty. The standard warranty can be upgraded with additional years of extended warranty to a maximum of 5 years.





Accessories specific for CFS-V Series vertical models

Basket lifting cranes ELEV-CLAV & ELEV-CLAV-R

To safely handle the baskets of larger autoclaves, we recommend the purchase of a basket lifting crane. There are two models with rotating arm available, ELEV-CLAV for heavy loads up to 30 Kg or ELEV-CLAV-R for very heavy loads up to 40 Kg.

Reference		ELEV-CLAV	ELEV-CLAV-R
Dimensions L x D x H mm		800 x 300 x 2100	800 x 300 x 2600
Power W		480	480
Voltage V		230	230
Frequency Hz		50/60	50/60
Weight Kg		40	45
Max. load Kg		30	40
Compatibility with autoclave models	CFS-75V	✓	-
	CFS-110V	✓	✓
	CFS-150V	-	✓
Dimensions of basket lifting cranes + autoclave assembly mm	CFS-75V	1276 x 1296 x 2100	-
	CFS-110V	1276 x 1296 x 2100	1276 x 1296 x 2600
	CFS-150V	-	1543 x 1536 x 2600

All crane models have wheels at the bottom, facilitating the movement of the autoclave during maintenance tasks.

Each crane is factory set to the specific measurements of the autoclave with which it is installed.



Download ELEV-CLAV
technical data sheet



Standard and custom baskets

CVT

TERRA Food-Tech® offers specific stainless steel baskets for each vertical autoclave model. However, in some instances the ideal basket height that offers the maximum productivity varies between clients and thus special custom baskets can be ordered for each model according to container requirements. Furthermore, to process bags and other containers, custom frames placed inside the basket can be ordered. The standard baskets offered are the following:

Basket models*

Vertical autoclave model and sterilization chamber dimensions

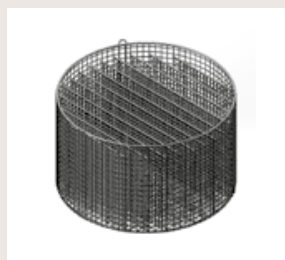
	CFS-28V (300x350)	CFS-50V (300x620)	CFS-75V (400x495)	CFS-110V (400x740)	CFS-150V (500x675)
CVT-300-S (240x95)	3	-	-	-	-
CVT-300-M (240x140)	2	4	-	-	-
CVT-300-L (240x185)	-	3	-	-	-
CVT-400-S (340x150)	-	-	3	-	-
CVT-400-L (340x225)	-	-	2	3	-
CVT-400-M (340x170)	-	-	-	4	-
CVT-500-S (440x120)	-	-	-	-	5
CVT-500-M (440x155)	-	-	-	-	4
CVT-500-L (440x210)	-	-	-	-	3

*Size of baskets in mm: Ø x height.



Reinforced stainless steel wire basket. Reference: CVT

Baskets and racks customization upon request



Development of custom accessories



Custom basket frame with bags



Custom basket frame without bags

Calculate your productivity with TERRA Food-Tech®



A free and online productivity calculator is available

On our website there is an open and free online productivity calculator where users can submit container diameter and height and the tool automatically returns the exact amount of containers that can be loaded per standard basket for each autoclave model.

www.terrafoodtech.com/en/productive-capacity/

Detailed productivity studies

For applications where the container shape is not cylindrical we perform productive capacity studies free of charge. Please contact us at foodconsultancy@terrafoodtech.com





Trays supports

SRA-CFS

TERRA Food-Tech® offers specific stainless steel trays supports with height adjustable trays* for each autoclave model.

Reference		SRA-CFS-300	SRA-CFS-400	SRA-CFS-500
Dimensions Ø x H mm		260 x 165	350 x 225	450 x 210
Maximum number of trays per support		4	4	4
Trays	Reference	TRAY-SRA-CFS-300	TRAY-SRA-CFS-400	TRAY-SRA-CFS-500
	Dimensions Ø x H mm	240 x 20	340 x 20	440 x 20
For autoclaves with the following chamber volumes	33 L	2	-	-
	55 L	3	-	-
	79 L	-	2	-
	115 L	-	3	-
	175 L	-	-	3

*The purchase of a tray support includes a set of 3 trays and 9 fastening clips. Likewise, the purchase of a tray includes a set of 3 fastening clips.



Silicone separators

SEP-CFS

This accessory is used to protect containers from physical defects. They are generally used in applications where several layers of containers are placed in each basket. Another common application is with SRA trays and heavy bags. The standard silicones separators are perforated and are offered with diameters of 300, 400 and 500 mm with a 3 mm thickness.

Reference	SEP-CFS-300	SEP-CFS-400	SEP-CFS-500
Dimensions Ø mm	230	330	430
Thickness mm	3	3	3
Material	Silicone	Silicone	Silicone
Compatible with	CV and SRA-CFS	CV and SRA-CFS	CV and SRA-CFS



Download SEP-CFS
technical data sheet



Accessories specific for CFS-H Series benchtop models

Frame & trays

ST & BAH

TERRA Food-Tech® offers specific stainless steel frames and trays for each model of benchtop autoclave. Each frame includes 2 wire trays and has a maximum capacity of 5 trays.

Frame model	Frame dimensions*	Benchtop autoclave model
ST-21	200 x 400 x 180	CFS-21H
ST-50	320 x 360 x 270	CFS-50H
ST-75	320 x 565 x 270	CFS-75H

*Size of frames in mm (L x D x H).

Tray model	Tray dimensions*	Benchtop autoclave model
BAH-21	190 x 350	CFS-21H
BAH-50-B	315 x 330	CFS-50H
BAH-75-B	315 x 530	CFS-75H

*Size of trays in mm (L x D).



Frame model ST-21



Frame model ST-50 and ST-75



Rectangular basket

RB

TERRA Food-Tech® offers a stainless steel basket for benchtop models. These baskets are specially recommended for tall and heavy loads.

Reference		RB-AH-21	RB-AHS-50	RB-AHS-75
Dimensions	Exterior L x D x H mm	170 x 340 x 180	324 x 360 x 235	324 x 560 x 235
	Interior L x D x H mm	160 x 330 x 170	314 x 350 x 225	314 x 550 x 225
For autoclaves with the following chamber volumes	22 L	1	-	-
	55 L	-	1	-
	79 L	-	-	1





Special trays for bags

BAP

TERRA Food-Tech® offers stainless steel special trays for bags for benchtop autoclave models. These trays are designed to load pouches and plastic bags.



Reference		BAP-21	BAP-75
Dimensions	Exterior L x D x H mm	400 x 180 x 80	300 x 180 x 95
Slots / support		20	20
For autoclaves with the following chamber volumes	22 L	1	-
	55 L	-	4
	79 L	-	6

*This accessory can be customized in size according to each client needs. For more information please contact us.



Customer support and food consultancy

Disclaimer: Services availability depends on location. Some services are offered for free, some are offered for free after placing an autoclave order and for others fees may apply. Furthermore, some of the listed services will be offered by the manufacturer or by an authorized distributor trained and certified by TERRA Food-Tech®.

TERRA Food-Tech® is aware that our autoclaves require a technical training for unexperienced individuals and that the acquisition of the equipment for new businesses is not simple. For this reason, included in the purchase of the unit we offer consultancy services before, during and after the equipment is installed, these include:



Before the installation

- Commercial consultancy services regarding model, accessories, installation requirements and recommendations.
- Technical consultancy services regarding application feasibility.
- Dedicated productivity study.
- Legal consultancy services related to labelling and legal requirements.

During the installation

- Remote or onsite technical support during installation.
- Remote or onsite end-user training.

After the installation

- Food consultancy services: sample technical report, stability and heat treatment studies, process optimization recommendations.
- Remote technical customer support for life by mail or phone.
- Quick access to spare parts.
- Maintenance, calibration and repair services.

Installation, Validation, Start up and Maintenance

Disclaimer: Services availability depends on location, furthermore some of the listed services will be offered by the manufacturer or by an authorized distributor trained and certified by TERRA Food-Tech®.

Installation

All the relevant information regarding the installation of TERRA Food-Tech® autoclaves (electric requirements, water quality, model sizes, connections, maintenance, etc.) can be found on our publicly available Installation guide documents.

Bear in mind that the maximum environmental conditions in which the equipment is designed to operate are:

- Room temperature: 30°C.
- Room humidity: 75%.
- Altitude: 3000 meters above sea level.

It may be possible to operate in settings with harsher environmental conditions after implementing some technical adjustments, contact TERRA Food-Tech® team to receive expert guidance.

Validation

Validation protocols and/or execution of protocols are available from TERRA Food-Tech® for new or existing autoclaves. These include an array of documentation, tools and expertise required to successfully qualify and validate an autoclave within accepted protocols that comply with the current European Union and international standards for autoclaves. The various protocols and services include:

- Installation Qualification (IQ): Provides documented evidence that the equipment has been built and installed to specification, and that all supporting services such as electricity and water are available and connected properly.
- Operation Qualification (OQ): Provides documented evidence that the autoclave operates in accordance with design specifications.
- Onsite validation and execution of protocols as well as cycle development services are available, including the provision of IQ/OQ protocols for third-party execution. Furthermore, remote or onsite training services are also available upon request. For more information, contact our technical team.

Guided start up

As part of TERRA Food-Tech® after-sales services our technical team (or authorized distributor) offers *in situ* guidance and training on equipment operation, program set up and recommended maintenance upon installing the autoclave. For clients in locations where *in situ* training is not possible we offer the option of conducting the training remotely.

We strongly recommend this session for all users and operators who will be responsible of setting up the autoclave programs and of the maintenance of the autoclave. We also conduct more advanced sessions for experienced processing professionals who are interested in advanced program features such as special pressure segments or data management.



Contents of an *in situ* guided start up

- Verification of the correct installation of the equipment.
- Performing a test cycle.
- Training session that covers the following topics:
 - How the autoclave works.
 - How to use the autoclave.
 - Setting up a program.
 - How to insert core probe.
 - Typical errors and solutions.
 - Precautions.
 - Maintenance explanations.
 - How to contact the technical service.
 - How to contact the food consultant.
 - QA of customer questions.
 - Posterior follow up.

Preventative maintenance

At TERRA Food-Tech®, we believe that autoclaves should be easy to use, service and maintain. To maximize uptime and keep your equipment in great condition, we offer several after-sales services: including remote maintenance guidance, onsite maintenance, remote technical guidance for overseas customers, onsite autoclave calibration and annual service plans which include maintenance, calibration and spare parts supply.

The standard maintenance for the average user includes

	DAILY	Cleaning the gasket and inner side of the door. Cleaning external surfaces.
	WEEKLY	Cleaning the sterilization chamber and accessories. Disinfection of external surfaces.
	MONTHLY	Cleaning the drainage filters.
	YEARLY	Yearly autoclave service, including temperature probes validation.
	EVERY 2 YEARS	Replacing the gasket.

A more detailed explanation can be found on the equipment manual and installation guide.

Emergency stock

Autoclaves are like cars, they are subject to high stresses and with use they require preventive maintenance and eventual repairs. For industrial customers who produce finished product on a daily basis and in large quantities and who can't afford any equipment downtime, we recommend acquiring a stock of spare parts. The exact components list will depend on the autoclave model and accessories acquired and consists of both spare parts which are subject to wear and spare parts that are critical for equipment operation. To receive a quote of this stock list please contact our technical service at sat@terrafoodtech.com. The

recommended parts to acquire for this emergency and maintenance stock may include replacements for the following components: pneumatic cylinder, chamber temperature probe, flexible core temperature probe, water level buoy, solenoid valves, safety thermostat, heating elements, silicone gasket, drain filter and electric fuses.

Maintenance contract

As a part of TERRA Food-Tech® after-sales services customers can benefit of special conditions by contracting an annual maintenance plan. The benefits include discounts on an annually scheduled onsite autoclave technical review, priority assistance and discounts on labor, spare parts and travel expenses.

The annually scheduled onsite autoclave technical review includes a verification and validation of 20 control points (mechanical and electric safety elements), a calibration of temperature probes and sterilization chamber cleaning. The review also includes a report of the tasks performed and recommendations of spare parts replacements if a component is detected not to be in optimum conditions. Should the client accept this recommendation the part can be replaced *in situ* within the same date using our client's stock or our technician stock.

To receive a quote of our maintenance contract please contact our technical service at sat@terrafoodtech.com.



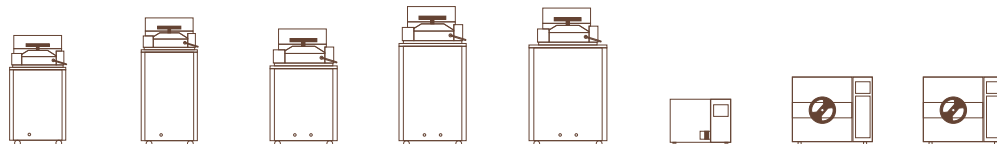
After-sales services

- **Professional consultancy services:** our experts offer training and technical and food consultancy services adapted to your case.
- **Maintenance:** we guide you about your autoclave's maintenance plan. Maintenance contracts are also available.
- **Guided start-up:** installation review, training on equipment operation, guidance on software/program configuration and recommended maintenance.
- **Spare parts and repairs:** we have a qualified technical team and a spare parts warehouse to attend as quick as possible any equipment malfunction or spare parts order.



Technical data

Specifications



Reference	CFS-28V	CFS-50V	CFS-75V	CFS-110V	CFS-150V	CFS-21H	CFS-50H	CFS-75H
Total/usable chamber volume L	33/30	55/48	79/73	115/104	175/150	22/19	55/50	79/75
Usable chamber dimensions Ø x H mm	300 x 350	300 x 620	400 x 495	400 x 740	500 x 660	210 x 430	400 x 400	400 x 600
Exterior dimensions L x D x H mm	505 x 580 x 1110	505 x 580 x 1290	610 x 700 x 1185	610 x 700 x 1435	750 x 820 x 1400	560 x 660 x 425	805 x 805 x 650	805 x 1005 x 650
Power W	2000	2800	4500	6000	9000	2000	2800	3200
Gross weight Kg	90	110	140	180	265	55	125	140
Voltage* V	230 (1P+N+PE)	230 (1P+N+PE)	400 (3P+N+PE)	400 (3P+N+PE)	400 (3P+N+PE)	230 (1P+N+PE)	230 (1P+N+PE)	230 (1P+N+PE)
Frequency Hz	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60

*Other voltages available under request. Special models with augmented power may operate with other voltages.

Safety features

- Safety valve.
- Safety thermostat.
- Pneumatic door blocking system while positive pressure exists inside the sterilization chamber.
- Open door sensor.
- Water level detectors.
- Heating elements cover
- Thermally insulated door.
- Several visual and acoustic safety and warning alarms.

Certifications

All TERRA Food-Tech® autoclaves are designed to comply with the strictest international directives and standards, including the following regulations:

- EN-61010-1 Safety requirements for electrical equipment for measurement, control and laboratory use. Part 1: General requirements.
- EN-61010-2-040 Part 2-040: Requirements for laboratory autoclaves.
- EN-61326 Electrical equipment for measurement, control and laboratory use. EMC requirements.
- AD 2000 Merkblatt Pressure vessels.
- 2014/35/UE Low voltage.
- 2014/30/UE Electromagnetic compatibility.
- 2014/68/UE Pressure equipment

Additionally, all units are TÜV Certified and certified by SGS to be compliant with ISO 9001 and ISO 14001.



General features

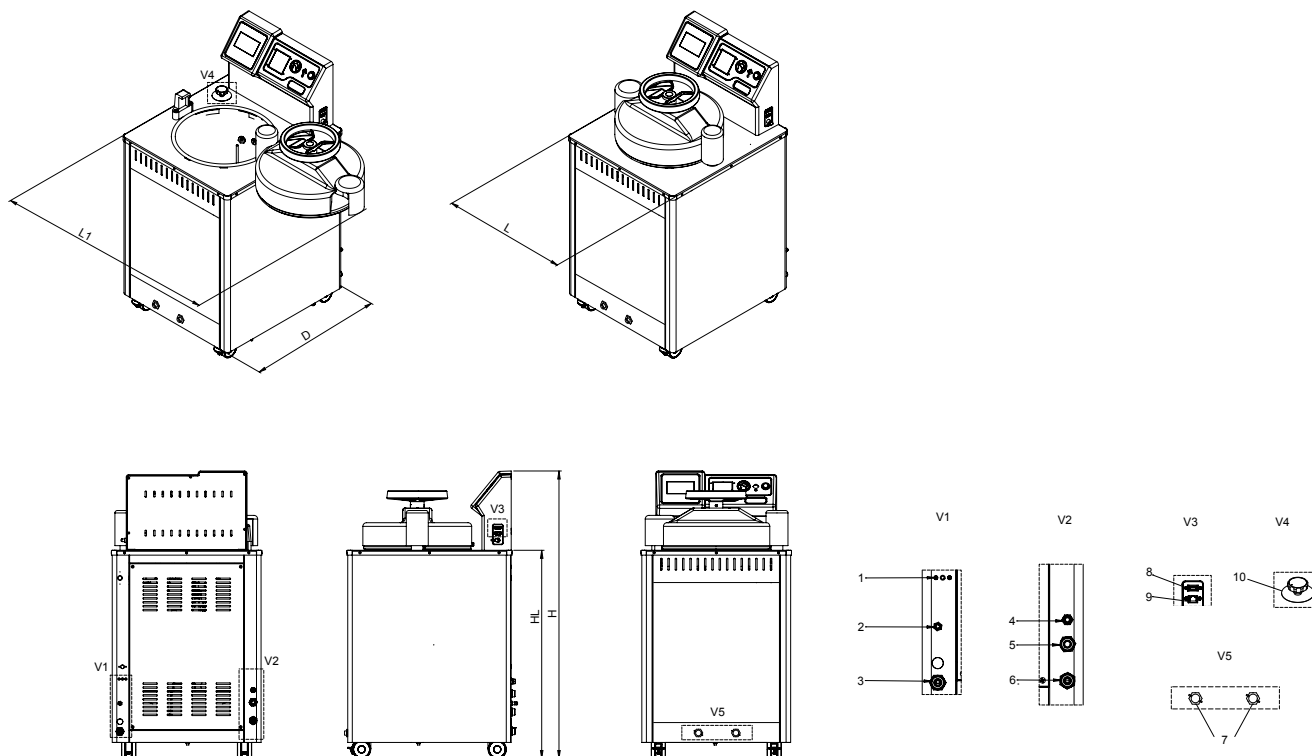
Adjustable processing temperature	90 - 130°C*
Adjustable reference temperature	90 - 130°C*
Adjustable processing time	1 - 250 min
Adjustable F ₀ /P ₀ values	0,1 - 1000
Adjustable pressure support	0,1-2,1 barg
Adjustable duration of each filling during fast cooling	1 - 30 min
Adjustable filling cycles during fast cooling	1 - 9
Adjustable target cooling temperature	30 - 100°C
Maximum pressure	2,1 Barg
Pasteurization/sterilization control system	Fully automatic microprocessor control by either flexible PT100 core temperature probe or fixed PT100 chamber temperature probe
Air purge system	Gravity displacement
Heating system	Heating elements
Pressure support system	Air pump (integrated in the equipment housing)
Fast cooling system	Water shower
External building material	AISI-304 stainless steel
Sterilization chamber and door material	AISI-316L stainless steel
Gasket material	Silicone rubber
Connection to PC	Ethernet
Connection to printer	Integrated
Number of programs	50 (4 preset and 46 user free)
Automatic storage of program data	A maximum of 200 cycles
Automatic back up to USB	On demand
Programmable auto-start	Unlimited range
Screen type	5" TFT touchscreen
Opening door system	Horizontal swiveling door with locking system in vertical models. Frontal swiveling door with locking mechanism in benchtop models
Monitoring of sterilization parameters	Self-control of obtained values (F ₀ , P ₀ , T ₀ , P & t) vs programmed values. Cycle is automatically interrupted if obtained values differ from programmed values
Pressure display	Pressure gauge on control panel, digital display on screen, registry on software and printer tickets
Water management	Sterilization chamber is automatically fed with water from water network for both steam generation via heating elements and fast cooling.
Drainage system	Drainage connection
Casters	Swiveling casters with brakes in vertical models and feet with resistant rubber in benchtop models

*For pasteurization at temperatures below 90°C, please contact us.



Technical drawings

Technical drawing of CFS-V Series



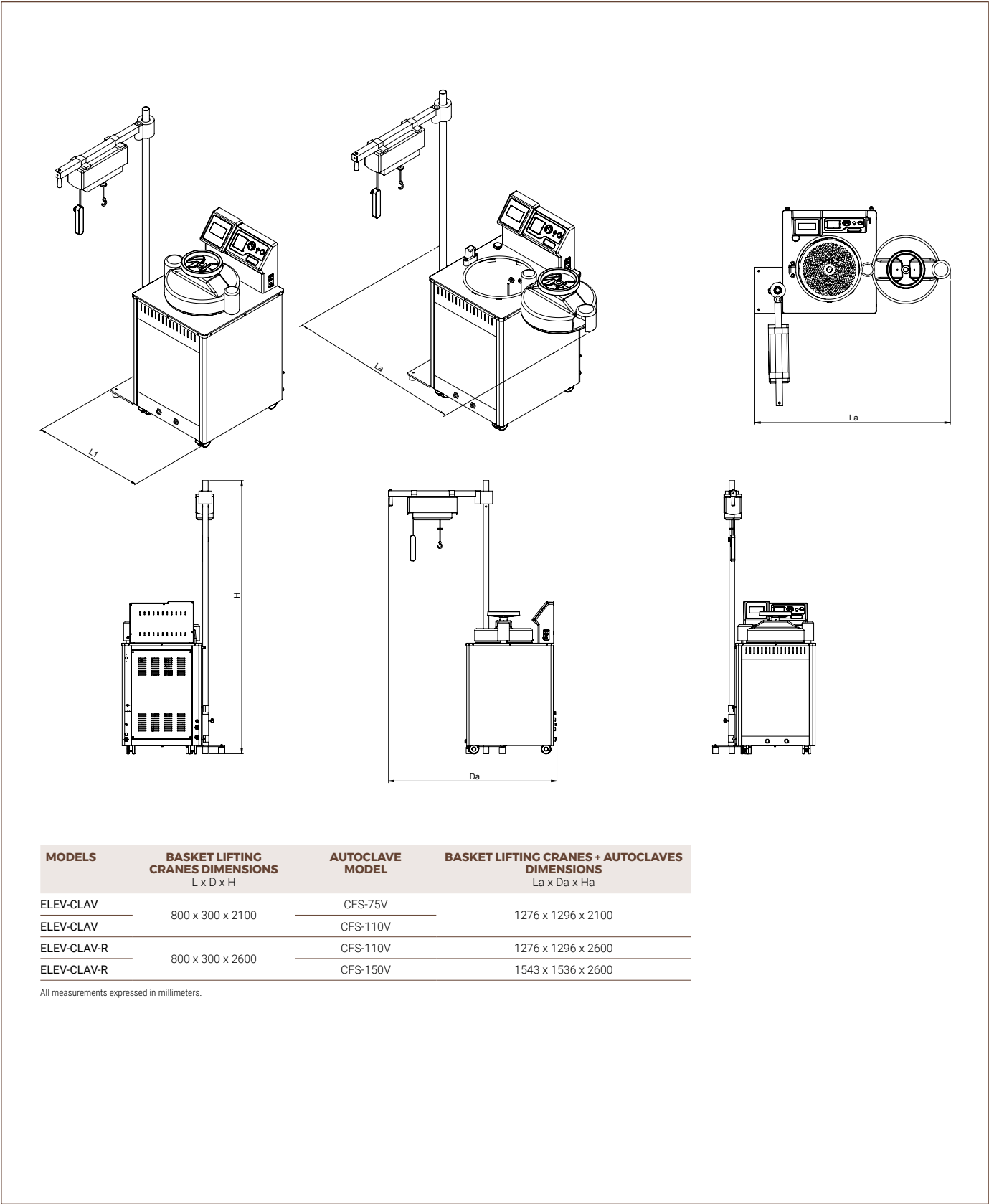
MODELS	L	L1	D	H	HL
CFS-28V	510	890	583	1103	778
CFS-50V	510	890	583	1282	957
CFS-75V	617	1097	700	1177	852
CFS-110V	622	1100	700	1425	1100
CFS-150V	750	1383	820	1383	1100

All measurements expressed in millimeters.

CONNECTIONS	
1	Safety thermostat
2	Safety valve
3	Water inlet
4	Electrical outlet
5	Steam drainage outlet
6	Water drainage outlet
7	Access to the drain filter
8	USB connection
9	Ethernet connection
10	Manual emergency tap to Drain or depressurize



Technical drawing of CFS-V Series + Basket lifting crane

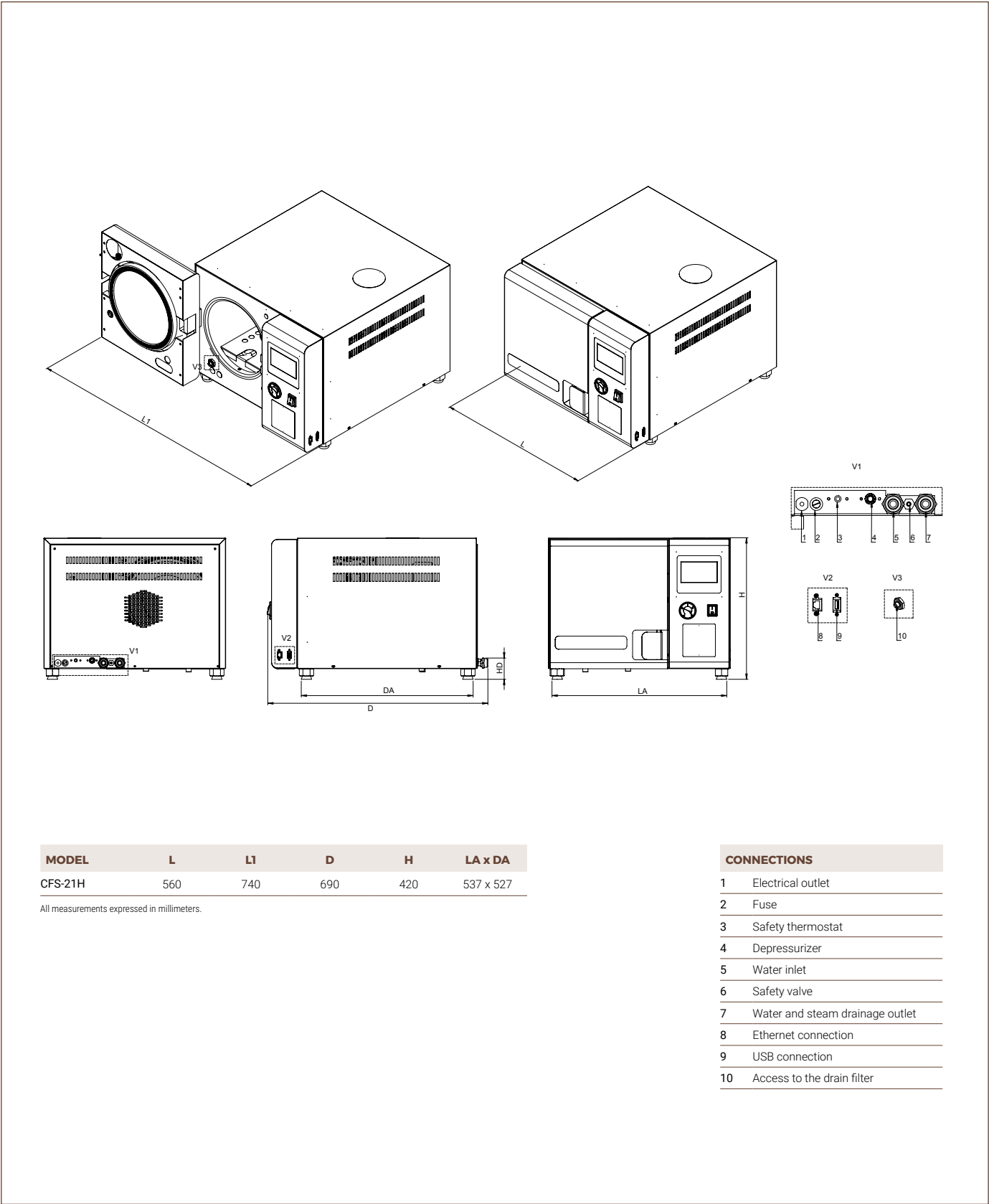


MODELS	BASKET LIFTING CRANES DIMENSIONS L x D x H	AUTOCLAVE MODEL	BASKET LIFTING CRANES + AUTOCLAVES DIMENSIONS La x Da x Ha
ELEV-CLAV	800 x 300 x 2100	CFS-75V	1276 x 1296 x 2100
ELEV-CLAV		CFS-110V	1276 x 1296 x 2100
ELEV-CLAV-R	800 x 300 x 2600	CFS-110V	1276 x 1296 x 2600
ELEV-CLAV-R		CFS-150V	1543 x 1536 x 2600

All measurements expressed in millimeters.

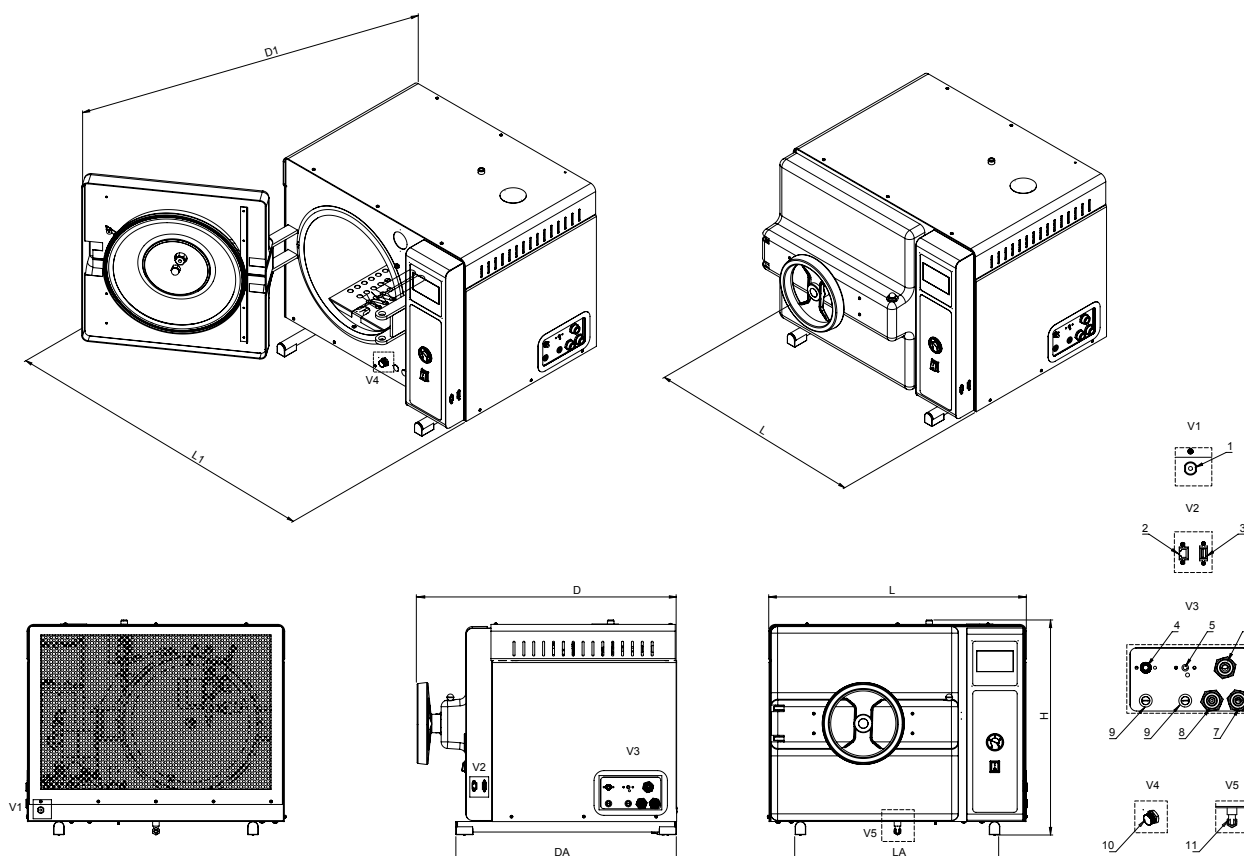


Technical drawing of CFS-21H





Technical drawing of CFS-50H & CFS-75H



MODELS	L	L1	D	D1	H	LA x DA
CFS-50H	790	1240	800	1230	650	622 x 670
CFS-75H	790	1240	1000	1430	650	622 x 830

All measurements expressed in millimeters.

CONNECTIONS	
1	Electrical outlet
2	Ethernet connection
3	USB connection
4	Depressurizer
5	Safety thermostat
6	Water inlet
7	Steam drainage outlet
8	Water drainage outlet
9	Fuses
10	Access to the drain filter
11	Safety valve



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