Service Manual

FAGOR INDUSTRIAL

G700 and G900 KORE MODULAR

07/07/2020

SERVICE MANUAL
G700 and G900 KORE

Service Manual

MONDRAGON

1. INTRODUCTION

Dear Customer,
Fagor Industrial would like to thank you for placing your trust in our product and our brand. We are convinced that our products will meet your requirements.
This manual is designed to provide the necessary information for the installation, commissioning and adjustment and maintenance of the equipment.
Use the equipment only for the uses intended by the manufacturer. Inappropriate use may cause risks to the integrity of the equipment and the safety of the user. This equipment should only be used by professionals or by trained and qualified personnel. Any other use is not recommended.
The warranty conditions do not cover damage to glass components, nor do they cover deterioration of the insulating material or damage caused by the improper installation of the equipment, misuse, inadequate maintenance or poor repair processes.
This Service Manual is a guide to help you maintain the equipment.
This equipment is subject to changes and modifications to support its technical progress.

2. FUNCTIONAL TESTING

Equipment manufactured and marketed by Fagor Industrial is supplied ready for correct operation; this has been certified by rigorous quality control tests.
The equipment has been tested and the results of tests established for its manufacture have been satisfactory.
In case of repair, the supplier may require the return of defective parts for analysis and statistics.
The company will correct any possible error or defect provided that the equipment has been used in accordance with the instructions in the manual.
IN CASE OF REPAIR OR REPLACEMENT OF PARTS, ALWAYS PROVIDE THE CODE AND THE REGISTRATION NUMBER OF THE EQUIPMENT, WHICH CAN BE FOUND ON THE RATING PLATE.
Fagor Industrial declines any responsibility for inappropriate use of the equipment or handling by unauthorised and/or qualified personnel.

3. PICTOGRAMS

Danger A situation of imminent danger, which may result in extremely serious physical injury or death.

Caustic substances

Fire hazard

Burn hazard

High voltage

Shock hazard

Important A potentially hazardous situation, which may result in physical injury and accidents

Warning A situation that requires your attention.

Technical Assistance Requires specialised technical attention.

Instructions Read the manual carefully before starting the equipment.

4. UNPACKING

Unpack the equipment and check that it has not suffered any damage in transit, if so, notify your supplier and the carrier immediately. In case of doubt, do not use the equipment until the extent of the damage has been analysed.

Packaging materials (plastics, woods, staples, etc.) should not be left within reach of children as they pose a potential danger.

The handling of the equipment must be done using the appropriate means. It may be necessary to use a forklift or similar to avoid damaging the structure of the equipment. Properly transport the equipment to the place where it is to be installed and then unpack the equipment.

4.1. RECYCLING

The packaging materials are fully recyclable, and so should be placed in appropriate recycling bin.
Recycle packaging materials properly by depositing them at the relevant collection points. Place packing material in the appropriate bins for recycling.
At the end of the equipment's useful life, it must be disposed of in accordance with local regulations.
Help protect the environment and public health and recycle electrical and electronic equipment. Take the product to a local recycling centre or contact their local office.
Depending on their characteristics, certain materials can be recycled. By recycling and other forms of processing electrical and electronic waste we can make a significant contribution to protecting the environment.
The European Standard 2012/19/EU Waste Electrical and Electronic Equipment Directive states that this equipment should not be disposed of as a domestic appliance but should be disposed of properly in order to optimise the recycling of its constituent materials and to protect the environment.

5. GENERAL INFORMATION AND WARNINGS

BEFORE INSTALLING OR COMMISSIONING THE EQUIPMENT, CAREFULLY READ THE INSTRUCTIONS IN THE USER, INSTALLATION AND MAINTENANCE MANUAL SUPPLIED WITH THE EQUIPMENT

THIS EQUIPMENT IS INTENDED FOR PROFESSIONAL USE ONLY, IT MUST ONLY BE USED BY QUALIFIED PERSONNEL AND INSTALLED AND REPAIRED EXCLUSIVELY BY AN AUTHORISED AND QUALIFIED TECHNICAL ASSISTANCE SERVICE

THE MANUFACTURER DECLINES ALL RESPONSIBILITY FOR IMPROPER INSTALLATION, USE, MAINTENANCE OR REPAIR AND FOR DAMAGE TO PROPERTY OR INJURY TO PERSONS CAUSED BY FAILURE TO COMPLY WITH THE ABOVE-MENTIONED STANDARDS AND INSTRUCTIONS

THE LOCATION, INSTALLATION, REPAIRS AND/OR CONVERSIONS MUST ALWAYS BE CARRIED OUT BY AN AUTHORIZED TECHNICAL SERVICE AND IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND THE REGULATIONS IN FORCE.
INSTALLATIONS, ADJUSTMENTS OR REPAIRS CARRIED OUT BY UNAUTHORISED PERSONNEL, IMPROPER MAINTENANCE OR USE, THE USE OF SPARE PARTS OTHER THAN THOSE SUPPLIED BY THE MANUFACTURER AND ANY OTHER TYPE OF ALTERATION TO THE DEVICE MAY RESULT IN BOTH MATERIAL DAMAGE AND INJURY AND LOSS OF THE WARRANTY.
THE EFFECTIVENESS AND PROPER FUNCTIONING OF THE EARTH CONNECTION MUST BE ENSURED

IF THE EQUIPMENT DEVELOPS A FAULT, THE USER SHOULD NOT ATTEMPT TO REPAIR IT OR ALLOW UNQUALIFIED OR UNAUTHORISED PERSONNEL TO DO SO

THE POSITION OF THE ELEMENTS THAT MAKE UP THE EQUIPMENT MUST NOT BE CHANGED, NOR MUST THEY BE MANIPULATED, AS THESE ACTIONS COULD AFFECT THE SAFETY OF THE EQUIPMENT

THE EQUIPMENT MUST BE WELL LEVELLED AND ELECTRICAL CABLES, WATER AND DRAINAGE HOSES SHOULD NOT BE PINCHED OR TRAPPED UNDER ANY CIRCUMSTANCE

THE EQUIPMENT HAS BEEN DESIGNED TO WORK AT AN AMBIENT TEMPERATURE OF BETWEEN 5 ºC AND 40 ºC AND SHOULD NOT BE USED IN ENVIRONMENTS WITH TEMPERATURES BELOW 5 ºC.

NEVER USE THE EQUIPMENT OR ANY OF ITS PARTS AS A SUPPORT OR PLACE OBJECTS ON ITS TOP AND/OR BOTTOM

THE DOOR OF THE EQUIPMENT MUST NOT BE OPENED WHEN THE EQUIPMENT IS IN OPERATION. DO NOT PUT YOUR HANDS INSIDE THE EQUIPMENT OR IMMERSE THEM IN THE WASHING SOLUTION. TURN OFF AND EMPTY THE TANK BEFORE ACCESSING THE INTERIOR

THE EQUIPMENT SHOULD NOT BE INSTALLED IN PLACES EXPOSED TO WATER FLOW

THIS EQUIPMENT HAS BEEN DESIGNED FOR FOOD PROCESSING OR SIMILAR. ANY OTHER TYPE OF USE IS CONSIDERED INAPPROPRIATE
NEVER USE ABRASIVE, CORROSIVE, ACIDIC, SOLVENT OR CHLORINE/HYPOCHLORITE-BASED DETERGENTS

WAIT AT LEAST 10 MINUTES AFTER SWITCHING OFF THE EQUIPMENT BEFORE CLEANING INSIDE.
DO NOT INSERT YOUR HANDS INTO AND/OR TOUCH INTERNAL PARTS WHEN THE EQUIPMENT IS IN USE AND WAIT 15 MINUTES AFTER IT HAS BEEN USED

6. SAFETY INSTRUCTIONS

6.1. FOR YOUR SAFETY

Do not store or use flammable and/or corrosive gases or liquids near the equipment.
Under no circumstances shall the operation of this equipment be entrusted to minors or to persons with physical, mental or sensory disabilities. The same applies to persons who lack experience and/or the necessary knowledge unless they operate under the supervision of a safety officer.

The operation of the equipment shall be carried out exclusively by hand. Any damage attributable to the use of sharp, pointed or similar objects, voids the right to claim under the warranty.

To avoid the risk of accidents and damage to the equipment, ensure that operating personnel are properly trained in safety matters at all times through appropriate courses, seminars and programmes.

- It is **NOT** advisable to use the equipment with non-potable water
- It is **NOT** advisable to use the equipment in absence of regular maintenance
- It is **NOT** advisable to use the equipment in unhygienic conditions or places that do not comply with local regulations
- It is **NOT** advisable to supply the equipment with wastewater, sea water or chemical, physical and biological water that does not comply with the allowable limits for drinking water

6.2. WHAT TO DO IF YOU SMELL GAS

- Turn off the gas supply immediately
- Do not touch any of the electrical connection components
- Ensure that the location of the equipment is well ventilated
- Avoid open flames and sparks
- Inform the relevant gas supplier (if you are unable to contact the gas supplier, call the fire service responsible for your location)

6.3. ONLY FOR GAS APPLIANCES

- If your equipment is installed under an exhaust hood, keep it connected while the equipment is running (fumes and combustion gases)
- If your equipment is connected to a flue system, clean the flue in accordance with the regulations in force in your country (fire hazard). Consult your installer for further information
- Do not put anything inside the exhaust pipes of your equipment (fire hazard)
- The space underneath the equipment must **NOT** be blocked by objects or modified in any way (fire hazard)
- Do **NOT** use the equipment in places exposed to the wind (fire hazard)

6.4. SAFETY MEASURES FOR USE OF THE EQUIPMENT

- Wear appropriate protective clothing
- When working with containers filled with liquid or loading food that will melt during cooking, only insert the containers at a height that allows the user to see the contents when placed on the rack (burn hazard)
- Always open the door of the cooking chamber very slowly (hot vapours) (burn hazard)
- Wear protective clothing when inserting or removing accessories from the hot cooking chamber (burn hazard)
- The outside temperature of the equipment may exceed 60°C, touch only the control elements (burn hazard)

- The hand shower and water can be very hot (burn hazard)
- Before activating the Cool Down function, ensure that the deflector plate is properly locked (burn hazard)
- Do not interfere with the fan rotor (risk of injury)
- Do not store explosive or flammable substances in or near the equipment (fire hazard)
- Use the brake to immobilise equipment wheels and mobile multi-loading racks that will always remain in the same place. If the ground surface is uneven trolleys can roll and slide (risk of injury)
- When using the racks in mobile service, always lock the containers. Cover containers of liquids and secure them properly to avoid spillage (burn hazard)

- Ensure that the transport trolley is securely fastened to the equipment when loading or removing multi-loading racks or plate racks (risk of injury)
- Multi-loading and plate racks, transport trolleys and roller-mounted devices can tip over when moving on uneven floors (risk of injury)

During cooking and until all parts of the equipment have cooled down, take the following precautions:

- Only touch the control knobs and handle. External parts reach very high temperatures (>60°C)
- When opening the door, do so slowly, taking care of the steam coming out of the cooking chamber
- Always wear heat-resistant clothing to handle objects inside the cooking chamber
- Exercise extreme care when removing trays from the chamber
- Remove the probe from the core before removing the trays, and place it in its holder ensuring that the cable does not obstruct the removal of trays

6.5. SAFETY MEASURES FOR CLEANING

- Always work with adequate protective clothing: safety glasses and mitts, face mask, etc.
- Observe the safety instructions in the "Cleaning" section
- To avoid the contamination of containers and to maintain hygiene, it is advisable to clean items that come into contact with food and the surrounding areas at the end of each use
- Before handling any cleaning chemicals, read the product safety information carefully and make use of appropriate PPE
- Do not open the door of the equipment when it is being cleaned. Risk of injury to eyes and skin

6.6. FIRE HAZARD

- Before use, make sure that there are no improper objects inside the equipment (manuals, plastics, etc.) and that the smoke outlet is free from obstructions
- Do not place heat sources, flammable or combustible substances near the equipment
- Do not use highly flammable foods or liquids (e.g. alcohol) during cooking
- Clean the cooking zones and/or cooking chambers regularly. Accumulated food and fat residues can catch fire

6.7. ELECTRICAL SHOCK HAZARD

Do not open compartments marked with this symbol. Access is restricted to personnel qualified and authorized by FAGOR INDUSTRIAL. Failure to comply with this rule will invalidate the warranty and expose the user to the risk of damage and injury that could be fatal.

6.8. OTHER

- It is absolutely forbidden to alter, circumvent, remove or bypass safety devices. Failure to comply with this warning may result in serious risks to the safety of the equipment and people.
- Use original spare parts, otherwise the warranty will be void
- Before starting up recently installed equipment for the first time, it is recommended to clean its interior with a cloth soaked in soapy water to eliminate the characteristic odour of new equipment
- **Never use** the equipment or any of its parts as a ladder or support, or place objects on top of it
- The equipment should not be installed in places exposed to water flow

7. UPKEEP

In order to preserve the quality of the stainless steel, to guarantee good hygiene and to avoid the anomalous operation of the equipment, it is essential to submit it to a daily cleaning process. To this end, follow the instructions in the "Cleaning" section.
If the equipment is not cleaned properly and often enough, there is a risk that dirt, grease and food debris will accumulate in the tank.

- To prevent corrosion, clean food residues daily
- Do not use high-pressure cleaners
- Do not treat the equipment with acid products or expose it to the effects of acid vapours. Acids damage steel and can cause discolouration
- Use suitable cleaning products. The use of inappropriate products may damage the equipment and void the warranty
- Do not use abrasive cleaning products
- **Daily cleaning of the door seal with a small amount of non-abrasive detergent prolongs its life**

8. PROLONGUED PERIOD OF INACTIVITY

In the event that the equipment is going to be inactive or out of use for a long period of time (holidays, temporary closure, maintenance, etc.), please take these guidelines into account:

- Completely empty the equipment
- Intensively clean the equipment, including the interior
- Disconnect the main power switch
- Shut off the water supply
- Shut off the gas supply
- The appliance must not be left in environments with temperatures lower than **5°C.**
- Leave the door half open to allow air to circulate and prevent the formation of mould and bacteria

9. MAINTENANCE

WARNING: This equipment requires regular periodic maintenance in order to ensure the requirements for which it has been designed and the maintenance of improvements as stated by the manufacturer.

- Inspection, maintenance and repair work must be carried out by a specialised Official Technical Service
- When carrying out cleaning, inspection, repair or maintenance work, it is essential to disconnect the power supply to the equipment
- When moving the equipment, make sure that the moving and/or removable parts are properly secured, that the water tanks of the equipment are emptied, that the mains cable and the water and drainage pipes are properly disconnected. When returning the equipment to its original location, fix it in position and ensure that the power supply and the water and drainage pipes are installed in accordance with the relevant standards
- To ensure that the equipment is in perfect technical condition, have it inspected at least once a year by an **Official Technical Service**

9.1. DAILY MAINTENANCE

Daily cleaning of the equipment is recommended.
For the proper functioning and maintenance of the equipment, clean daily with products specifically designed for this purpose.

IMPORTANT Do **NOT** use gritty or abrasive detergents and do not use a water hose to clean the outside of the equipment, as this may affect its internal components.

Manual Cleaning should always be done with the equipment disconnected
Do not use products or utensils that will scratch the surface the equipment or the glass
Clean daily to prevent corrosion of the tank

In order to maintain the high quality of the stainless steel, as well as for reasons of hygiene and to avoid the abnormal operation of the equipment, it is essential to subject it to a daily cleaning process

It is essential to carry out the relevant and necessary cleaning tasks in order to increase the useful life of the equipment and to ensure its correct operation. Efficient processes require perfectly clean and disinfected equipment.
The equipment is made of stainless steel. However, under certain conditions corrosion may occur.
After switching off and emptying the equipment each day, the following should be done:

- Disconnect the power supply
- Remove the frames and filters and clean them with a brush under a strong jet of water
- Return all parts to their original location
- Carefully clean the chamber; any food residues should be removed with a brush
- It is advisable to leave the door open at the end of the day

9.2. DAILY CLEANING

Before carrying out any cleaning task, the equipment must be disconnected from the power supply

Detergents are highly active, so be careful, as they can cause irritation to the skin and eyes. Follow the manufacturer's instructions carefully.
When applying detergents and degreasers, it is advisable to wear rubber gloves, a mask to prevent inhalation and safety glasses, in accordance with the current safety regulations.

If the cleaning is carried out on a daily basis, it takes very little time to do and has the advantage of keeping the equipment in perfect condition and ready to use the following day.
Cleaning of the interior of the equipment must be performed with great care.

- **DO NOT** wash the appliance with direct jets of water, as leaks into electrical components could impair normal operation.
- Cleaning of the outside of the equipment should be done with a damp cloth, following the direction of the stainless steel satin finish. It must be properly rinsed and dried

- Use neutral detergents and not chlorine-based and/or abrasive substances
- **DO NOT** use abrasive, corrosive, acidic, solvent or detergent products based on CHLORINE/HYPOCHLORITE
- **DO NOT** use utensils that may cause incisions and lead to the formation of rust
- If there are hardened residues, use water and soap or neutral detergents and, if necessary, a plastic or wooden spatula
- Clean the interior of the chamber to prevent the build-up of dirt, using non-abrasive neutral detergents that do not contain chlorine
- The areas near the equipment should also be cleaned daily, always using soap and water and not toxic or chlorine-based detergents. Rinse with clean water and dry thoroughly
- Some models are equipped with a drainage system to facilitate cleaning, as well as the possible drainage of liquids from the food. During cleaning, it is essential to remove the drain plug and clean the drain, in order to avoid obstruction by solid elements. Any liquids that may be present should not be allowed to stagnate. **Replace after cleaning.**
- It is essential to disconnect the appliance if it is to be cleaned with water. Panels should not be removed to gain access to electrical components except by authorized service and repair personnel.
- **DO NOT** treat the equipment with acid products or expose it to the effects of acid vapours, as this may result in damage to the passive layer of nickel chrome steel and the possible discolouration of the equipment
- Use food-grade detergents for cleaning
- Follow the instructions on the detergent
- Use specific cleaning products only. The use of inappropriate products may damage the equipment and void the warranty
- **If the cleaning of the equipment is deficient, accumulations of grease and food residues inside the tank can cause deterioration of the stainless steel**
- **Use protective clothing, protective gloves, safety glasses and masks in accordance with local regulations**
- **Do not store chemical cleaning products inside the equipment**

As the inner doors are made of glass, they are simple to clean, as they can be cleaned with the same products that are used to clean glass-ceramic equipment.

- Use a scraper to remove grease from the glass
- Spray a trusted cleaning product on the glass
- Wipe the glass with a cloth
- Thoroughly cleanse with water

- **Contact a cleaning agent distributor to obtain detailed information on the methods and products for the regular disinfection of equipment**
- **Only use products suitable for industrial equipment**
- **The warranty does not cover damage caused by the improper use of chemicals**
- **When handling chemicals, follow the safety instructions and recommended dosages on the product. Wear protective clothing, protective gloves and safety glasses when handling chemicals**

9.2.1. REGULAR CHECKS TO BE PERFORMED BY THE USER

- It is not advisable to place the equipment in the vicinity of a heat source
- The appliance must be properly levelled to avoid excessive vibrations
- The door seal is in good condition and it seals tightly with the body
- Check that the drainage channel is not obstructed

9.3. SPECIALISED MAINTENANCE

To ensure that the equipment is in perfect condition for its use and safety, it is recommended that it be maintained and serviced by an Authorised Technical Assistance Service at least once a year.

DANGER
• High voltage
Before opening the equipment panel, accessing components and performing work on live components, disconnect the equipment from the power supply.

Use the appropriate means and tools for each intervention on the equipment.
Twice a year, the technical service should be called in order to carry out the relevant checks.

9.3.1. MAINTENANCE OF ELECTRICAL EQUIPMENT

		Cooker	Oven	Induction Cooker	Wok Cooker	Solid Top	Fry Top	Fryer	Grill	Boiling Pan BM	Pressure Boiling Pan BM	Tilting Bratt Pan	Chip Scuttle	Bain Marie	Pasta Cooker
Oven Door	Adjustment		X												
	Hinge		X												
	Gasket		X												
Oven Insulation			X												
Boiling Pan Liner	Safety Valve									X	X				
	Working Valve									X	X				
	Pressure Gauge									X	X				
Lid	Safety Valve										X				
	Closures									X	X				
	Adjustment									X	X	X			
	Hinge									X	X	X			
	Gasket										X				
Water Tap														X	X
Water Level Control										X	X				
Drain Key								X		X	X	X		X	X
Thermostat	Function		X				X	X		X	X	X		X	X
	Safety		X				X	X		X	X			X	X
Seals	Oil							X				X			
	Water									X	X	X		X	X
	Steam										X				
Elevation	Screw/Nut											X			
	Motor											X			
	Sensor Position							X				X			
Electrical Connections	Resistor	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Contactor	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Contacts	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Decalcification/Cleaning										X	X				
Exterior	Panels	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Handles	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Control Panel	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Smoke Outlet	X	X	X	X	X	X	X	X	X	X	X	X	X	X

9.3.2. MAINTENANCE OF GAS EQUIPMENT

		Cooker	Oven	Paella Cooker	Solid Top	Fry Top	Fryer	Grill	Boiling Pan	Boiling Pan BM	Pressure Boiling Pan	Pressure Boiling Pan BM	Tilting Bratt Pan	Bain Marie	Pasta Cooker
Oven Door	Adjustment		X												
	Hinge		X												
	Gasket		X												
Oven Insulation			X												
Boiling Pan Liner	Safety Valve									X		X			
	Working Valve									X		X			
	Pressure Gauge									X		X			
Lid	Safety Valve											X			
	Closures									X		X			
	Adjustment									X		X	X		
	Hinge									X		X	X		
	Gasket											X			
Gas Tap/Valve		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Water Tap									X	X	X	X	X	X	X
Water Level Control										X		X			
Drain Key							X			X	X	X		X	X
Thermostat	Function		X			X	X			X		X	X	X	X
	Safety		X			X	X			X		X		X	X
Seals	Gas	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Oil						X						X		
	Water									X	X	X	X	X	X
	Steam										X	X			
Elevation	Screw/Nut												X		
	Motor												X		
	Sensor Position						X						X		
Pilot light	Flame	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Primary Air	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Thermocouple	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ignition	Ignition		X		X	X	X	X	X	X	X	X	X	X	X
	Electrode		X		X	X	X	X	X	X	X	X	X	X	X
	Cables		X		X	X	X	X	X	X	X	X	X	X	X
Burner	Injector	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Primary Air	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Electrical Contacts		X	X	X	X	X	X	X		X		X	X	X	X
Decalcification/Cleaning										X		X			
CO^2 Measurement		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Exterior	Panels	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Handles	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Control Panel	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Smoke Outlet	X	X	X	X	X	X	X	X	X	X	X	X	X	X

10. INSTALLATION OF THE EQUIPMENT

THE MANUFACTURER DECLINES ALL RESPONSIBILITY FOR IMPROPER INSTALLATION, USE, MAINTENANCE OR REPAIR AND FOR DAMAGE TO PROPERTY OR INJURY TO PERSONS CAUSED BY FAILURE TO COMPLY WITH THE ABOVE-MENTIONED STANDARDS AND INSTRUCTIONS

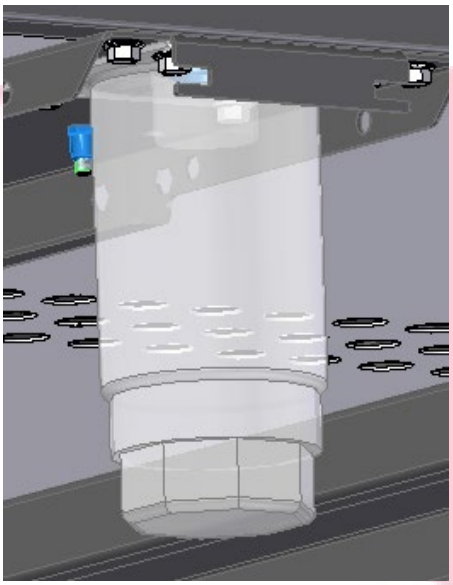
Use the equipment in a sufficiently ventilated room, in accordance with the regulations in force, to prevent the formation of unacceptable concentrations of harmful substances in the place where it is installed. An exhaust hood must be installed to ensure the correct operation of the equipment.
The equipment must be installed in accordance with the dimensions of the hood. The equipment may only be installed on and/or against a non-combustible surface.
It is recommended that you analyse the proposed installation site before installing the appliance, in order to avoid any damage during its use.
Unless otherwise specified, parts that have been protected by the manufacturer must not be handled by the installer.

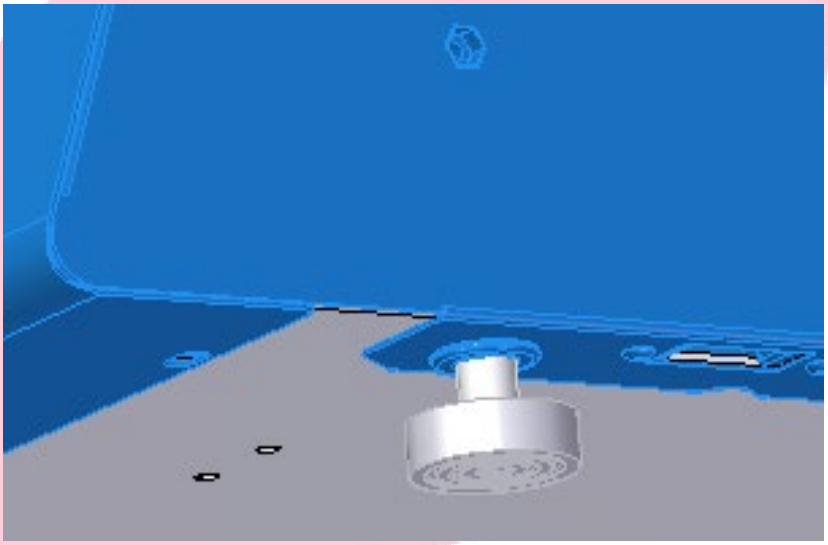
10.1. LOCATION

- Positioning, installation, repairs and/or conversions must always be carried out by an Authorized Technical Service and in accordance with the manufacturer's instructions and the regulations in force.
- The position of the elements that make up the equipment should not be changed, nor should they be manipulated, as these operations could affect safety of the equipment.
- The equipment must be well levelled and electrical cables, water and drainage hoses should not be pinched or trapped under any circumstance

10.2. LEVELLING

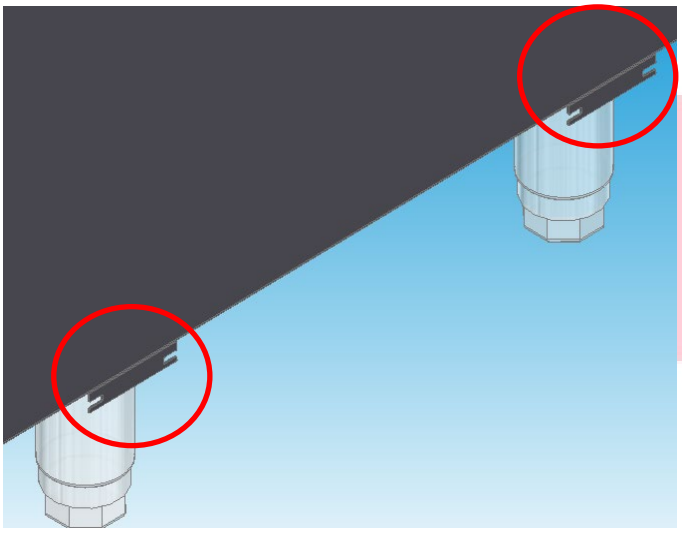
It is important that the equipment is correctly levelled. It must be levelled on all three axes (X, Y, and Z).
The equipment has adjustable feet to enable correct levelling. Turn the feet in one direction or another to adjust the level.

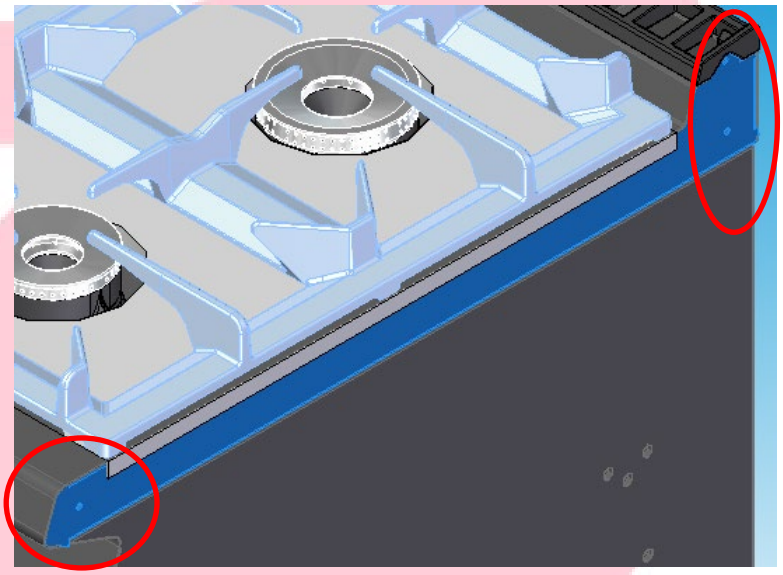


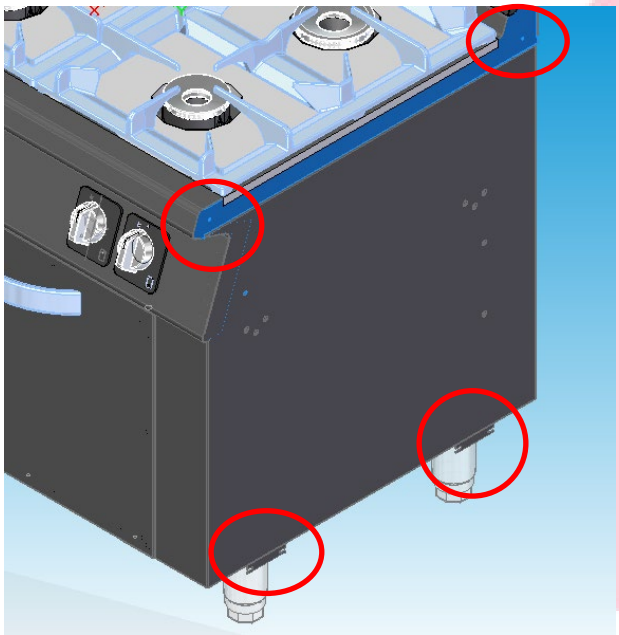


10.3. JOINING MODULES

M5 screws are used to join all the different modules that could make up a modular kitchen; when housed in their corresponding locations they ensure the correct assembly of the modules.







11. CONNECTIONS

11.1. ELECTRICAL CONNECTIONS

Before connecting the appliance to the power, check that the mains voltage and frequency correspond to those indicated on the equipment's rating plate and ensure that the power outlet is adequate for the consumption it will support.

It is essential that the electrical installation to which the equipment is to be connected has EARTHING, as well as adequate thermal magnetic and differential protection.

The electrical connection of the equipment must always be carried out by an AUTHORISED TECHNICIAN

The legal regulations in force in each country or geographical area regarding connections to the electrical grid must be taken into account.

- The rating plate indicates the maximum power value in kilowatts (kW) and amps (A), for sizing installation components (line, power cable, etc.). The values must be reviewed if the configuration is changed.
- Check that the mains voltage corresponds to that indicated on the equipment rating plate
- Flexible cable with an oil-resistant sheath should be used for the electrical connection and it should be no lighter than ordinary polychloroprene or equivalent synthetic elastomer sheath cable (H05RN-F or H07RN-F)
- The electrical cord must comply with the standard **EN 60335-1:2002** "ordinary polychloroprene sheathed flexible cord"
- The power cable must be sized according to the nominal current of the equipment
- The equipment must be earthed through the terminal strip connector
- The manufacturer is not liable for any damage caused by the failure to comply with this requirement
- An adequately sized omnipolar thermal magnetic circuit breaker with a minimum opening of 3 mm between contacts must be installed in an easily accessible location close to the equipment. This device should be used to disconnect the equipment for installation work, repairs, cleaning and maintenance. The manufacturer is not liable for any damage caused by the failure to comply with this requirement
- An adequately sized differential protection device must be installed in an easily accessible location close to the equipment. The manufacturer is not liable for any damage caused by the failure to comply with this requirement
- If any fault is detected during the installation of the equipment, inform your supplier immediately

To access the terminal block of the equipment, release the front panel, pass the cable through the cable gland located on the lower outer base and connect as indicated on the block.

VERY IMPORTANT: Before fitting the left side panel, tightly secure the power cable in the cable gland

When several pieces of equipment are installed in line, they must be connected to each other by means of a grounding point located at the base of the equipment at the rear. The connection is indicated by this symbol

This equipment has a voltage configuration stipulated according to its rating plate (FACTORY ELECTRICAL CONNECTION). All equipment has a terminal box through which different voltage and power/amperage options can be configured (230V 1N~, 230V 3~ or 400V 3N~).

To access the terminal block, the cover must be removed, the power cable can then be connected, and optional changes to the equipment configuration can be made.

If a change is made to the configuration of the equipment, it must be indicated next to the rating plate using the stickers provided.

The power cable must be secured using the cable gland.

11.2. WATER CONNECTION

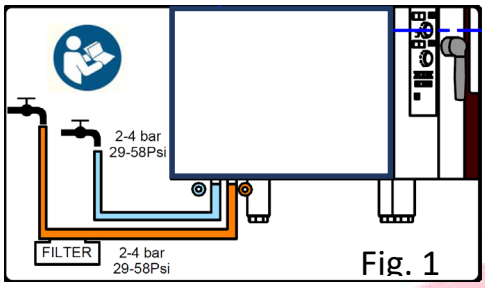
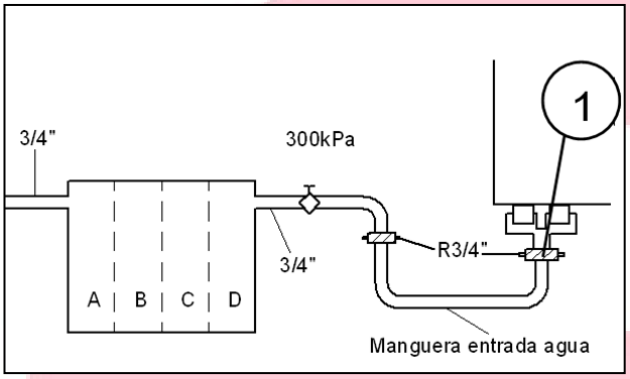


Fig. 1

Connect to the water network at the points indicated, using the hose provided.
The water inlet pressure must be between 200 and 400 kPa (2-4 kg/cm^2 = 2-4 bar). 250 kPa is advised.



Fagor Industrial recommends supplying the equipment with water of the following characteristics:

pH: 6.5 - 7.5
Total water hardness: 5 - 10 ºfH
3.5 - 7 ºeH
2.8 - 5.6 ºdH
Impurities: Ø < 0,08 mm
Chlorides: ≤ 150 mg/l
Chlorine: 0.2 - 0.5 mg/l
Conductivity: 400 - 2.000 µS/cm

WATER HARDNESS CONVERSION					
	CaCO3	ºD	ºF	ºA	ºE
	ppm: parts per million	ºD: German degrees	ºF: French degrees	ºA: American degrees	ºE: English degrees
ºF	10	0.56	1	10	0.7
ºA	1	0.056	0.1	1	0.07
ºE	14.26	0.8	1.47	14.26	1
ºD	17.85	1	1.785	17.85	1.25

If the quality of the water does not meet the specified requirements, it is necessary to contact a professional to advise on suitable water treatment systems in order to adapt the water and to offer a solution.
If the hardness of the water is greater than that indicated, it is necessary to install a water softening unit to avoid an excessive accumulation of limescale in the equipment and to be able to achieve optimum results.
In addition to the quality of the water, the pressure of the mains water must also be taken into account, as this is very important for the correct operation of the equipment. The dynamic water inlet pressure must be between the values indicated in the table below.

DYNAMIC PRESSURE WATER INLET					
MOD "A"	**Min.**	200 kPa	2 bar	2 kg/cm^2	29 psi
	Max.	400 kPa	4 bar	4.1 kg/cm^2	58 psi
MOD "B", "C"	**Min.**	100 kPa	1 bar	1 kg/cm^2	14.5 psi
	Max.	400 kPa	4 bar	4,1 kg/cm^2	58 psi

If the mains pressure is higher than recommended, it is necessary to fit a water pressure regulator.
If the mains pressure is lower than recommended, it is necessary to fit a water pressure pump. Contact your supplier or manufacturer to order a PRESSURE PUMP KIT.
The inlet temperature of the water is also important.

WATER INLET TEMP.	Min.	Max.
Cold Water	15 ºC / 59 ºF	40 ºC / 104 ºF
Hot Water	40 ºC / 104 ºF	60 ºC / 140 ºF

For the correct installation of the water connection to the equipment you must:

- Connect the equipment to a water supply that meets the requirements specified above. Every piece of equipment has a 3/4" thread water hose connector. Do **NOT** reuse old or used hoses
- Install a stop valve near the equipment in an accessible location
- Check that the mains pressure is between the values shown above.
- Check that there are no leaks.

MOST COMMON FILTERING SYSTEMS

A) Fine filter
If the water contains impurities such as sand, iron particles or substances floating in it, we recommend using a fine filter at the inlet.

B) Activated carbon filter
If the water contains a concentration of chlorine above 0.2 mg/l (this information can be obtained from the water company) an activated carbon filter must be used.

C) Reverse osmosis system
If the chloride concentration exceeds 150 mg/l (this information can be obtained from the water company), a reverse osmosis system should be installed. In this case, note that the minimum conductance value must be 400 µS.

D) Water softening
Recommended for treating water with high mineral content (not chloride). Systems: H+. Ion exchange or Kleensteam. We strongly discourage the use of sodium/ion exchangers (as is usual in dishwashers) because of the sodium sediments and the boiling delay with common salt.
When selecting the filter system (A, B, C, D), it is advisable to contact a company specialised in water treatments (for example: BRITA).

11.3. WASTEWATER CONNECTION

The equipment's drainage pipe must be connected to the drain in such a way that the water draining from the equipment can flow freely by gravity. The drain must, therefore, be located at a lower level than the equipment's drainage pipe, with a slope of at least **≈ 5 - 3%**.
The equipment drainage pipe must always be connected to a sump with a siphon to prevent the return of bad odours.
The drain must be checked to ensure that it works properly and is not blocked.
Improper installation of the equipment can lead to inadequate operation.
Check that the drainage pipe is of the correct size.
The average temperature of the residual water discharged by the equipment is 55 ºC.

11.4. PNEUMATIC GAS CONNECTION

It is essential that the gas supply pipes and connections to the corresponding gas meters have the indicated ø.
After connecting the equipment, check that there are no leaks using a gas detector (spray, etc.). **NEVER** use a flame to check for leaks.

Fig.9

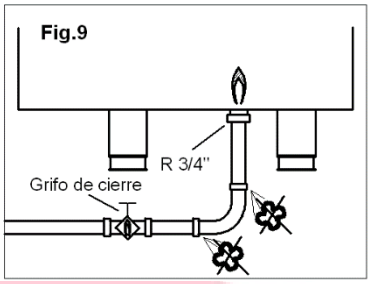
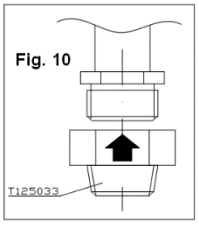


Fig. 10



Please note:

- The gas connection can only be carried out by an approved gas installer.
- It is essential that the gas supply pipes and connections to the corresponding gas meters have the indicated ø.
- Check that the gas connection is hermetic.

11.5. ROOM VENTILATION

This equipment must be installed in such a way that the ventilation conditions are sufficient to avoid the accumulation of unauthorized concentrations of fumes and products released during combustion, which are harmful to health.
We recommend the installation of an exhaust hood for the extraction of fumes and vapours in compliance with the standard **UNE–100165:2004**. The hood should protrude 200-400mm from the front of the equipment.

11.6. EXTRACTION OF COMBUSTION PRODUCTS

Gas appliances can be installed in different ways according to installation requirements.

Incorrect connection can lead to fire hazard

12. WHAT IS COOKING?

Cooking consists in the application of heat to modify the physical-chemical properties and organoleptic characteristics of foods so that they can be properly ingested. Food preparations must be subjected to high temperatures so that the inside of the product exceeds 70 °C in order to destroy and/or deactivate most of the microorganisms present that can harm health. During cooking, there is heat transfer from a hot body to a cold body, which is the food.

13. CHARACTERISTICS OF COOKING

The processes applied when cooking food determine the final result of the cooked product, with favourable or less favourable results. There are two different processes to consider when cooking:

1. **Primary:** of a fundamentally physical nature. This process affects the two transport mechanisms: energy transfer, which results from the heat being applied to the surface of the food spreading to the interior, and mass transfer, as a consequence of the movement of molecules inside the food. In this process, it is important to consider the nature, size and shape of the food, the intensity of the heat source and the application time.
2. **Secondary:** of a physical and chemical nature. The amount of heat a food receives during cooking can produce both physical and chemical changes, which will affect the quality of the food. These changes can be grouped into:

Changes to the physical nature: visible changes that make up the external aspect of the food, which includes its appearance, texture and flavour.

1. **Volume:** changes in volume can be due to different physical phenomena, such as loss of water, loss of fat through melting, increase in volume by rehydration and expansion of gases.
2. **Colour:** changes in colour can be due to a variety of causes, although it basically depends on the nature of the food, its chemical composition and the selected cooking method. For example, changes in pH (pigments in vegetables), caramelisation of sugars, browning of protein structures.
3. **Consistency:** changes in consistency are linked to various phenomena, mainly those associated with effects on proteins and polysaccharides, such as denaturation and coagulation of proteins, gelatinization and dextrinization of starch, softening of plant tissues.
4. **Flavour:** cooking produces chemical transformations that determine changes in the aroma and taste of the food. For this reason, the correct choice of cooking technique makes it possible to achieve a concentration or a dilution of the substances responsible for the taste, depending on the desired result.

Modifications to chemical structures: cooking food can produce changes in its chemical structure, with reactions that vary according to the chemical nature of the substance concerned, especially when they correspond to the substances responsible for its sensory characteristics or nutritional value.

1. **Proteins:** the temperature levels of different cooking methods have different effects on protein molecules. Up to 100 °C, denaturation occurs with loss of solubility and coagulation of proteins, with inactivation of enzymes, improved digestibility, reduction of some toxic power. Between 100 and 140 °C, the Maillard reaction occurs and there is a reduction in digestibility due to the formation of covalent, intra- and intermolecular bridges. At more than 140 °C, the same occurs as in the previous case, with the addition of a loss of nutritional value due to the destruction of amino acids, such as cysteine or tryptophan, with isomerisation to D-form.
2. **Lipids:** heat treatment applied to foods rich in lipids makes them go from a solid or semi-solid state to the melting point, which can vary between foods, as they are made up of different fatty acids. Above this point, glycerol dehydration can occur, reaching the smoke point and decomposition.
3. **Carbohydrates:** In this group of organic substances, what happens with sugars and polysaccharides is different. When heat is applied to sugars in a solid state (sucrose), they melt, change colour and are transformed into caramel at 170 °C, there is a chance of reaching carbonisation if heat is continued to be applied. When the sugar is in solution, a syrup is formed, the consistency of which (determined by the concentration and heat treatment) changes in texture, allowing for a variety of uses in cooking or confectionery.

In the case of polysaccharides, many foods of plant origin are rich in starch, which behaves uniquely when heated in water. From 50 °C it begins to thicken, which leads to gelatinization. This happens at a specific temperature for each type of starch and it can vary depending on other factors such as: agitation or rest of the molecules, the water used, the addition of other substances, whether or not it is combined with other foods. When the cooking medium is dry (not in water), dextrinization occurs, with a change in colour and taste.

14. CLASSIFICATION OF COOKING METHODS

In the heat treatment of food, various methods or types of cooking can be used depending on the heating system used, materials employed, working methods, characteristics of the food and the desired results (texture, colour, etc.).

WET OR AQUEOUS MEDIUM

1. **Blanching**
   Incomplete cooking of a food, which receives the thermal effects of boiling water for a very short period of time (between 10 and 30 seconds). It may be considered a prior operation for the purpose of inactivating enzymes, removing skins or attenuating flavours, for example, in freezing vegetables and fruits.
2. **Boiling**
   Cooking a food by immersion in water or in a broth, which can be started with cold, hot or boiling water.
3. **Steaming**
   At a temperature of 100 °C and 760 mmHg pressure, heating occurs by convection of water vapour at 100 °C. Boiling water is also at 100°C; it has the same temperature but a different amount of heat. The amount of water that comes into contact with the food during steam cooking is minimal and therefore dissolution is limited.
4. **Pressure cooking**
   The difference with steam cooking is that the boiling point of the water can rise above 100°C in a pressure cooker or autoclave, where steam takes the place of the air and the pressure rises rapidly. It is necessary to increase the temperature as the pressure increases so that the water molecules can be transformed into steam.

DRY OR NON-AQUEOUS MEDIUM

5. **Open air**
   Radiant energy heating the air produces the evaporation of water, maintaining the dry character of the food. There are different procedures depending on the relationship between the heat source and the food, including:

6. **Griddle**
   The heat source is at variable distance but it is never far away (about 30 cm) and all parts of the food are at an equal distance from it. Cooking is done by continuous heating.
7. **Grill**
   The heat source is further away and at different distances from the food. The drying action is sustained and slow, without much modification to the surface and the heating is continuous, taking 2 or 3 hours. No crust is formed and the inside is cooked at the same time as the outside.
8. **Rotisserie**
   Heating is discontinuous and, in addition, the layer of fat added to the surface of the food facilitates the formation of a crust. This film of fat prevents or reduces the evaporation of water, making it a very juicy preparation.

9. **Confined air**

   OVEN

   The heat energy produced in an oven is mainly due to radiation and, to a lesser extent, conduction. The heat produces the evaporation of water from the food, which remains in the enclosed area, making the hot air more humid. It is important to take into account the material of the cookware used when oven cooking, as some shiny surfaces prevent the passing of the electromagnetic rays and, in this way, the cooking time is excessively prolonged. The most highly recommended are opaque or dark materials, which allow the passage of radiant energy, reducing cooking time. Glass is also good material to use with radiant energy.

10. **Cooking fats**

    Due to the physical characteristics of cooking fats, heat transfer through this medium is done at very high temperatures, providing a particular texture and taste and favouring the palatability of the food.

11. **Sautéing**

    A method of quickly, partially or completely cooking food, characterized by the use of a low amount of oil at a high temperature.

12. **Frying**

    A method of completely cooking food by immersing it in fat that has been previously heated to a high temperature (about 180 °C) resulting in the quick and even heating of the food.

13. **Hot plate**

    High temperature cooking of the food on a hot cast iron plate, which uses conduction to transfer the heat received from a heat source, usually gas or electric.

14. **Bain Marie**

    This method is used when the food contains large quantities of eggs and flours forming gel-like consistencies, such as flans and puddings. It eliminates the need to beat the mixture continuously and, as the food is not being cooked directly on the heat source, it stops the breaking down or curdling of ingredients that can occur when exposed to excessive heat. Bain Marie cooking is slow, because the heat (temperature between 90°C and 95°C) reaches the food by conduction from the water in the recipient, which must not reach boiling so as to avoid the phenomenon explained above.

15. **Gratin**

    Gratin is a method that uses a high-temperature heat source to brown the top of a product. A product cooked using this technique will have a golden colour on its surface due to the Maillard reaction. Gratin is usually used when the outermost layer of the product consists in grated cheese, breadcrumbs, mashed potatoes, etc.

MIXED COOKING

This method involves the combination of dry and wet cooking mediums and is used for vegetables and particularly meat. The dry medium produces particular modifications such as the drying of the surface and the other benefits of roasting that later influence the taste and colour of the preparation. The liquid is then added, which may be water or broth, and the cooking is completed over a low heat, resulting in tender meat due to the softening of the connective tissues. For example, this method is used for cooking different types of meat, stews and casseroles.

15. ENERGIES USED

Since food cooking processes consist in the application of heat to modify the physical-chemical properties and organoleptic characteristics of food, food preparations must be subjected to high temperatures so that the inside of the food exceeds 70°C. For this, energy is required to fuel the different heating systems of the equipment that will process the food.

The energies used to supply the different heat production systems used in cookery equipment are:

- **Electricity**
- **Gas**
- **Steam**

16. ELECTRICAL HEATING

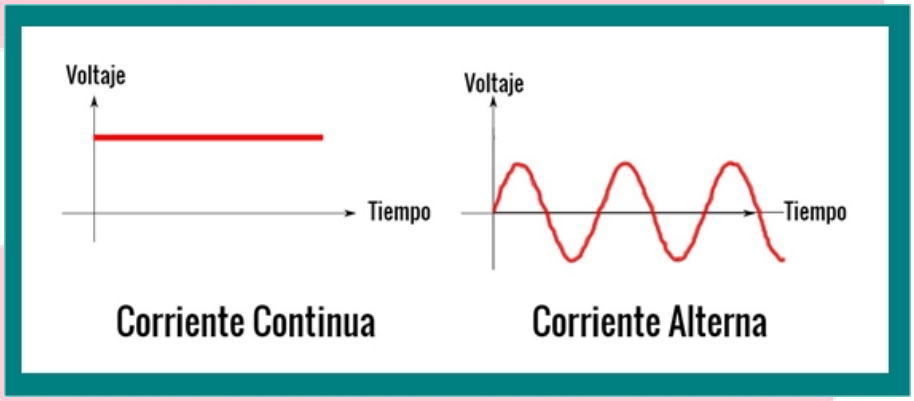
16.1. ELECTRICITY

Electrical energy is a form of energy resulting from the existence of a difference in potential between two points, an electrical current is established between the two when they are brought into contact by means of an electrical conductor. Electrical energy is caused by the movement of electrical charges inside conductive materials. In other words, every time a switch on a lamp is operated, an electrical circuit is closed and the movement of electrons is generated through metal wires, such as copper.
This energy produces 3 effects:

- **Luminous**
- **Thermal**
- **Magnetic**

Electrical energy manifests itself as an electric current, that is, as the movement of negative electrical charges, or electrons, through a metal conductor cable as a result of the difference in potential that a generator is applying at its ends.
Each time an electrical circuit is closed, electron movement is generated through the conductor cable. The moving charges are part of the atoms of the cable substance, which is usually metallic, because metals — with more free electrons than other substances — are the best conductors of electricity. Most of the electrical energy consumed in daily life comes from the electrical network through outlets called plugs, through which the power supplied by electrical companies reaches the various electrical appliances we wish to use, washing machine, radio, television, etc., by means of the corresponding transformations. For example, when electrical energy reaches an appliance, it is transformed into mechanical energy, heat energy and, in some cases, light, thanks to the electric motor and the different mechanical components of the devices.
There are two types of currents in an electrical circuit which are based on the movement of the charges.

- **Direct current** Electrical charges move in a linear fashion through the electrical conductor.
- **Alternating current** Electrons vibrate, generating ripples.



16.2. DIRECT CURRENT

Direct current is produced by batteries, cells and dynamos. A constant voltage is generated between the ends (terminals) of any of these electrical generators, which does not vary over time. Furthermore, the current that circulates when a receiver is connected to the generator terminals is always the same and always moves in the same direction, from the + to the - pole.
The direction of the electrical current is considered to be from + to -, but the direction of the movement of the electrons is actually from - to +.

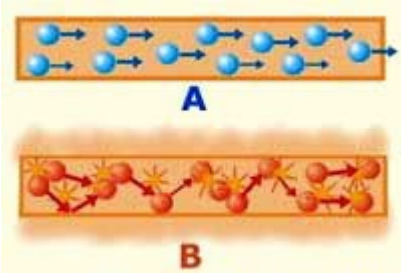
16.3. ALTERNATING CURRENT

This type of current is produced by alternators (alternating current generators) and it is what is generated in power plants.
Alternating current is the easiest to generate and transport, which is why it is the most common and the one we use in the sockets in our homes.
To produce this type of current, the alternator turns its rotor (shaft) 50 times every second. Thanks to electromagnetism and electromagnetic induction, the rotation of the alternator produces a wave of sinusoidal current and voltage.
This speed of rotation of the alternator is constant, so we can say that the alternators have a frequency of 50 Hertz (Hz), or the equivalent of 50 rotations per second. In America it is 60Hz.

16.4. HEATING ELEMENTS

Heating elements are used for heating electrical cooking equipment.

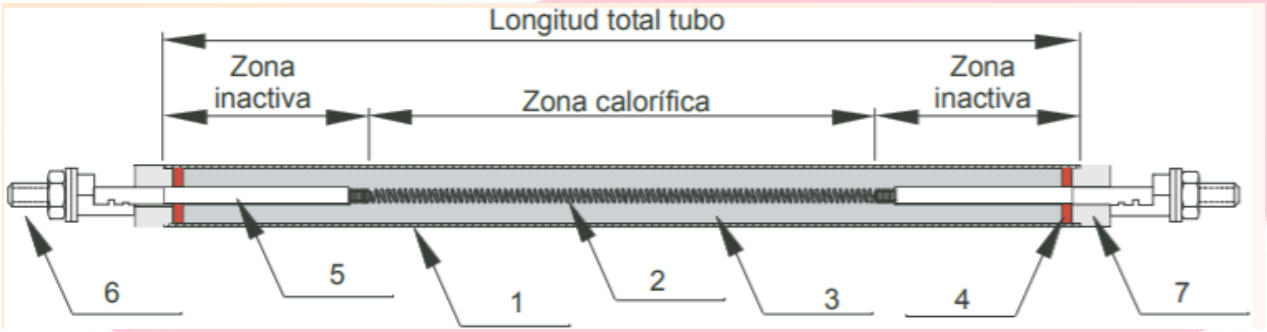
Electrical resistors are devices that transform electricity into heat. A heating element is an electrical resistor intended for heat production. Its operation is based on the Joule effect. Electrical heating elements can heat by convection, conduction or radiation.
Electrical resistance is the opposition to the flow of electrical current through a conductor. The unit of resistance in the International System is the ohm, which is represented by the Greek letter omega (Ω), in honour of the German physicist Georg Simon Ohm, who discovered the principle that now bears his name.



A - Electrons flowing through a good electrical conductor, which offers low resistance.
B - Electrons flowing through a bad electrical conductor, which offers high resistance. In this case, electrons collide with each other because they cannot circulate freely and, as a result, generate heat.

16.4.1. PARTS OF A HEATING ELEMENT

A heating element consists of:



- Tubular sleeve
  Varies depending on the material to be heated and the temperature of use.
- Resistive spiral
  Resistive wire of nickel chrome alloys or other materials. Varies according to the type of work for which it is intended. The resistive spiral can be made of one, two or three wires.
- Granular insulation
  Electro-fused magnesium oxide with the characteristics appropriate to the thermal class
- Seal
  Protects against the ingress of moisture into the interior of the resistor. There are five types of seal depending on the thermal class:
  - Airtight seal
  - Extra airtight seal
  - Extra airtight high temperature seal
  - Porous seal
  - Porous high temperature seal
- Termination
  Usually in nickel-plated steel, stainless steel or steel

- Connection terminal
  There are different types of terminals
  - Faston
  - Threaded rod
  - Welded cable
- Isolating terminal
  Ceramic or thermoplastic cable glands to ensure dielectric insulation between the outlet and the tubular sleeve

16.4.2. TYPES OF HEATING ELEMENTS

There are different types of resistors for heating air, liquids or solids, these include:

1. Immersion heater: Used for heating liquids in tanks

The most efficient heat transfer is achieved by locating the resistor at the bottom of the tank using a threaded union, a flange and fittings.
It is essential to include a control system that ensures that the element will always be submerged, such as electrodes and level control.
To control the temperature, it is recommended to use a thermocouple in contact with the liquid, in the upper part of the tank.

2. Flat heating element

Used to heat flat surfaces.
They are made from resistance wire wound on a mica sheet
They may have a stainless steel sheath.
To ensure the correct functioning of a flat heating element, a good fit across the whole area should be ensured, there should also be thermal insulation on one side and a temperature control system.

3. High-density heating element

Tubular resistors with cable outlets at one end only.
They are used to heat jaws and moulds in packaging and polymer processing machines.
Because the temperature must be maintained in each cycle of the process, the resistors must have sufficient power, a good fit in the mould and a temperature control.
When installing high-density elements, the expansion that will occur during its operation must be considered. The recommendation is to leave a maximum of 2 microns difference in diameter with respect to the hole.

4. Forced air heater

These are tubular heaters with heat sinks or fins, to increase the area of temperature dissipation in applications such as air conditioning, drying systems, dehydrator cabinets, etc.
Generally, panels of heaters are constructed to facilitate installation in the duct and to protect the connections.
They are heated by single-pass or recirculated air.
The control system must include circuit protection and a sensor that ensures the panel is disconnected if the air flow is reduced or stopped. This may be a flow or temperature sensor.

5. Heating element for refrigeration systems

Tubular heating elements for refrigeration systems are installed in the evaporator to prevent freezing.
They have vulcanised tips and cable outlets to achieve hermeticity in the connection terminals.
The power is relatively low because a maximum temperature of 60ºC is required on the surface of the pipe.

6. Band heater

These are elements for heating cylindrical surfaces in industrial processes.

7. Trace heating cable

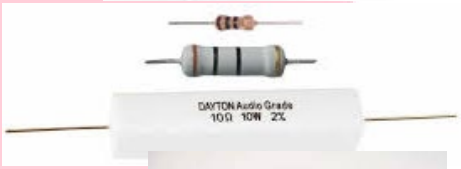
In many industrial processes we must heat the pipe externally to help maintain the temperature of the fluid inside the pipe.
Some applications of pipe heating include:
Avoid freezing in cold room drains.
Maintain the temperature of the oil flow in a food production line.
Avoid condensation of steam in the pipes connecting boilers to production machines.
Facilitate the transportation of crude oil through pipework.
Heat a plastic container or tank without affecting its integrity.

8. Infrared heating element

The main advantage of infrared heating elements is their high efficiency in heat transfer, as they combine conduction and radiation.
They also respond quickly to temperature control, which contributes to a controlled heating.

9. Power resistors

For applications where we need to dissipate large amounts of power.



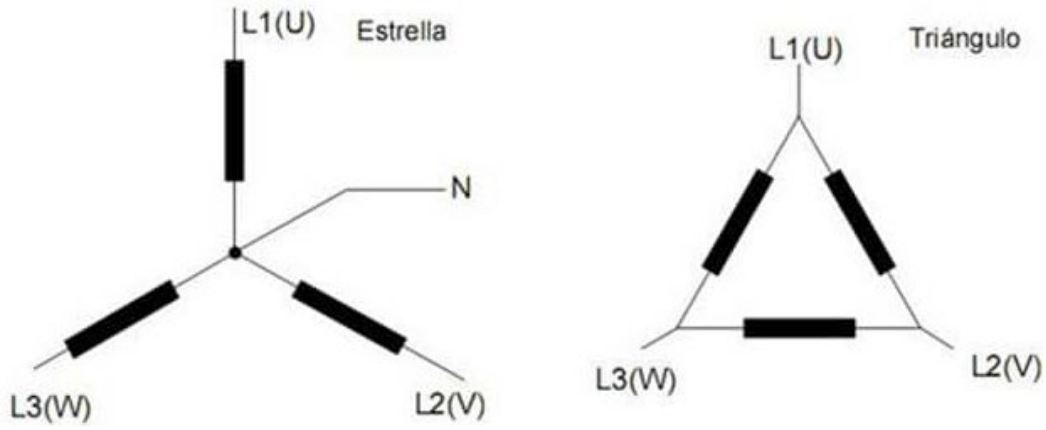
10. Furnace or muffle heating element

Furnaces that require temperatures between 700ºC and 1000ºC can be heated in two ways:
Open coil: The resistive wire is installed in a ceramic base. The electrical specifications of the furnace and the dimensions of the supports must be taken into account.
The maximum temperature for this type of element is 1200ºC.
Embedded in refractory cement: The resistive wire is embedded to optimize the temperature concentration and protect it from thermal shock.
The maximum temperature for this type of element is 1000ºC.

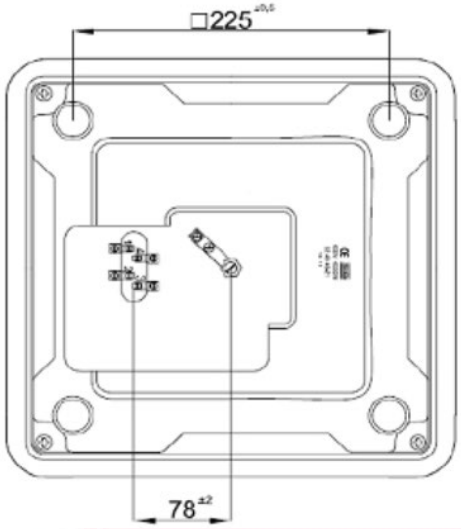
16.4.3. CONNECTION OF HEATING ELEMENTS

When connecting electrical heating elements, we must take into account the available electrical voltage and the electrical voltage required by the heating element.
The possible connections are:

- Star
- Delta

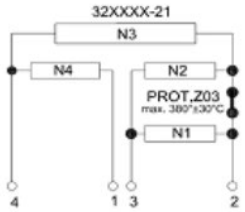


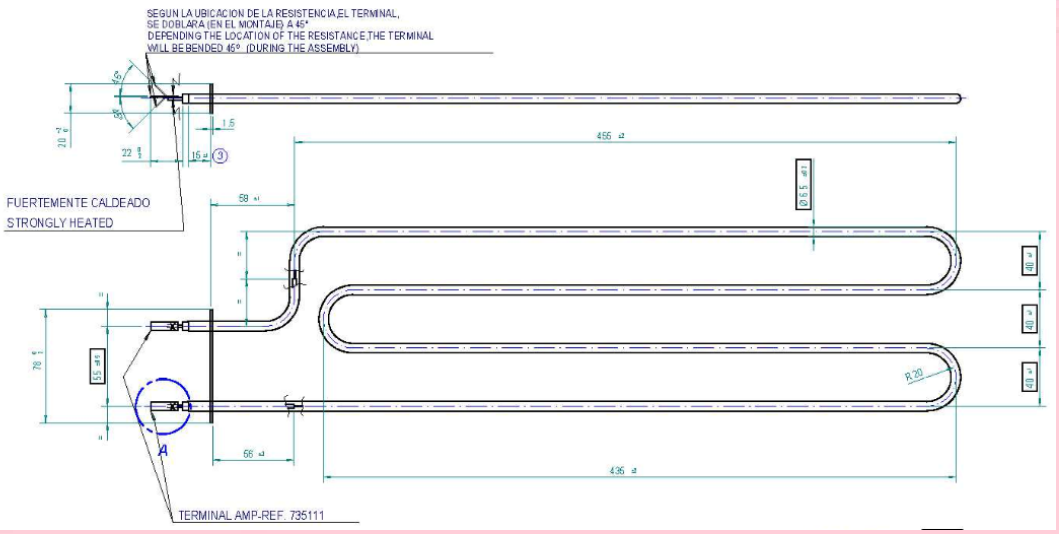
Star connections are used when a 380 V (3P+N+E) power supply is available.
Delta connections are used when a 220 V (3P+E) power supply is available.
Special 440 V resistors are used for boat voltages when a 440 V (3P+E) power supply is available.



POTENCIA (W) POR POSICION						
POSICION	1	2	3	4	5	6
POTENCIA	430	600	1000	1500	2500	4000

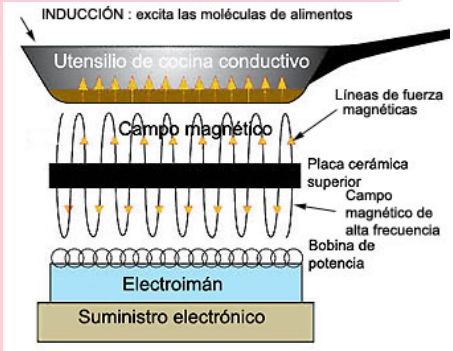
N1	500W
N2	1000W
N3	1000W
N4	1500W





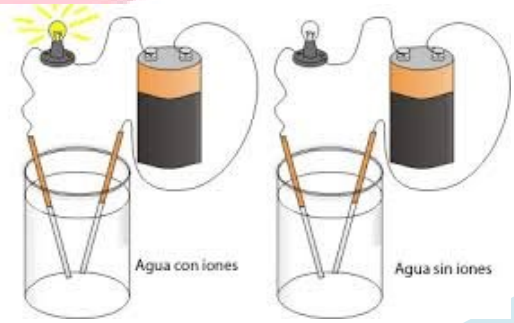
16.5. INDUCTION

An induction cooker is a type of glass-ceramic cooker that directly heats the recipient by means of an electromagnetic field instead of heating by means of heat produced by resistors. These cookers use an alternating magnetic field that magnetizes the ferromagnetic material of the container in alternating directions. This process results in the loss of very little energy. The material is magnetically agitated, the absorbed energy is released as heat and that heats the recipient. The recipients must contain a ferromagnetic material, at least in their base, so aluminium, terracotta, ceramic, glass or copper pans cannot be used with this type of cooker.

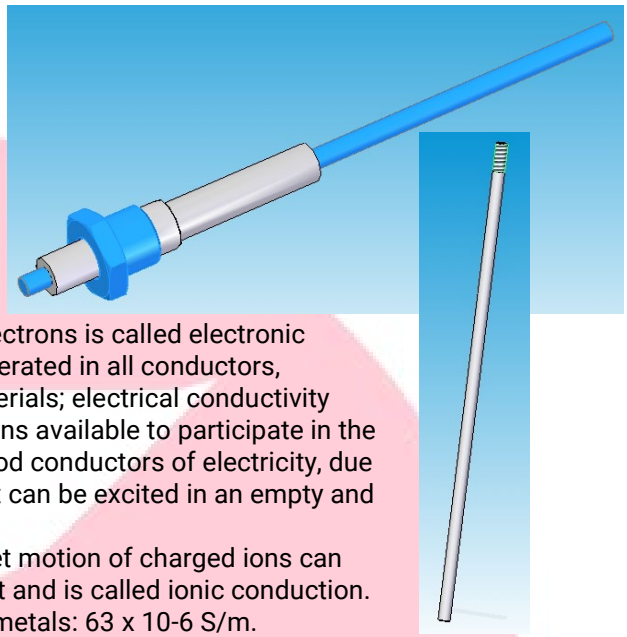


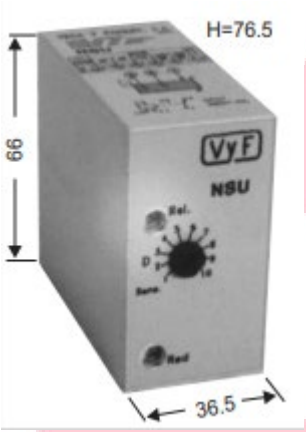
16.6. WATER LEVEL CONTROL

A system based on the principle of water conductivity is used to control the water level in the tank.
Conductivity is the measurement of the water's ability to conduct an electrical current. This measure is related to the concentration of ions in the water, their concentrations, mobility and valence, as well as the temperature in which the liquid medium is found.



Ions come from dissolved salts and inorganic matter (alkalis, carbonates, chlorides and sulphides). The dissolved compounds in the water are then transformed into ions that can also be referred to as electrolytes. The higher the concentration of electrolytes in the water, the higher its conductivity (or electrolytic conductivity). Some of the electrolytes that can be found in water are: Ca2+, Mg2+, Na+, K+, HCO3−, SO42-.
Ions conduct electricity due to their positive and negative charges (cations and anions). Regardless of the amount of anions and cations in the water, the electrical conductivity always remains neutral.
The conductivity of a substance is defined as "the ability or power to conduct or transmit heat, electricity or sound". The units are Siemens per meter [S/m] in the International System of Units.

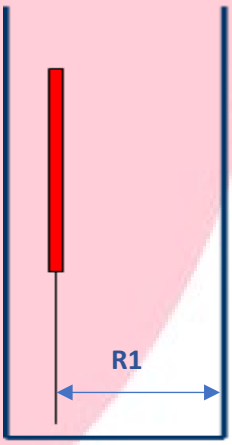




An electrical current results from the motion of electrically charged particles in response to forces that act on them from an applied electric field. Within most solids there is a flow of electrons that causes a current, and this flow of electrons is called electronic conduction. Electronic conduction is generated in all conductors, semiconductors and most insulated materials; electrical conductivity depends largely on the number of electrons available to participate in the conduction process. Most metals are good conductors of electricity, due to the large number of free electrons that can be excited in an empty and available energy state.
In water and ionic materials or fluids a net motion of charged ions can occur. This produces an electrical current and is called ionic conduction. Silver has the highest conductivity of all metals: 63 x 10-6 S/m.
Pure water is not a good conductor of electricity. Ordinary distilled water in equilibrium with carbon dioxide of the air has a conductivity of about 10 x 10-6 W-1*m-1 (20 dS/m). Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases. Therefore, the more ionic compounds dissolved in water, the more conductivity it has.

Conductivity of different water types:

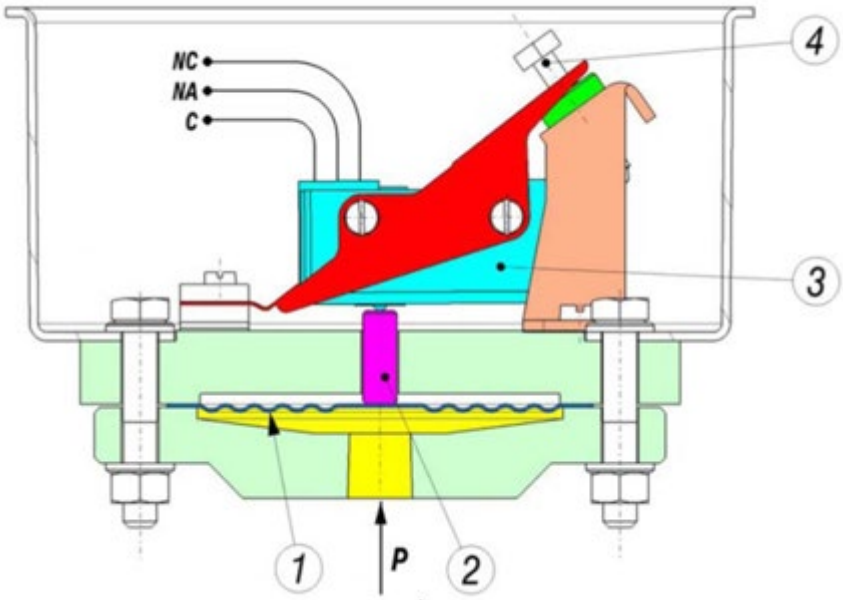
- Pure water: 0.055 µS/cm
- Distilled water: 0.5 µS/cm
- Spring water: 1.0 µS/cm
- Domestic water: 500 to 800 µS/cm
- Max. for potable water: 10.055 µS/cm
- Sea water: 52 mS/cm



- When the water level is not touching the dipstick, it opens the water inlet and the heating stops
R1 >= 40 KH
- When the water level touches the dipstick, it stops the water flow and activates the heating
R1=< 20 KH

16.7. STEAM PRESSURE CONTROL (PRESSURE SWITCH)

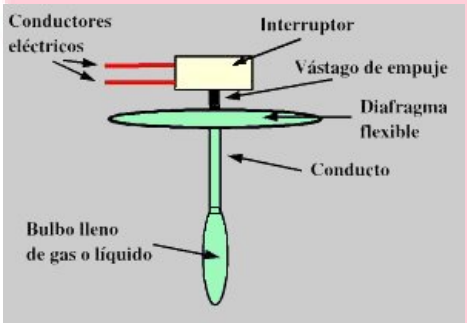
The pressure of the steam in Bain Marie boiling pans is regulated by the pressure switch.
A pressure switch is a device that opens or closes an electrical circuit depending on the pressure reading of a fluid. It is also known as a pressure switch.
The fluid exerts pressure on an internal piston causing it to move until two contacts are joined. When the pressure drops, a spring pushes the piston in the opposite direction and the contacts separate.
Pressure switches are generally mechanical instruments. It is adjusted by means of a screw or a small cam, which increases the pressure it exerts on a central spring and, in turn, on the contact or contacts. When the system pressure exceeds that of the spring, the contacts change position and, conversely, when the system pressure drops and the spring pressure is higher, the contacts change again. With this manoeuvre, the contacts open or close and allow the central control of the compressor or the corresponding compressed air equipment to carry out the function for which it was designed.

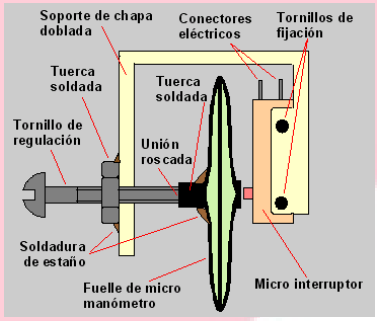


P – Pressure outlet
1 – Membrane
2 – Push rod
3 – Contact box
4 – Regulator
C – Common contact
NA – Normally Open Contact
NC – Normally Closed Contact

16.8. TEMPERATURE CONTROL (THERMOSTAT)

Temperature control is performed by a thermostat.
A thermostat is the component of a simple control system that opens or closes an electrical circuit depending on the temperature.



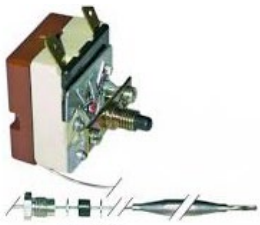


16.8.1. TYPES OF THERMOSTAT

BIMETALLIC

Automatically controlled bimetallic thermostat.
This thermostat consists of two sheets of metal bonded together, with a different coefficient of thermal expansion. When the temperature changes, the sheet changes shape, acting on contacts that close an electrical circuit.

They can be normally open or normally closed, changing their state when the temperature reaches the defined level.



MANUAL

These thermostats require human intervention to return to their initial state, such as safety thermostats that act when temperatures reach dangerous levels.

AUTOMATIC

These thermostats return to their initial state without the need for human intervention. They work automatically, hence their current application in most households.

GAS BELLOWS

This thermostat consists of a gas enclosed in a copper tube. When the temperature rises, the gas expands and pushes the valve, which performs a certain function. It can be regulated by changing the volume of the tube.

WAX

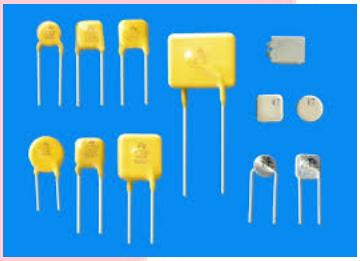
Used in fluid control valves, they contain encapsulated paraffin that expands as the temperature increases, which in turn pushes a disc that allows fluid to pass through. When the temperature of the fluid decreases, a spring returns the disc to its initial position, stopping the flow. For example, this type of thermostat is used in the cooling system of internal combustion engines.

ELECTRONIC

Electronic thermostats are becoming more common because of the advantages they offer.
They can be free of moving parts and contacts that are subject to wear and tear.
It is possible to configure a temperature as well as a threshold or a minimum time between activations.
They can be easily integrated as a time programmer in a system with additional functions.

With a PID controller you can make management smarter.
An electronic thermostat can improve the applications in which mechanical thermostats are used.

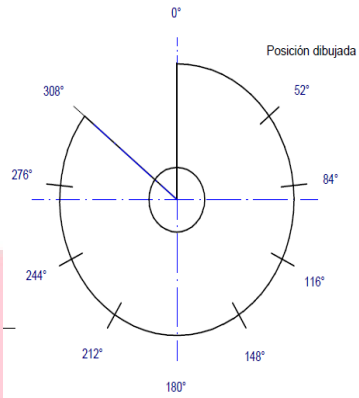
NTC THERMISTOR



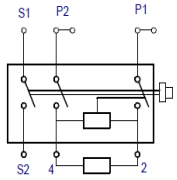
These types of thermostats are built around a thermistor. A thermistor is a device that changes its resistance depending on the temperature.
The resistance of a thermistor is read by a control system, usually based on a microcontroller, which is programmed to perform different operations at certain temperatures.
There are many variants of electronic thermostats, but most of the time, the actual temperature reading component is a thermistor. There are older versions in which gas thermostats were used. In general, any device that allows electronic temperature measurement can be integrated into a thermostat. For example, platinum resistors, semiconductor temperature sensors, etc.

16.9. ENERGY REGULATOR

Energy regulators control temperature by periodically switching the power between ON/OFF for different lengths of time. At the highest level, the output is continuous. Energy regulators are installed just behind the control knob.
Energy regulators consist of a bimetal connection and a snap-action switch, i.e. a spring switch, with one contact.
When the heating element is switched on, the bimetal band heats up, allowing the current to flow parallel to the heating element in the cooking zone. This heats the bi-metallic band that changes its shape causing the corresponding contact.
When the position of the control knob changes, the distance between the bimetallic strip and the regulator contact changes by means of a cam plate. The energy regulator allows current to flow at shorter or longer intervals depending on this distance.



POSICION	% ±2%	P1 - 2 TON	P1 - 2 TON+TOF	P2-4	S1-S2
o	o	O	↻		
52°	6%	3"	45"	X	X
84°	10%	4"	38"	X	X
116°	15%	5"	32"	X	X
148°	25%	7"	29"	X	X
180°	30%	9"	30"	X	X
212°	40%	13"	32"	X	X
244°	55%	21"	37"	X	X
276°	75%	45"	60"	X	X
308°	100%	↻	↻	X	X



Temperatura amb.max. 125°C

Rango de trabajo 52-308° sentido agujas del reloj

Salida variable 6 70% ←

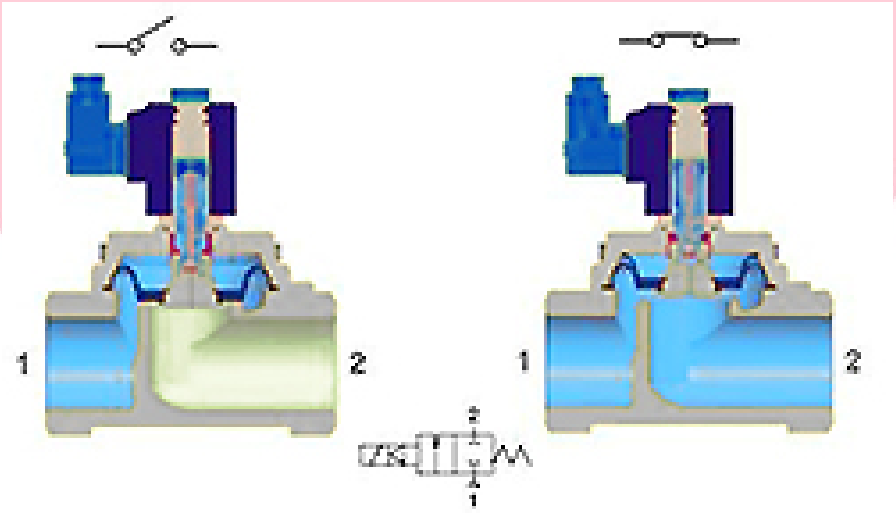
Desviación max. ±3° ◁

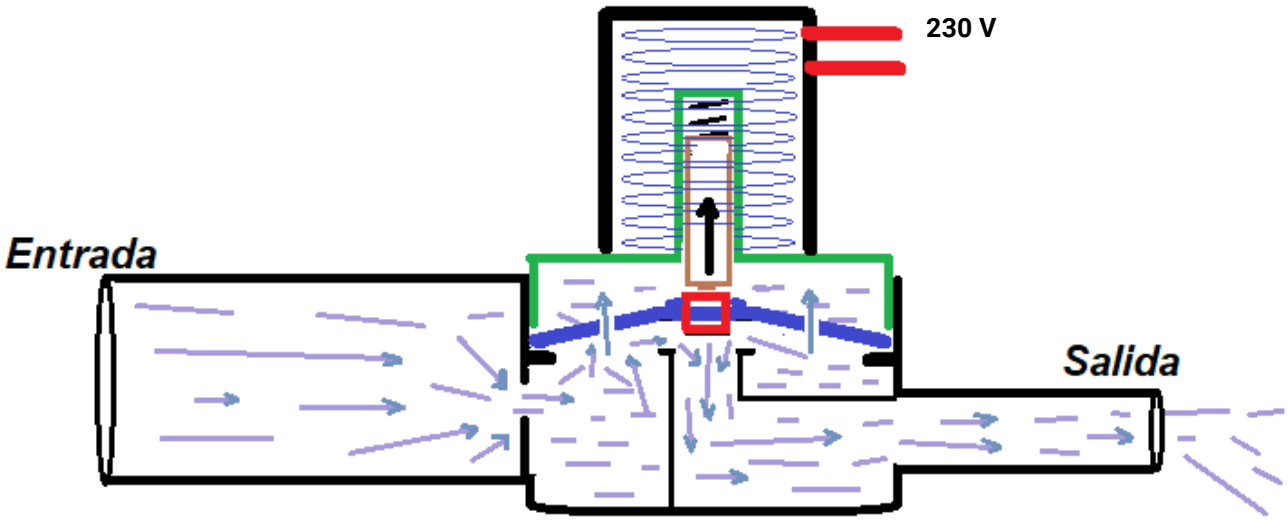
CONTACTOS
CAPACIDAD
P1-2 7/400 13/240 TEST CLASE II MICRO GAP
P2-4 7/400 13/240 3mm >
S1-S2 0,6/400 - -

16.10. WATER SOLENOID VALVE

A solenoid valve is an electromechanical valve, designed to control the passage of a fluid through a duct or pipe. The valve is actioned by a solenoid coil. It generally has only two positions: open and closed, all or nothing. Solenoid valves are used in many applications to control the flow of all types of fluids.

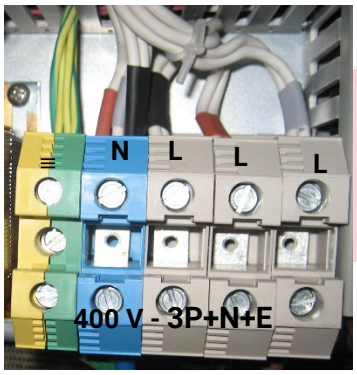
A solenoid valve has two main parts: the solenoid and the valve. The solenoid converts electrical energy, through magnetism, into mechanical energy to drive the valve.

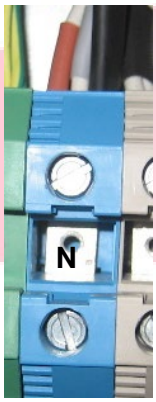


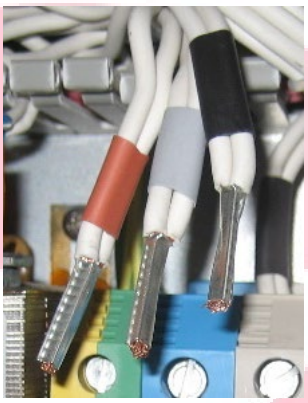

230 V
Entrada
Salida

17. ELECTRIC POWER CONVERSION

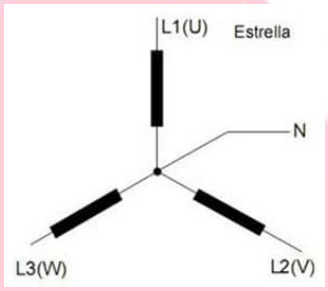
Electrical heating equipment is normally connected to 380 V (3P+N+E). Although the equipment can operate at different voltages, such as 220 V (3P+E) or 230 V (P+E), the latter is not recommended for equipment with significant electrical consumption since the total power will overload a single phase. The power cable and protections in the electrical box should therefore be sized to the appropriate calibre for the electrical connection. Power conversion consists in changing the connection from Star to Delta.

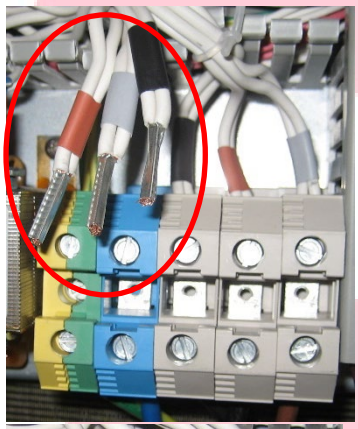




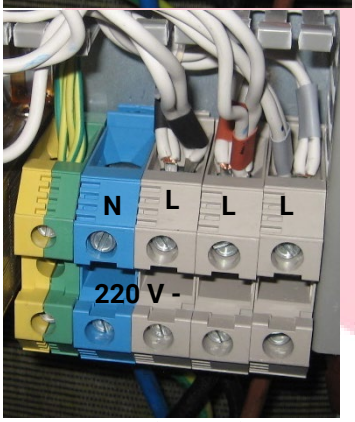


- In order to convert the power supply to the equipment, the three groups of cables (black, brown and grey) must be released from the Neutral (N) strip.

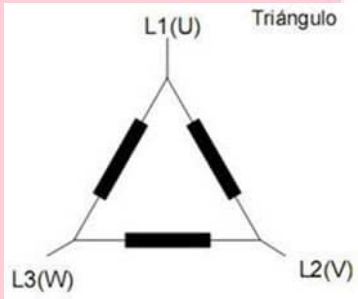




- After disconnecting the three groups of cables from the Neutral (N) strip, distribute the three groups of cables across the L1, L2 and L3 strips by matching the colours black, brown and grey (black-black, brown-brown, grey-grey).



- After the conversion, the Neutral (N) strip is unused and the Earth strip (E) remains as it was.



For a 230 V (P+N+E) connection, connect all cables from the L1, L2 and L3 strips to a single strip. The Neutral (N) and Earth (E) connection remain as they were.

18. GAS HEATING

18.1. GAS

In order to be useful as an energy in cooking equipment, the gas must be ignited in the different burning systems. For this it requires oxygen O^2.

Composition of the air: 20.95% O^2 + 79.05% N^2
The main gases used by cooking equipment are:

- Town Gas (G110 = 26% CH^4 + 50% H^2 + 24% N^2)
- Natural Gas (G20 = CH^4)
- Butane (G30 = C^4H^{10})
- Propane (G31 = C^3H^8)

Town Gas

Town gas is produced during the distillation of oil, and it is primarily made up of hydrogen and hydrocarbons. It is also known as an illuminating gas because it burns very brightly.
Natural gas and town gas are different in their composition and use. Natural gas is a mixture of gases, mostly methane, and is found in underground pockets, attached to oil pockets.
Another difference is the calorific value; natural gas has a much higher calorific value than town gas, about 40% higher. In addition, the cost of obtaining natural gas is much lower than that of town gas.
Town gas was the technology used before the discovery of natural gas, that is why it is often confused with natural gas.

Natural Gas

Natural Gas is a hydrocarbon mixture of light gases of natural origin. Natural Gas comes from the degradation of organic matter from plants and animals that occurs over millions of years. This organic matter has accumulated and been buried under successive layers of earth as a result of different geological phenomena.
The gases generated by the decomposition of organic matter filtered through different layers of soil until they reached an area of impermeable material where they became trapped in large reservoirs or natural gas deposits.
The fundamental component of natural gas, methane, normally includes variable amounts of other alkanes and sometimes a small percentage of carbon dioxide, nitrogen, hydrogen sulphide or helium. It forms when various layers of decaying plant and animal matter are exposed to intense heat and pressure below the Earth's surface over millions of years. The energy that plants initially obtain from the sun is stored as chemical bonds in the gas. It is an important source of fossil energy that is released by combustion. It is extracted either from independent wells (non-associated gas), or together with oil or coal deposits (gas associated with other hydrocarbons and gases). It can also be produced by the bacterial fermentation of organic matter from wastewater, urban solid waste, compost and biomass, and is the basis for obtaining biomethane.
Natural gas deposits can be found on top of oil wells or in independent reserves isolated from other raw materials.

Butane/Propane

Propane and Butane, also called LPG (liquefied petroleum gases), are present in crude oil and natural gas, although a part is obtained during the oil refining process, mainly as a by-product of fractional catalytic distillation.

18.2. CATEGORIES, GASES AND OPERATING PRESSURES

The different gases and pressures for appliances are regulated by the standard UNE-EN 437.

COUNTRY	CATEGORY	PRESSURE (mbar)
AT	$II_{2H3B/P}$	20*50
AL - BG - DK - EE - FI - HR - LT - LV - MK - NO - RO - SE	$II_{2H3B/P}$	20*30
BE - FR	II_{2E+3+}	20/25*28-30/37
CH - CY - CZ - ES - GB - GR - IE - IT - PT - SI - SK - TR	II_{2H3+}	20*28-30/37
DE - LU	$II_{2E3B/P}$	20*50
PL	II_{2E3P}	20*37
HU - IS - MT - NL	$I_{3B/P}$	30

{A1►} Tabla 2 – Características de los gases de ensayo[a] de la primera y de la segunda familia, gas seco a 15 °C y 1 013,25 mbar

Familia y grupos de gas	Gases de ensayo	Denominación	Composición en volumen % [c]	W_i MJ/m³	H_i MJ/m³	W_s MJ/m³	H_s MJ/m³	d
Gases de la primera familia[b]								
Grupo [a]	Gas de referencia Gas límite de combustión incompleta, de desprendimiento de llama y de depósito de hollín	G 110	CH_4 = 26 H_2 = 50 N_2 = 24	21,76	13,95	24,75	15,87	0,411
	Gas límite de retroceso de llama	G 112	CH_4 = 17 H_2 = 59 N_2 = 24	19,48	11,81	22,36	13,56	0,367
Gases de la segunda familia[b]								
Grupo H	Gas de referencia	G 20	CH_4 = 100	45,67	34,02	50,72	37,78	0,555
	Gas límite de combustión incompleta y de depósito de hollín	G 21	CH_4 = 87 C_3H_8 = 13	49,60	41,01	54,76	45,28	0,684
	Gas límite de retroceso de llama	G 222	CH_4 = 77 H_2 = 23	42,87	28,53	47,87	31,86	0,443
	Gas límite de desprendimiento de llama	G 23	CH_4 = 92,5 N_2 = 7,5	41,11	31,46	45,66	34,95	0,586
	Gas límite de sobrecalentamiento[d]	G 24	CH_4 = 68 C_3H_8 = 12 H_2 = 20	47,01	35,70	52,09	39,55	0,577
Grupo L	Gas de referencia y gas límite de retroceso de llama	G 25	CH_4 = 86 N_2 = 14	37,38	29,25	41,52	32,49	0,612
	Gas límite de combustión incompleta y de depósito de hollín	G 26	CH_4 = 80 C_3H_8 = 7 N_2 = 13	40,52	33,36	44,83	36,91	0,678
	Gas límite de desprendimiento de llama	G 27	CH_4 = 82 N_2 = 18	35,17	27,89	39,06	30,98	0,629
Grupo E	Gas de referencia	G 20	CH_4 = 100	45,67	34,02	50,72	37,78	0,555
	Gas límite de combustión incompleta y de depósito de hollín	G 21	CH_4 = 87 C_3H_8 = 13	49,60	41,01	54,76	45,28	0,684
	Gas límite de retroceso de llama	G 222	CH_4 = 77 H_2 = 23	42,87	28,53	47,87	31,86	0,443
	Gas límite de desprendimiento de llama	G 231	CH_4 = 85 N_2 = 15	36,82	28,91	40,90	32,11	0,617
	Gas límite de sobrecalentamiento[d]	G 24	CH_4 = 68 C_3H_8 = 12 H_2 = 20	47,01	35,70	52,09	39,55	0,577

[a] Para los gases distribuidos nacional o localmente, véase el capítulo B.5.

[b] Para los otros grupos véase el capítulo B.5.

[c] Véase también el anexo A.

[d] Gas límite utilizado únicamente para determinados tipos de aparatos, especificado en las normas del aparato individuales.

{◄A1}

{A1►} *texto eliminado* {◄A1}

{A1►} Tabla 3 – Características de los gases de ensayo[a] de la tercera familia, gas seco a 15 °C y 1 013,25 mbar

Familia y grupo de gas	Gases de ensayo	Denominación	Composición en volumen % [d]	W_i MJ/m³	H_i MJ/m³	H_i MJ/kg	W_s MJ/m³	H_s MJ/m³	H_s MJ/kg	d
Gases de la tercera familia[b]										
Tercera familia y Grupos B/P	Gas de referencia Gas límite de combustión incompleta y de depósito de hollín	G 30	n-C_4H_{10} = 50 i- C_4H_{10} = 50	80,58	116,09	45,65	87,33	125,81	49,47	2,075
	Gas límite de desprendimiento de llama	G 31	C_3H_8 = 100	70,69	88,00	46,34	76,84	95,65	50,37	1,550
y B	Gas límite de retroceso de llama	G 32	C_3H_6 = 100	68,14	82,78	45,77	72,86	88,52	48,94	1,476
Grupo P	Gas de referencia, gas límite de combustión incompleta, de desprendimiento de llama y gas de depósito de hollín[c]	G 31	C_3H_8 = 100	70,69	88,00	46,34	76,84	95,65	50,37	1,550
	Gas límite de retroceso de llama y de depósito de hollín[c]	G 32	C_3H_6 = 100	68,14	82,78	45,77	72,86	88,52	48,94	1,476

[a] Para los gases distribuidos nacional o localmente, véase el capítulo B.5.

[b] Para los otros grupos véase el capítulo B.5.

[c] Las normas de aparatos pueden establecer un único gas límite de depósito de hollín.

[d] Véase también el anexo A.

{◄A1}

{A1►} NOTA Las características de los gases de la segunda familia en condiciones de referencia distintas de 15 °C para el caudal y 15 °C para la combustión se pueden calcular con ayuda de los coeficientes indicados en el anexo A (Normativo) de la Norma EN ISO 13443:2005. A título de ejemplo, en la tabla 4 se incluyen las características de los gases de referencia de la segunda familia a 0 °C para el caudal y para la combustión y 1 013,25 mbar (gas seco). {◄A1}

{A1►} Tabla 4 {◄A1}– Características de los gases de referencia de la segunda familia a 0 °C y 1 013,25 mbar

Grupos de gas	Gases de ensayo	Denominación	Composición en volumen %	W_i MJ/m³	H_i MJ/m³	W_s MJ/m³	H_s MJ/m³	d
Grupo H	Referencia	G 20	CH_4 = 100	48,20	35,90	53,61	39,94	0,555
Grupo L	Referencia y límite de retroceso de llama	G 25	CH_4 = 86 N_2 = 14	39,45	30,87	43,88	34,34	0,613
Grupo E	Referencia	G 20	CH_4 = 100	48,20	35,90	53,61	39,94	0,555

{A1►} Tabla 5 {◄A1} – Presiones de ensayo cuando no existe par de presión[a]

Presiones en milibar (mbar)

Categoría de los aparatos con subíndice	Gases de ensayo	p_n	$p_{mín.}$	$p_{máx.}$
Primera familia: 1a	G 110, G 112	8	6	15
Segunda familia: 2H	G 20, G 21, G 222, G 23	20	17	25
Segunda familia: 2L	G 25, G 26, G 27	25	20	30
Segunda familia: 2E	G 20, G 21, G 222, G 231	20	17	25
Segunda familia: 2N[d]	G 20, G 21, G 222, G 231, G 25, G 26, G 27[a]	20	17	30
	G 25, G 26, G 27	25	20	30
Tercera familia: 3B/P	G 30, G 31, G 32	29[b]	25	35
	G 30, G 31, G 32	50	42,5	57,5
{A1►} Tercera familia, 3P	G 31, G 32	30	25	35 {◄A1}
Tercera familia: 3P	G 31, G 32	37	25	45
	G 31, G 32	50	42,5	57,5
Tercera familia: 3B[c]	G 30, G 31, G 32	29	20	35

[a] Para las presiones correspondientes a los gases distribuidos nacional, o localmente, véase tabla B.5.

[b] Los aparatos de esta categoría pueden utilizarse sin ajuste a las presiones de alimentación indicadas de 28 mbar a 30 mbar.

[c] Los ensayos con los gases G 31 y G 32 se efectúan únicamente a la presión normal de ensayos (p_n = 29 mbar), teniendo en cuenta que estos gases son más restringidos que todos los gases distribuidos. Esta condición cubre las variaciones normales de alimentación de gas.

[d] Véase la definición en el apartado 6.1.2.2.

18.3. FLOW, PRESSURE AND VOLUME

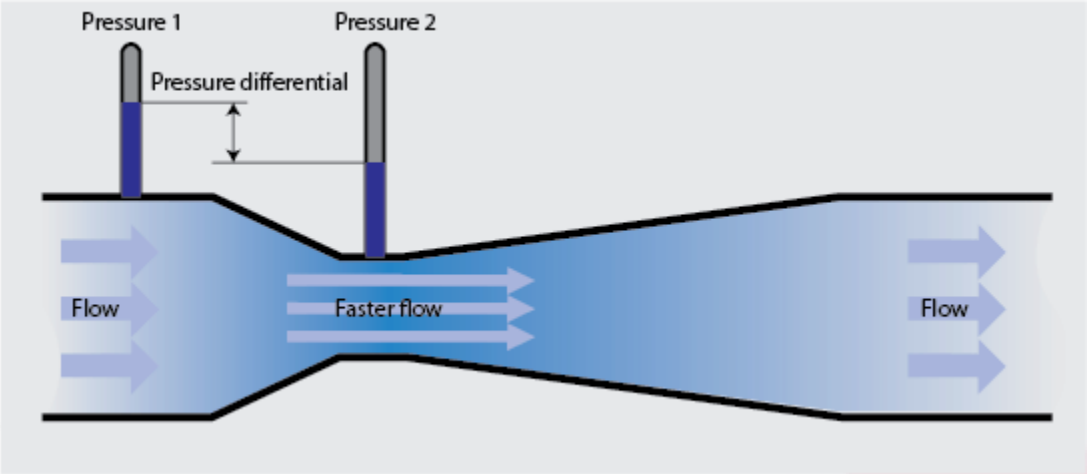
Flow Rate is the amount of fluid that circulates through a duct (plumbing, piping, oil pipelines, rivers, channels, etc.) per unit of time. It is usually identified with the volumetric flow rate or the volume of fluid that passes per unit time. Less frequently, it is identified with the mass flow rate or the mass of a substance that passes per unit of time.
Q=Av (A=area x v=velocity)

Pressure (symbol: p or P) is the force applied perpendicular to the surface of an object per unit area over which that force is distributed.
In the International System of Units, pressure is measured in a derived unit called pascal (Pa), which is equivalent to a total force of one newton (N) acting uniformly over an area of one square meter (m^2). In the English system, pressure is measured in pound per square inch (psi), which is equivalent to a total force of one pound acting over an area of one square inch.
P=F/A (F= force / A= area)

Volume is the measure of the three-dimensional space that a substance occupies or contains. It is a measurement derived from length, for example, to find the volume of a cuboid you multiply the three sides: the length, width and height. Mathematically, volume can not only be defined for any Euclidean space, but also for any other type of metric space, including, for example, Riemann varieties.
From a physical point of view, material bodies occupy a volume because they are extensive, a phenomenon that is due to Pauli's exclusion principle. The notion of volume is more complicated than that of surface and in its formal use can give rise to the so-called Banach-Tarski paradox.

The unit of measure for volume in the International System of Units is the cubic metre. In the metric system, the unit of volume was the stere, equal to one cubic meter, but it is now infrequently used. The same system created

the litre to measure the volume of liquids, which is accepted by the SI. For historical reasons, there are separate units for each, however they are related by the equivalence between the litre and the cubic decimetre:
1 dm3 = 1 litre = 0.001 m3 = 1000 cm3.



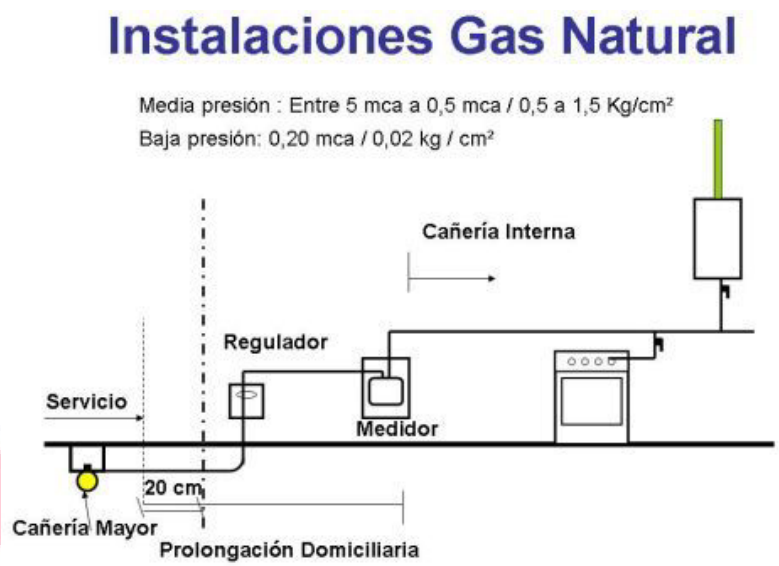
$V=\pi r^2 h$
(π=3.1416 x r^2=tube radius^2 x h = tube height/length)

18.4. GAS INSTALLATION

The materials and methods to be used to construct the receiving facilities and/or connection to gas appliances must comply with the applicable UNE standards. However, the standards accepted in the other EEC Member States will be accepted, provided that they guarantee safety levels equivalent to those required by the corresponding UNE standards.
Where there is a Directive, the installation should comply with that.
Depending on the maximum operating pressure, gas reception facilities will be classified as follows:

- Low pressure (LP): up to 0.05 bar (500 mm water column)
- Medium pressure A (MPA): up to 0.4 bar
- Medium pressure B (MPB): up to 4 bar

Where the maximum operating pressure, or supply pressure in the case of LPG tanks, in the receiving installation is higher than the pressure required for use, pressure regulators must be installed as part of the gas installation, and in such cases, there should be a system of protection against excess pressure. In the case of installations supplied by fixed tanks or LPG cylinders, this requirement is understood to be met by the devices at the outlet of the tanks or cylinders which prevent the pressure from reaching values higher than those set as maximums inside the home. If necessary, a shut-off system can also be installed which acts in the event of abnormal drops in operating pressure.
To make it more difficult for unauthorised persons to tamper with regulators, they can be sealed and a stopcock will be fitted if one is not already built in.
The regulators and, where appropriate, the cabinets in which they are housed shall be located in areas that cannot be damaged or impede the free movement of people.

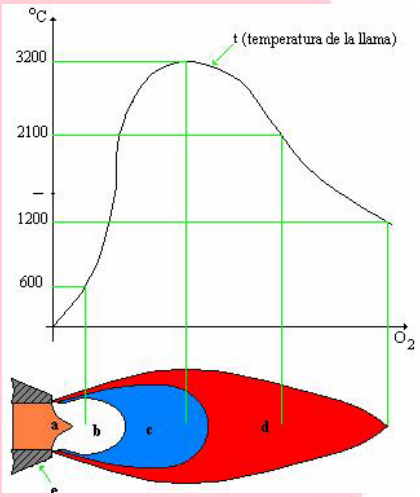


18.5. BURNER

SYSTEM

For a correct burn, we must refer to the UNE-EN 203 standard.
Combustion is a chemical reaction in which one element (combustible) combines with another (generally oxygen in the form of gaseous O2), giving off heat and producing an oxide. Combustion is an exothermic reaction that produces:

- Heat
- Light

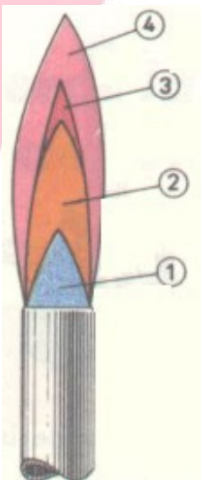


There are several types of combustion, including incomplete and complete combustion:

- Incomplete combustion is when part of the fuel does not fully react because of insufficient oxygen It is recognised by a yellowish flame.
- Complete combustion is when all carbon in the burned organic matter is transformed into CO2 It is recognized by a blue flame, which is produced by the incineration of the material.

The reaction of the fuel with oxygen produces gaseous substances, the most common of which are CO^2 and H^2O.
Among the most common substances that can be found in reaction products or fumes are:

- CO^2
- H^2O as water vapour
- N^2
- O^2
- CO
- H^2
- Carbon in the form of soot
- SO^2



- 1 - Inner region: No oxygen
- 2 - Reducing region: Low oxygen
- 3 - Oxidizing region: Abundant oxygen
- 4 - Outer region: reaching 1500 ºC

According to the type of fuel, fires are classified into four classes, which correspond to the first four letters of the alphabet:

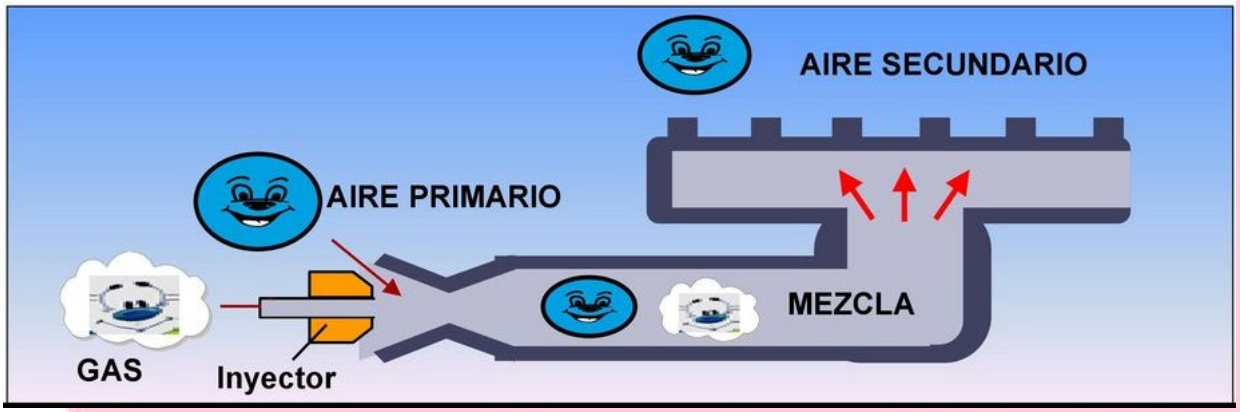
- Class A: Produced or generated by solid fuels, such as wood, coal, straw, fabrics, etc. They retain oxygen inside, forming coal.

- Class B: Produced or generated by liquid fuels, such as gasoline, oils, paints, fats, etc., or materials that are solid at the temperature of ignition, such as asphalt, paraffin, etc. They only burn on the surface, which is in contact with the oxygen of the air.
- Class C: Produced or generated by gaseous substances, such as propane, methane, hexane, town gas, butane, etc.
- Class D: Produced or generated by combustible metals, such as magnesium, aluminium powder, sodium, zirconium, etc. The methods used to extinguish these fires must be carefully studied.

There are three factors involved in combustion:

- Combustible (gas)
- Oxygen (O^2)
- Heat (ignition)

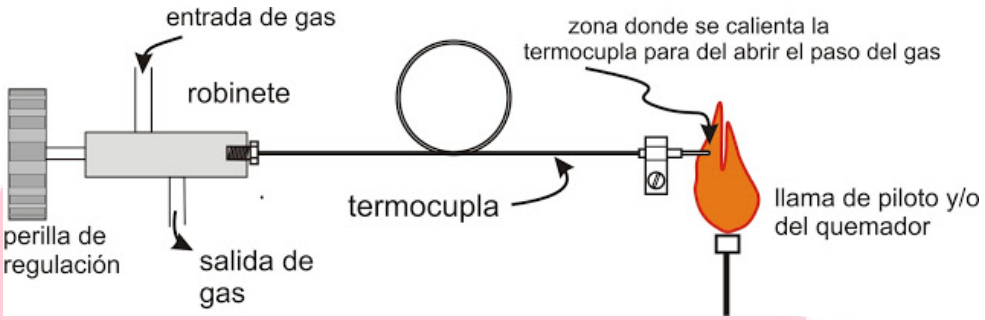
This is why O^2 is an important aspect when regulating a flame. There must be a balance of gas and air in the mixture.

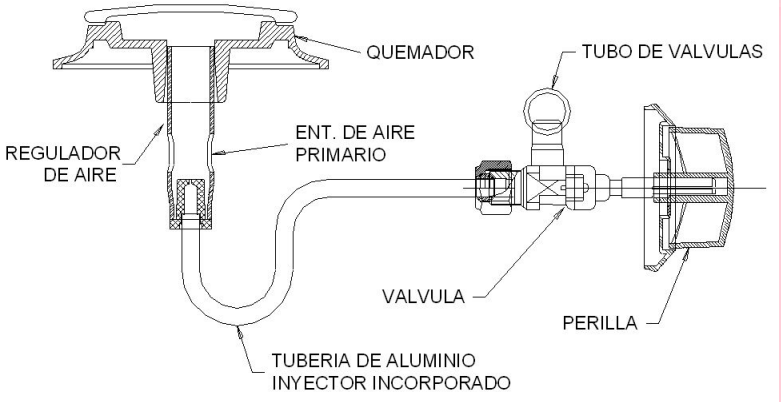


In a Gas burning systems are made up of the following subsystems and components:

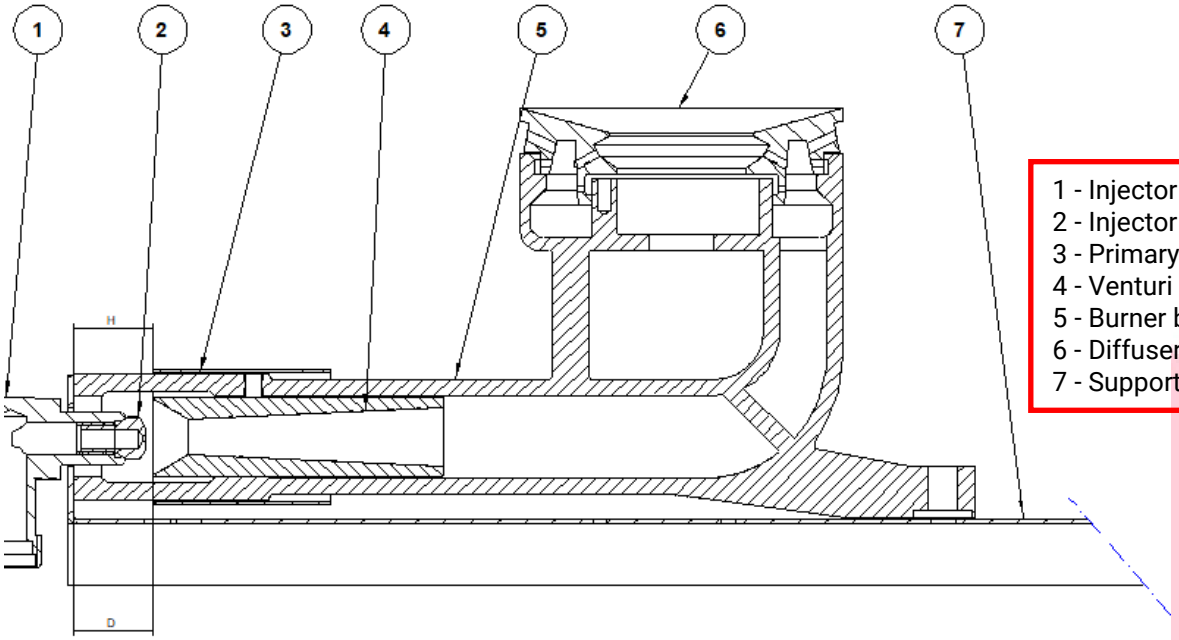
- Burning
  - Burner
  - Primary air regulator
- Maximum power
  - Injector
- Gas control
  - Gas valve (gas tap)

- Minimum power
  - Injector bypass
- Safety
  - Pilot light
  - Thermocouple





18.6. BURNER



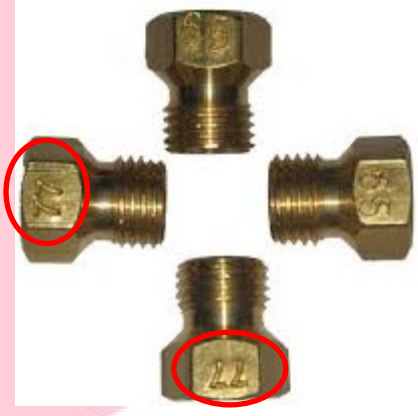
1 - Injector holder
2 - Injector
3 - Primary air regulator
4 - Venturi
5 - Burner body
6 - Diffuser
7 - Support

A burner is any device that facilitates the mixing of a fuel and an oxidizer and in which combustion takes place. In some, generally low-power appliances that use gaseous fuels, the burner can be a simple tube or a disc with perforations through which the gas is introduced by an injector and the Venturi effect draws in the oxidising air. Combustion is initiated by a spark, or even manually with a flame. As the combustion power increases, the function of the burner becomes more complex until it becomes, in industrial burners, a machine that brings the fuel into contact with air in the proportion, form and conditions that allow continuous, stable and controlled combustion, with maximum efficiency.

18.7. MAXIMUM POWER INJECTOR

An injector is an element of the gas burning system whose function is to introduce a certain amount of gas into the burner's mixing chamber, distributing it as evenly as possible within the air contained in the mixing chamber. The injector defines the maximum power of the burner.

Injectors are identified by engravings on one of the sides. This engraving specifies the Ø that defines the gas flow rate.



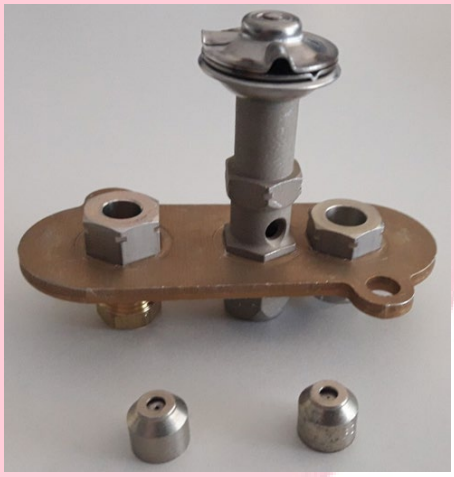
18.8. MINIMUM POWER BYPASS

A bypass is a diversion designed to avoid an obstacle or interruption in a communication path or circuit. The term has applications in different areas.

In our case, the bypass acts as an injector that regulates the minimum power of the burner.
Injectors are identified by engravings on the top. This engraving specifies the Ø that defines the gas flow rate.

18.9. PILOT LIGHT

A burner is any device that facilitates the mixing of a fuel and an oxidizer and in which combustion takes place. Standard UNE-EN 203 states that the pilot light must not exceed 250 W.

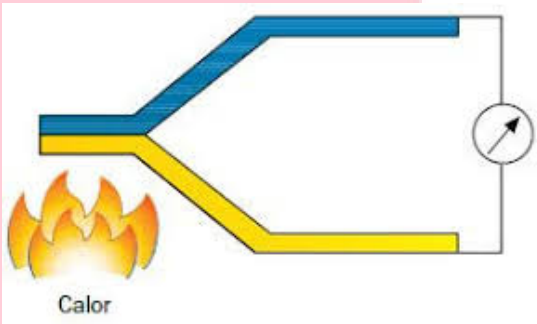


18.10. PILOT LIGHT INJECTOR

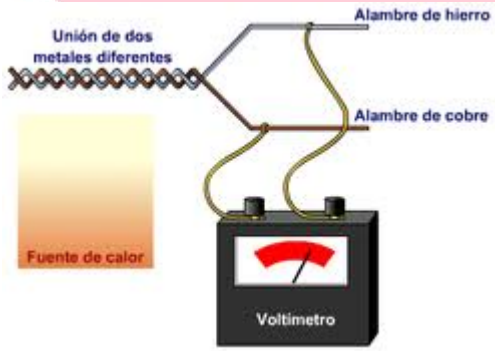
An injector is an element of the gas burning system whose function is to introduce a certain amount of gas into the burner's mixing chamber, distributing it as evenly as possible within the air contained in the mixing chamber. The injector defines the maximum power of the burner.
Pilot light injectors are identified by engravings on the cylinder. This engraving specifies the Ø that defines the gas flow rate.

18.11. THERMOCOUPLE

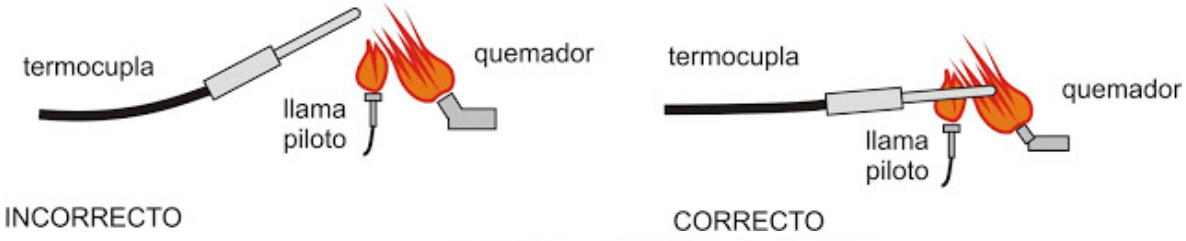
A thermocouple is a transducer formed by the union of two different metals that produces a very small potential difference (millivolts) due to the temperature difference between one of the extremes called the "hot point", "hot union" or "measurement" and the other called the "cold point", "cold union" or "reference" (Seebeck effect).
A thermocouple is a sensor for measuring temperature. It consists of two different metals, joined at one end. When the union of the two metals is heated or cooled, a voltage is produced that is proportional to the temperature. Thermocouple alloys are commonly available as wire. Thermocouples are available in different combinations of metals or calibrations to suit different applications. The three most common are the J, K and T type, of which the K type is the most popular due to its wide temperature range and low cost.
The K type thermocouple has a positive nickel-chrome conductor and a negative nickel-aluminium conductor. Types R, S, B, G, C and D are available for high temperature offering a performance up to 2320°C. These are made of precious metals (platinum/rhodium and tungsten/rhenium) and are therefore relatively expensive.



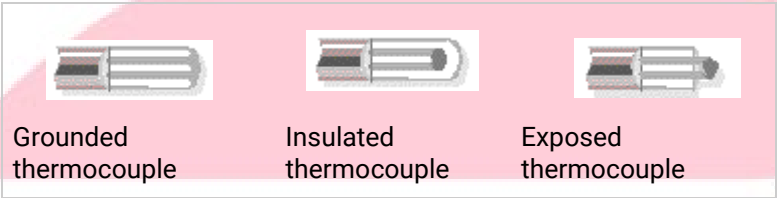
A thermocouple probe consists of thermocouple wire housed inside a metal tube. The wall of the tube is known as the probe sheath. The most common sheath materials include stainless steel and Inconel. Inconel withstands a higher temperature than stainless steel, however, stainless steel is preferred because of its broad chemical compatibility. For very high temperatures, other exotic materials are also available.
The thermocouple probe tip is available in three different styles. Grounded, insulated and exposed. With a grounded tip, the thermocouple is in contact with the sheath wall. Grounding provides fast response time but is more susceptible to electrical ground loops. In ungrounded junctions, the thermocouple is separated from the sheath wall by a layer of insulation. In an exposed junction, the tip of the thermocouple protrudes out of the sheath. Exposed junction thermocouples are the most suitable for air measurement.



The working range of a thermocouple is 8-12 mV. Below 8 mV the magnet unit will disengage.

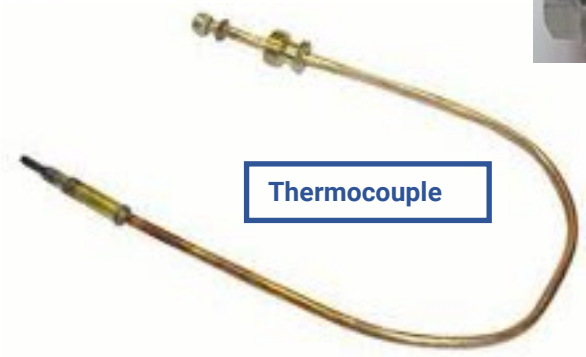


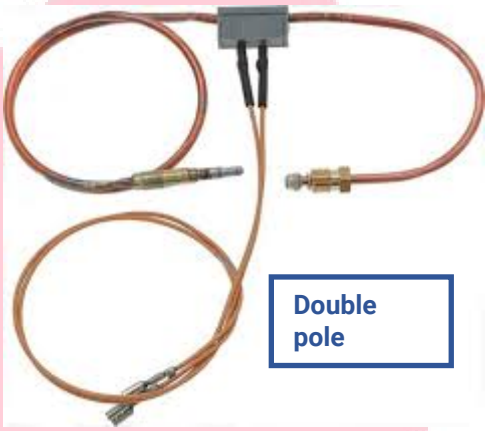
Thermocouple tip types:



There are two types of thermocouples:

- Thermocouple
- Double pole

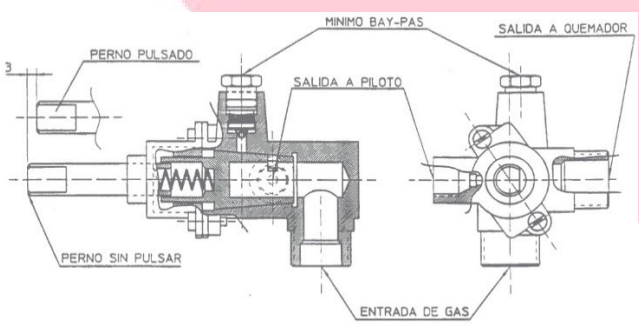


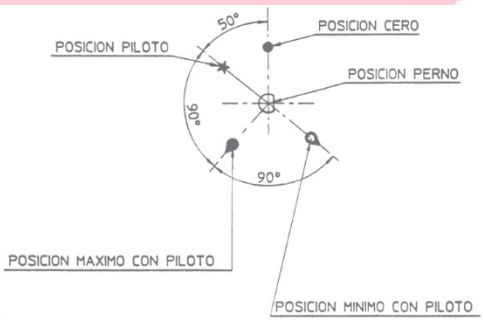


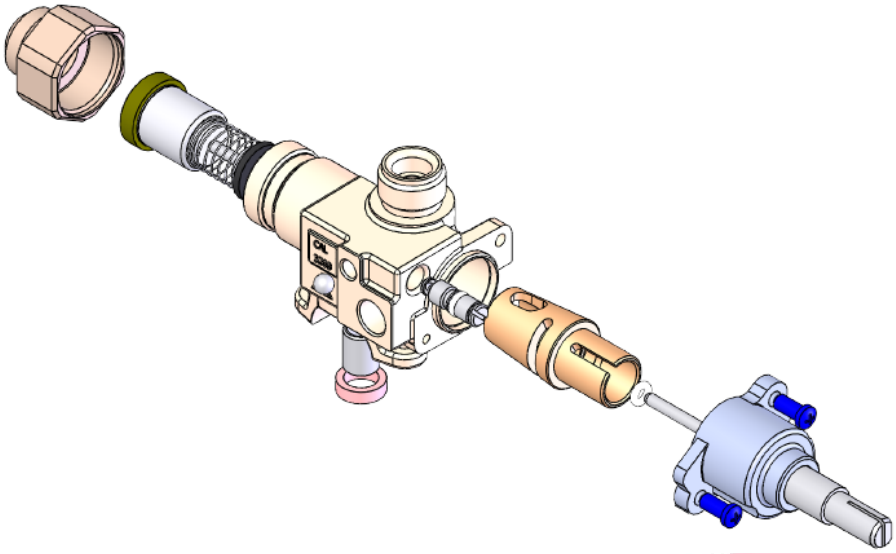
18.12. GAS VALVES AND TAPS

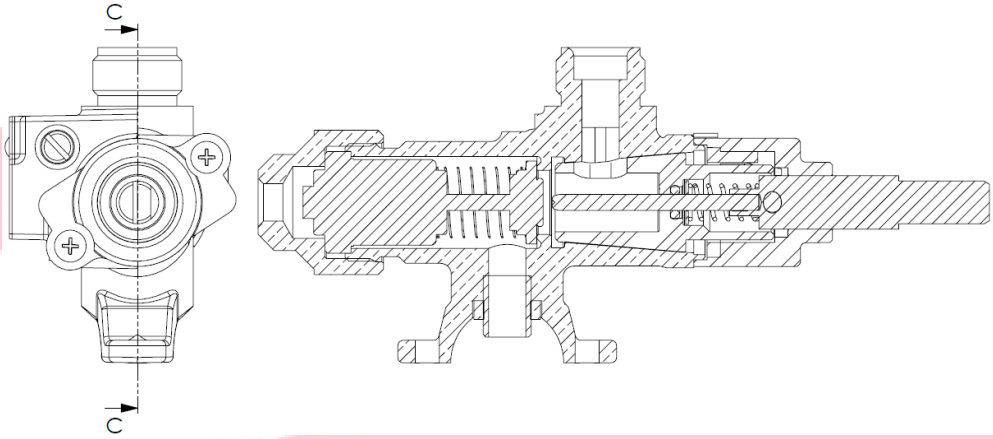
A valve is a fluid control and regulation instrument. A more complete definition describes the valve as a device with which the circulation (passage) of liquids or gases can be started, stopped or regulated by means of a moving part that opens, closes or partially blocks one or more holes or conduits.
Due to their design and materials, valves can open and close, connect and disconnect, regulate, modulate or isolate a huge range of liquids and gases, from the simplest to the most corrosive or toxic.

18.12.1. GAS TAP OPERATION



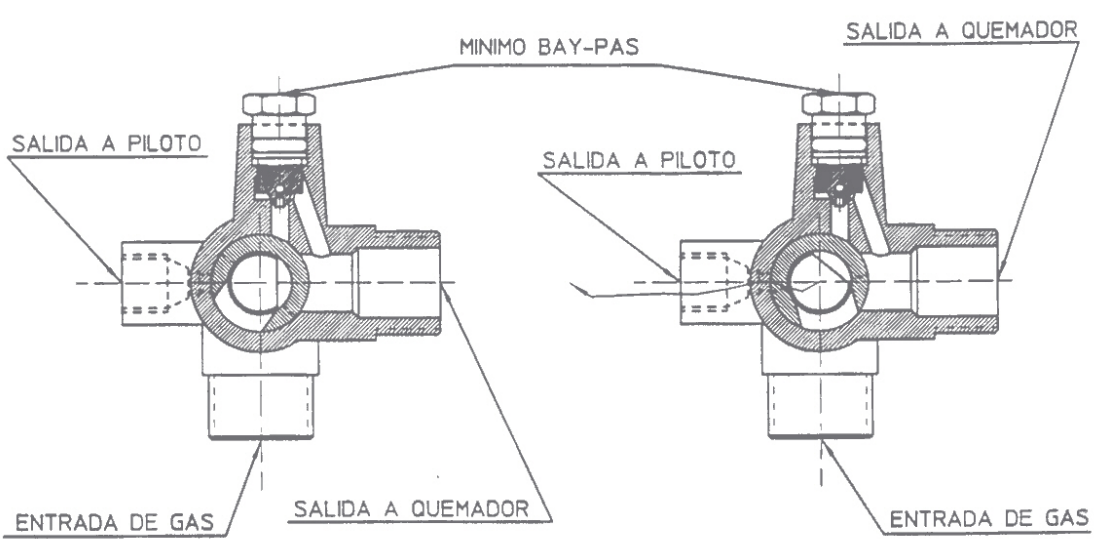






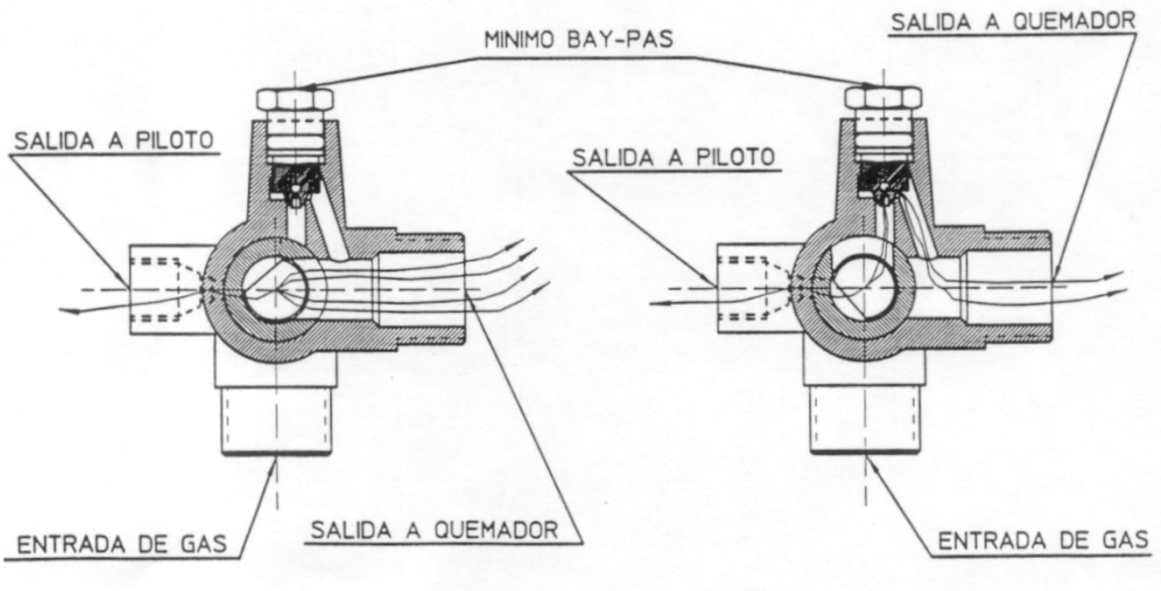
CLOSED POSITION

PILOT POSITION



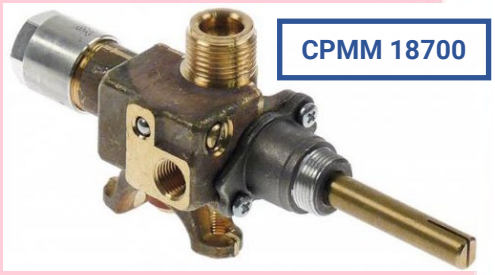
PILOT POSITION AND MAXIMUM

PILOT POSITION AND MINIMUM



18.12.2. CPMM 18700 (gas tap)

A stopcock is a device, usually made of metal, some alloy or more recently of polymers or ceramic materials, used to allow the passage or cut off the flow of water or other fluid through a pipe or conduit into which it is inserted.
They also often called valves, since some of them, in addition to stopping the flow, had the function of preventing water from circulating in the opposite direction to the desired (reflux), that is, they were also valves in the original sense of the term.
Although a gas tap may be a valve that releases any gas, the word is most commonly used to refer to the taps that control the supply flow of gaseous fuels (NG, LPG) in homes for gas fires or other applications.

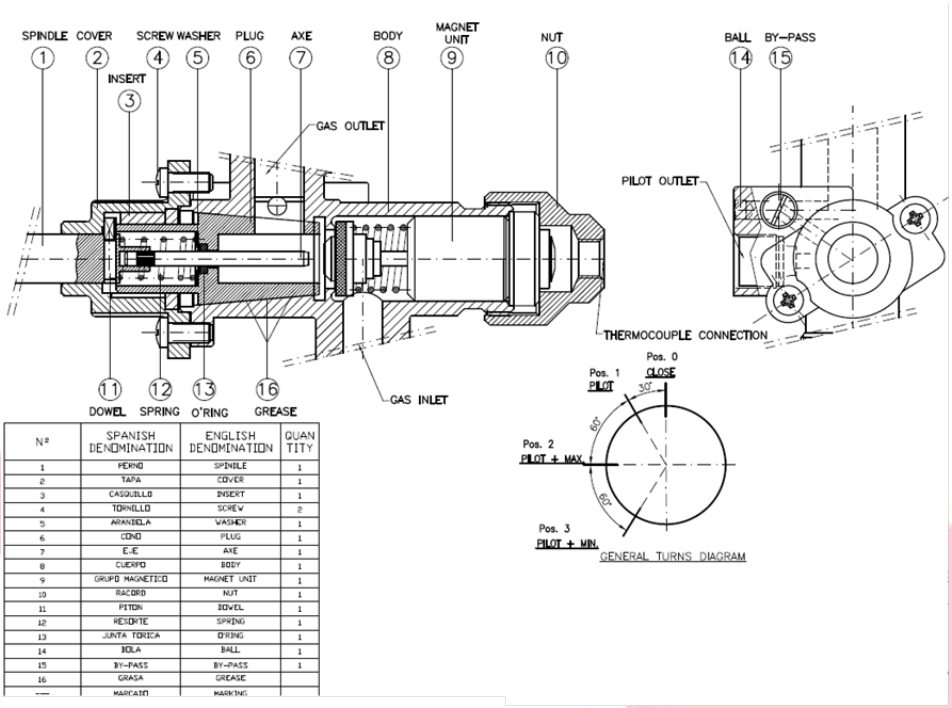

CPMM 18700

18.12.3. CAL 3200 (gas tap)

A stopcock is a device, usually made of metal, some alloy or more recently of polymers or ceramic materials, used to allow the passage or cut off the flow of water or other fluid through a pipe or conduit into which it is inserted.
They also often called valves, since some of them, in addition to stopping the flow, had the function of preventing water from circulating in the opposite direction to the desired (reflux), that is, they were also valves in the original sense of the term.
Although a gas tap may be a valve that releases any gas, the word is most commonly used to refer to the taps that control the supply flow of gaseous fuels (NG, LPG) in homes for gas fires or other applications.


CAL 3200

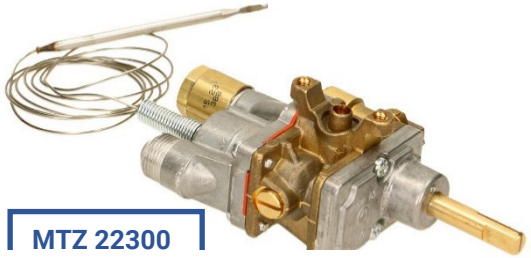

CAL 3200

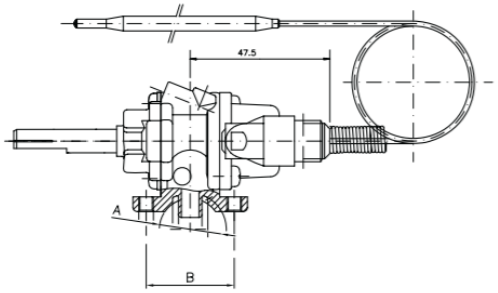


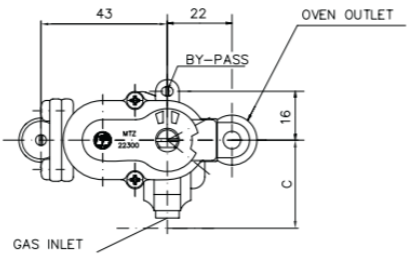
Nº	SPANISH DENOMINATION	ENGLISH DENOMINATION	QUANTITY
1	PERNO	SPINDLE	1
2	TAPA	COVER	1
3	CASQUILLO	INSERT	1
4	TORNILLO	SCREW	2
5	ARANDELA	WASHER	1
6	CONO	PLUG	1
7	EJE	AXE	1
8	CUERPO	BODY	1
9	GRUPO MAGNETICO	MAGNET UNIT	1
10	RACORD	NUT	1
11	PITON	DOWEL	1
12	RESORTE	SPRING	1
13	JUNTA TORICA	O'RING	1
14	BOLA	BALL	1
15	BY-PASS	BY-PASS	1
16	GRASA	GREASE	
	MARCADO	MARKING	

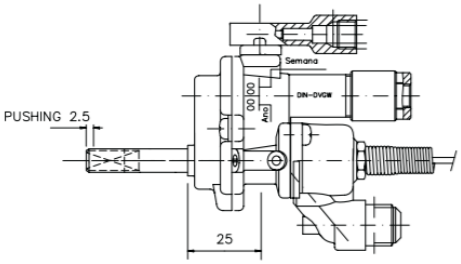
18.12.4. MTZ 22300 (thermostatic gas tap)

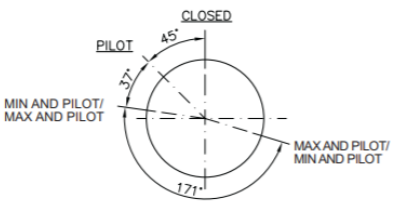
Thermostatic taps are characterized by two clearly differentiated functions: one is gas flow and the other is temperature. This allows a certain temperature to be set regardless of the desired flow rate.
The function of a thermostatic gas taps is, as the name suggests, to maintain the desired temperature and to keep the burner operating automatically.





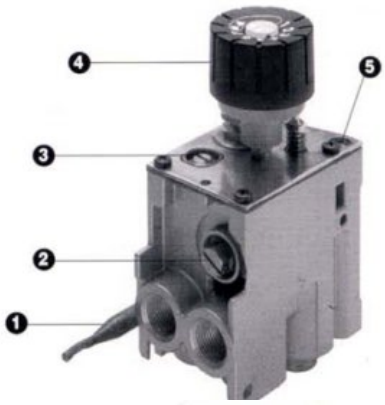






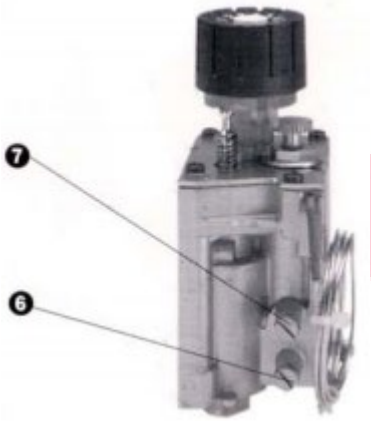
18.12.5. EUROSIT 630 (thermostatic valve)

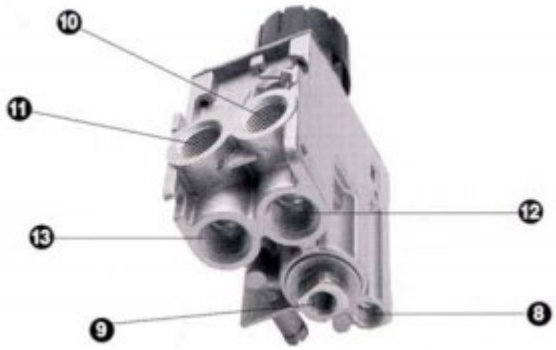
Single-knob multi-function valve with combined thermostatic control

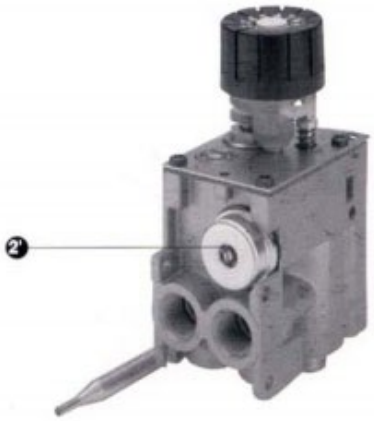


1- Bulb
2- Maximum flow regulator
3- Minimum flow regulator
4- Control knob
5- Pilot flow regulator
6- Inlet pressure test
7- Outlet pressure test
8- Pilot outlet
9- Magnet unit cover
10- Gas inlet
11- Gas outlet to burner
12- Gas inlet
13- Gas outlet to burner

EUROSIT 630





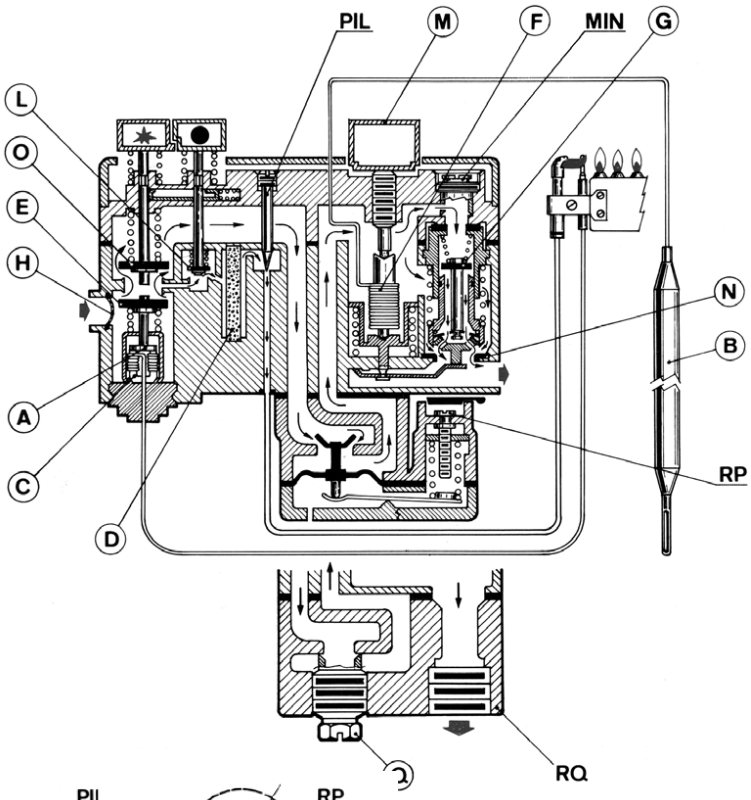


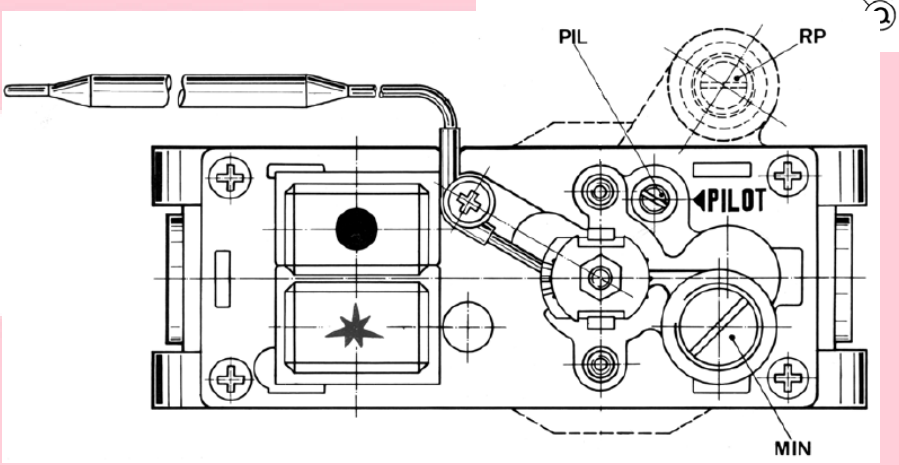
18.12.6. 710 MINISIT (thermostatic valve)

Multifunctional control for gas appliances (stoves, boilers, fryers, ovens, etc.).
It includes:
• thermoelectric safety device
• switch-off device with protection against incorrect operation (INTERLOCK)
• combined temperature regulator, with minimum "all or nothing" and proportional (modulating) action from minimum to maximum
• gas flow regulator to the pilot burner
• pressure regulator
• flow regulator (as an alternative to the pressure regulator)
• inlet and outlet pressure tests
• piezoelectric ignition (optional)

710 MINISIT

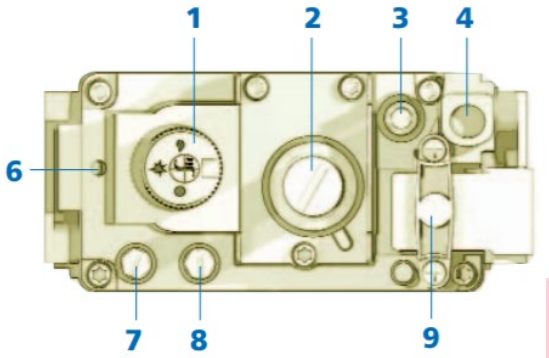
A – Safety valve
B – Bulb
C – Magnet unit
D – Chamber
E – Magnet unit safety valve
F – Liquid expansion spring
G – Minimum safety valve
H – Gas inlet
L – Safety valve
M – Control button
N – Thermostat modulating knob
O – Main safety valve
Q – Output flow regulator
MIN – Minimum flow regulator
PIL – Pilot regulator
RP – Outlet pressure regulator
RQ– Flow regulator



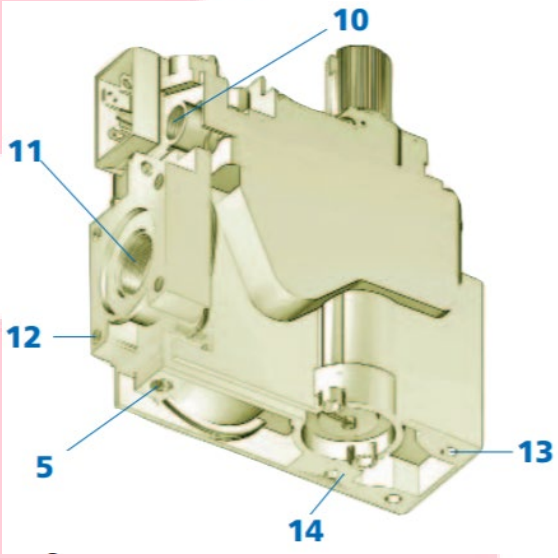


18.12.7. 820 NOVA (valve)

Knob with off, pilot, on positions.
• Thermoelectric flame detection device with resetting lock (Interlock).
• Silent automatic shut-off valve.
• Servo-assisted pressure regulator
• Slow opening device (optional)
• Main gas flow regulation device (optional)
• Filter at inlet and pilot
• Inlet and outlet pressure tests
• Threaded gas inlet and outlet with provision for flange connection.
• Connection for the pressure regulator to the combustion chamber



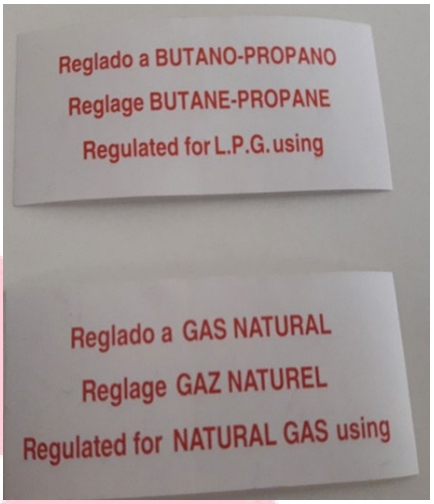
1- Control knob
2- Pressure regulating device
3- Adjustment screw for gas flow to the pilot
4- Thermocouple connector
5- Alternative thermocouple connector
6- Accessories support bracket
7- Inlet pressure test
8- Outlet pressure test
9- Actuating solenoid valve
10- Pilot outlet
11- Main gas outlet
12- Holes (M5) for fixing flanges
13- Supplementary valve body fixing points
14- Connection for pressure regulator to the combustion chamber



19. CONVERSION TO DIFFERENT GASES

To convert equipment to a gas other than the one it was intended for, we must take into account the different physical and chemical characteristics of different gases. They each require particular conditions that usually do not coincide with each other.
Each burner has been designed, tested and proven to provide a certain power for each of the gases for which it is certified on its Certification Report. For this reason, the power assigned to each burner must be respected, so as not to invalidate the equipment.
Power is defined by:

- Quantity of gas (Ø injector)
- Quantity of air



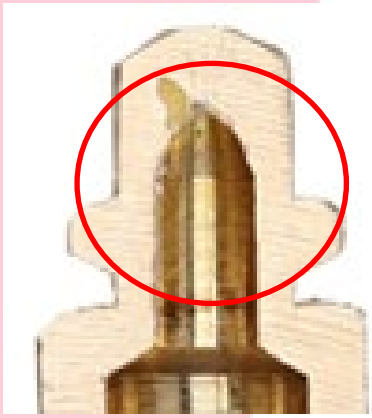
The quantity of gas and air are the aspects that must be regulated when converting a gas supply.
It should also be considered that the burning systems can have three different flames and, consequently, three different powers:

- Pilot light (max. 250 W)
- Maximum (nominal power)
- Minimum (minimum power)

19.1. PILOT LIGHT ADJUSTMENT

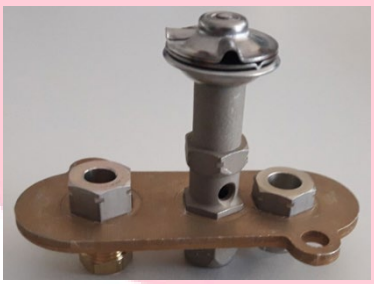
Converting a pilot light consists in replacing (adjusting if necessary) the pilot light injector. The pilot light injector closes on the pilot body by means of a conical adjustment. It is also necessary to regulate the primary air supply to the pilot with the air ring (if available). It is possible to regulate the amount of gas for gases with lesser calorific power, such as town gas, by turning the conical adjustment clockwise limiting it to the Ø of the injector. If the pilot injector is turned counter-clockwise it will open the gas flow.

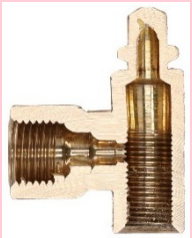
DETAIL PILOT LIGHT BODY



Series 100

PILOT LIGHT INJECTOR
NG – Ø 0,41 mm
LPG – Ø 0.30 mm

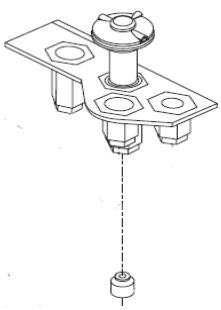


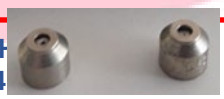


SECTION PILOT LIGHT BODY

PILOT LIGHT BODY

C ODY



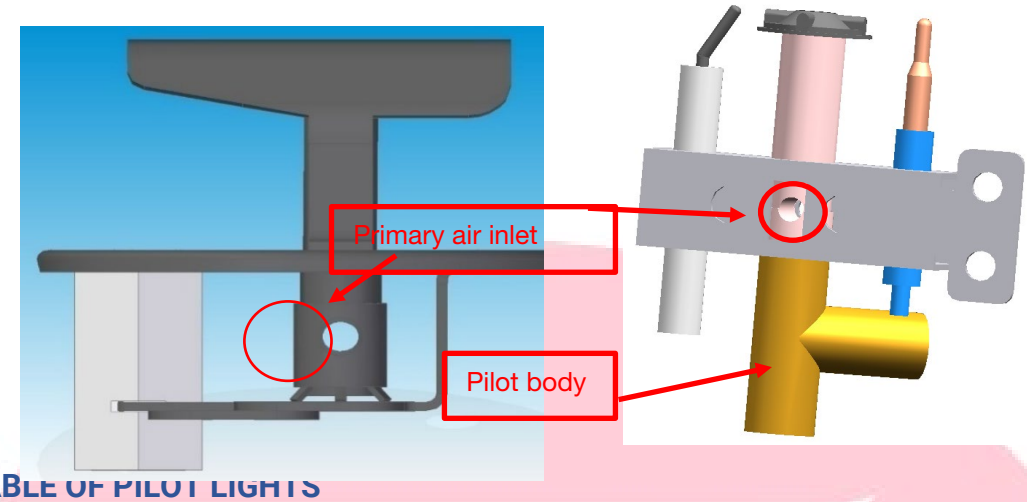


PILOT LIGH
NG – Ø 0,4
LPG – Ø 0.25 mm

PILOT LIGHT INJECTOR

PRIMARY AIR REGULATOR
NG – 100% open
LPG – 50% open

PRIMARY AIR RING



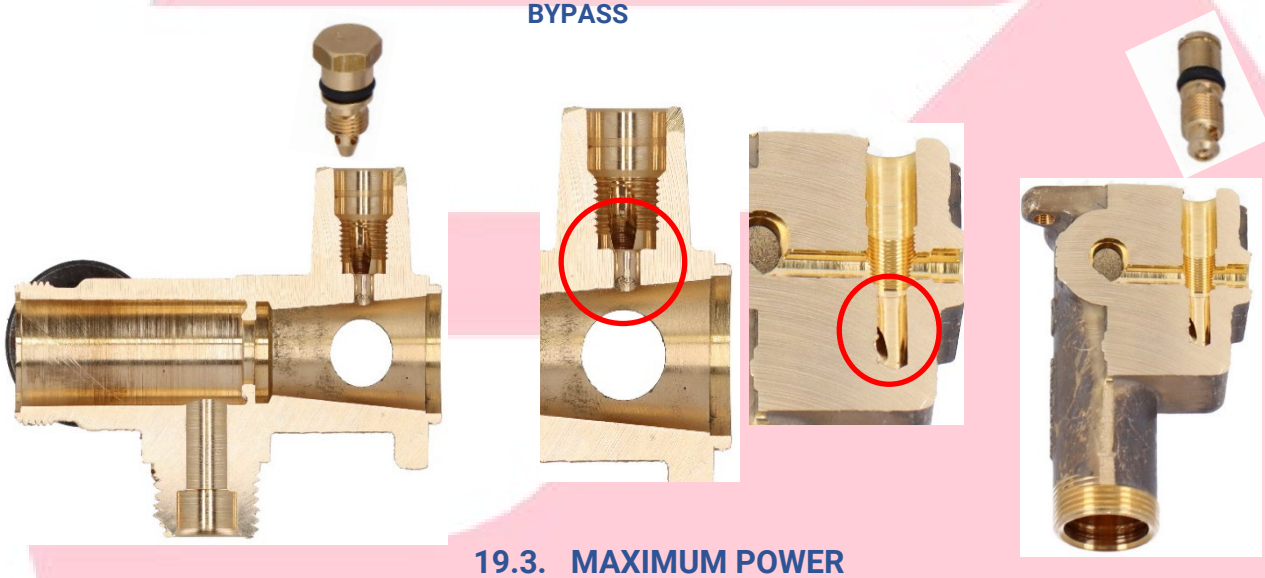
19.1.1. TABLE OF PILOT LIGHTS

Equipment	Functional part	Pilot complete		Pilot body		Pilot head		Ignition inter injector		Pilot injector		Air regulation	
		NG	LPG	NG	LPG	NG	LPG	NG	LPG	NG	LPG	NG	LPG
Cooker	Worktop			12224047	12224046	12224045 (until 03-2020) 12263611 (from 03-2020)						Open	½ Open
	Oven	12224038	12224031									Open	½ Open
	OP Oven	12224038	12224031					12008109	12008110			Open	½ Open
Solid Top	Worktop	12224038	12224031									Open	½ Open
	Oven	12224038	12224031									Open	½ Open
Paella Cooker	Worktop	12224042	12224039									Open	½ Open
	Oven	12224038	12224031									Open	½ Open
Fryer	Worktop	12224038	12224031									Open	½ Open
Bain Marie	Worktop	12224044	12224043							12131759	12131760	Open	
Fry Top	Worktop	12224038	12224031									Open	½ Open
Grill	Worktop	12224038	12224031									Open	½ Open
Boiling Pan	Worktop	12224044	12224043							12131759	12131760	Open	
Tilting Bratt Pan	Worktop	12224038	12224031									Open	½ Open
Pasta Cooker	Worktop	12224044	12224043							12131759	12131760	Open	

19.2. MINIMUM POWER ADJUSTMENT

Adjusting the minimum power consists in replacing (adjusting if necessary) the bypass. The bypass closes on the pilot body by means of a conical adjustment. It is possible to regulate the quantity of gas for gases with lesser calorific power, such as town gas, by turning the conical adjustment clockwise limiting it to the Ø of the injector. If the pilot injector is turned counter-clockwise it will open the gas flow.
The minimum power must be 30 - 40% of the declared maximum power.

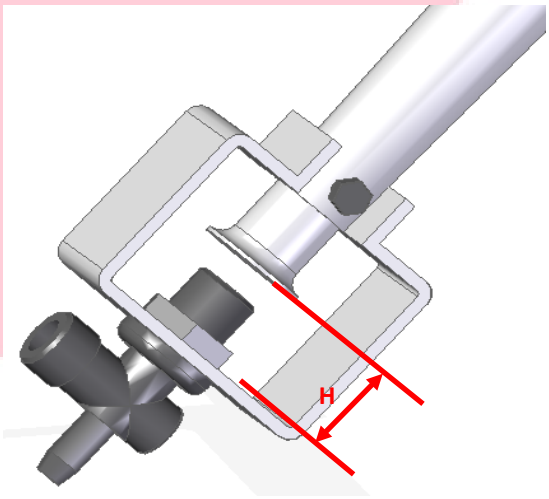
BYPASS

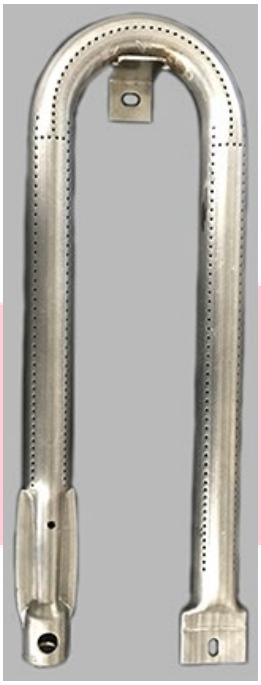


19.3. MAXIMUM POWER

ADJUSTMENT

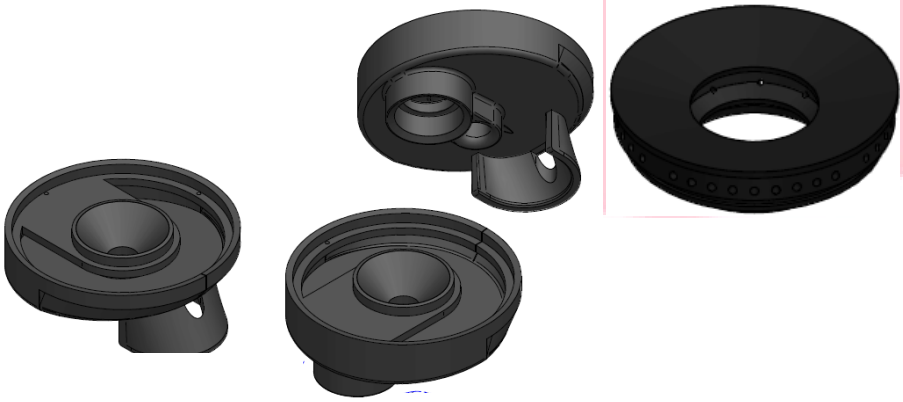
Adjusting the maximum power consists in replacing (adjusting if necessary) the main injector and adjusting the primary air inlet of the burner.







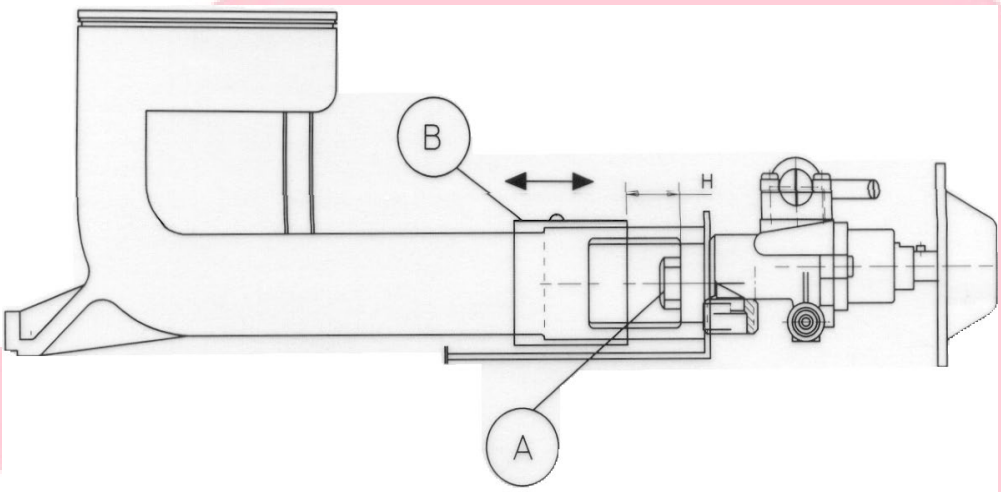



The following must be avoided when converting a burner:

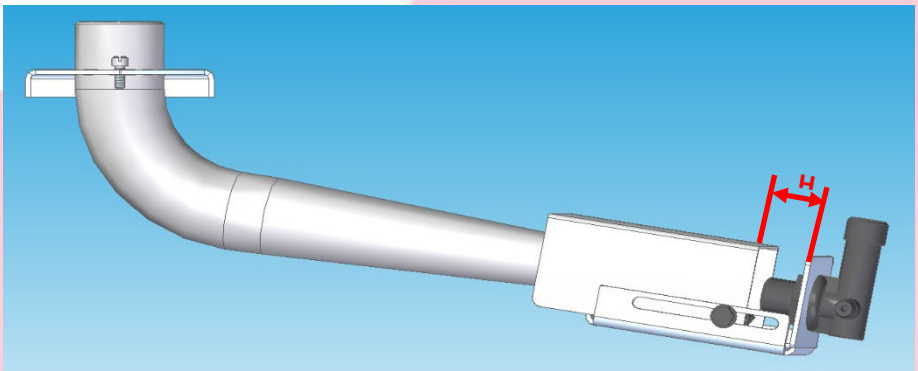
- FLAME RETURN
  - Increase the minimum of the burner by adjusting the minimum on the gas tap
  - Reduce primary air (Monitor CO^2 emission)
- FLAME ESCAPE
  - Clean diffuser, to increase stabilizing flame
  - Reduce primary air (Monitor CO^2 emission)
- FLAME WITH RED TIPS (bad combustion)
  - Centre the orientation of the injector on the venturi
  - Open primary air or clean injector

A = Injector

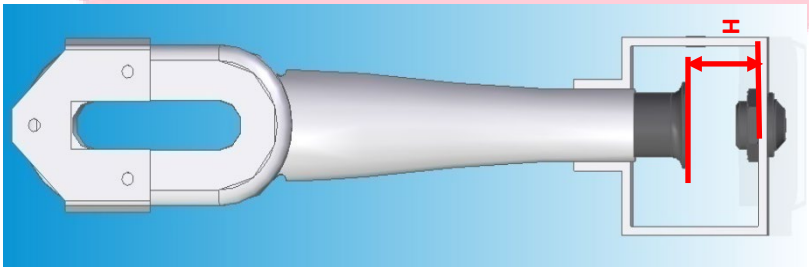
B = Primary air regulator (adjustment "H")



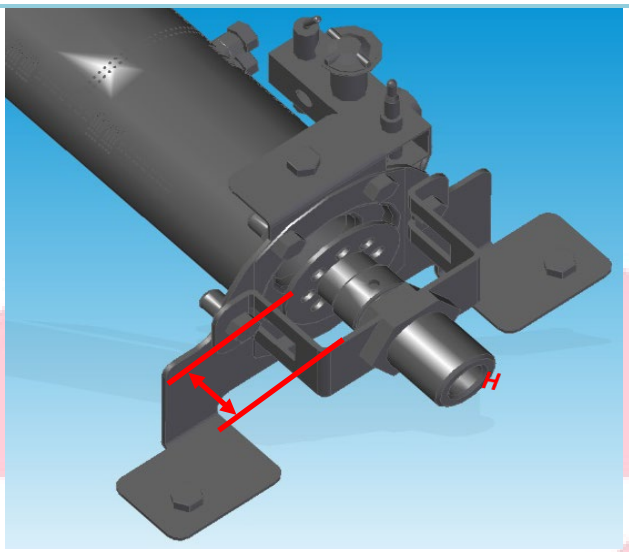
19.4. MAXIMUM POWER ADJUSTMENT COOKER



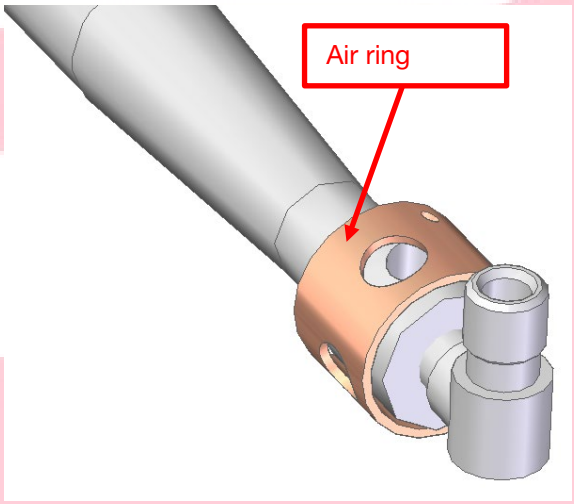
19.4.1. MAXIMUM POWER ADJUSTMENT FRYER



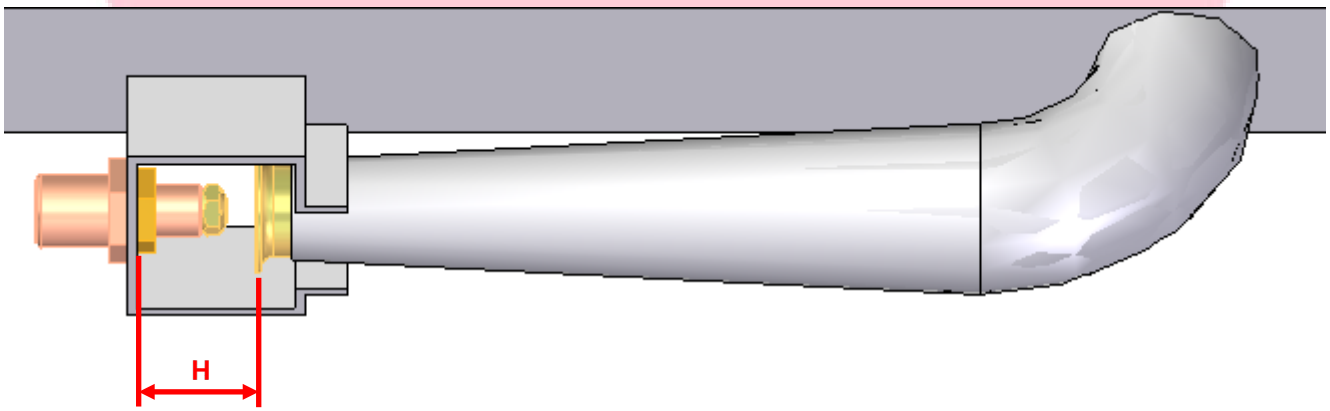
19.4.2. MAXIMUM POWER ADJUSTMENT BOILING PAN, FRY TOP, PASTA COOKER AND OVEN



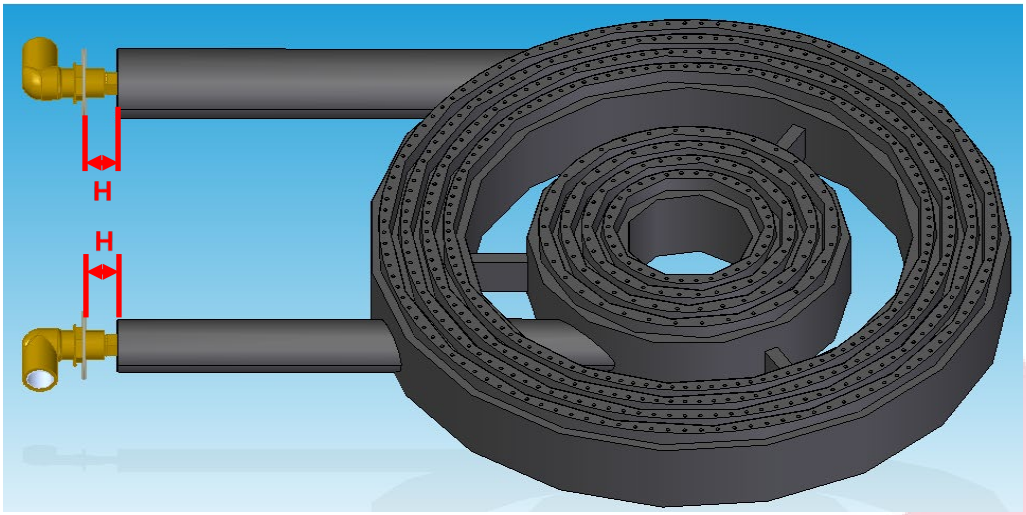
19.4.3. MAXIMUM POWER ADJUSTMENT BAIN MARIE



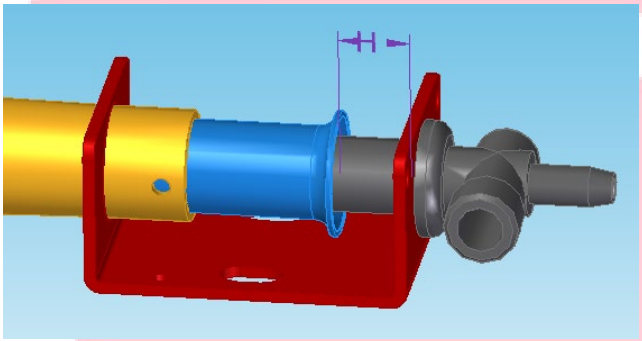
19.4.4. MAXIMUM POWER ADJUSTMENT TILTING BRATT PAN

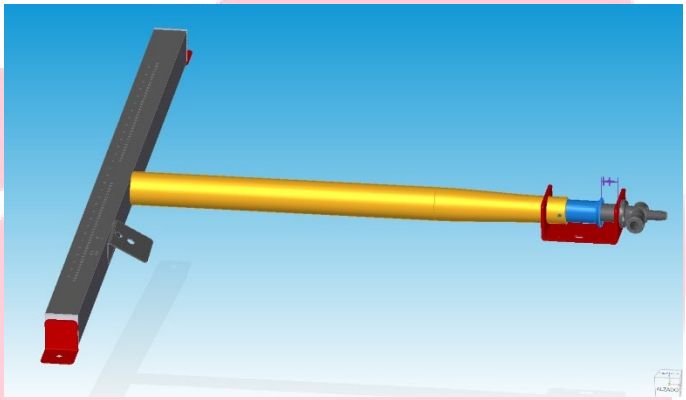


19.4.5. MAXIMUM POWER CONVERSION PAELLA COOKER

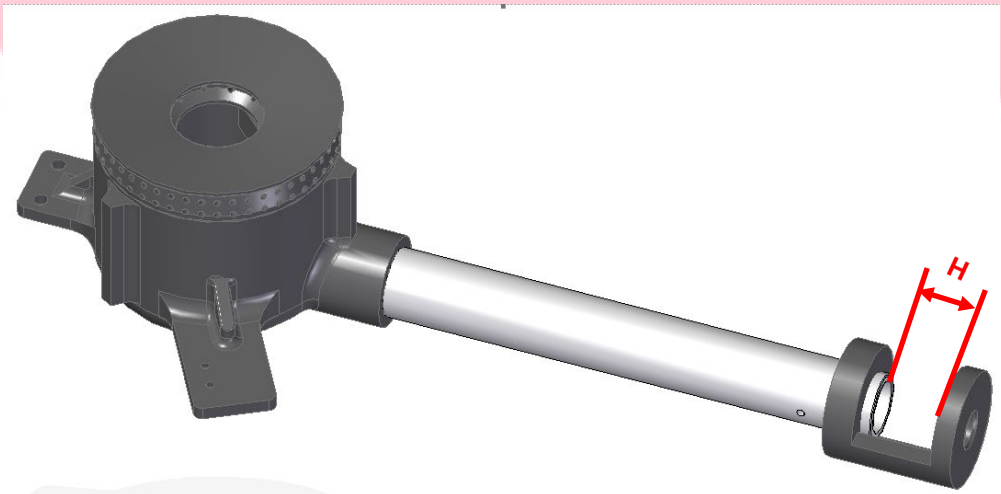


19.4.6. MAXIMUM POWER ADJUSTMENT PAELLA OVEN





19.4.7. MAXIMUM POWER ADJUSTMENT SOLID TOP

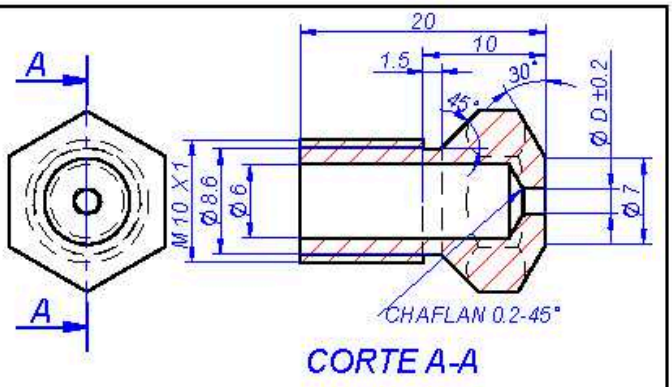


19.4.8. TABLE OF BURNERS

Equipment	Functional part	Burner									
		Power Unit (kW)	Burner			NG			LPG		
						Injector		H (mm)	Injector		H (mm)
			Code	Quantity	Power (kW)	(Ø mm)	Code		(Ø mm)	Code	
Cooker	Worktop	5.25	12150612 + 12154471	1	5.25	1.65	12008793	10	1.15	12008807	30
	Worktop	8	12150615+ 12154473	1	8	2.10	12008794	10	1.35	12008809	30
	Worktop	10.2	12150619 + 12154475	1	10.2	2.40	12008795	20	1.55	12008797	30
	Oven	8.6	12048301	1	8.6	2.35	12024248	28	1.50	12009579	22
	OP Oven	7	12048301	2	14	2 x 2.35	12024248	30	2 x 1.40		27
Solid Top	Worktop	11.5	12007687 + 12091667	1	11.5	2.60	12008760	20	1.65	12008893	25
	Oven	8.6	12048301	1	8.6	2.35	12024248	28	1.50	12009579	22
Paella Cooker	Worktop	18	12173809	1	18	3.20	12187216	6	2.15	12183518	10
	Worktop	8		1	8	2.10	12187214	4	1.40	12183519	10
	Oven	7.3	12006913	1	7.3	2.05	12008814	20	1.35	12008809	20
Fryer 21 L	Worktop	7	12101779	3	21	3 x 2.05	12008814	30	3 x 1.35 (brake 2.5 mm)	12159549	30
Fryer 15 L	Worktop	5	12092079	3	15	3 x 1.75	12017441	25	3 x 1.15	12008807	25
Bain Marie ½ mod.	Worktop	3.25	12119550	1	3.25	1.25	12039112	closed	0.85	12137191	½ closed
Bain Marie 1 mod.	Worktop	6.5	12119538	1	6.5	2.00	12008812	closed	1.25	12039112	½ closed
Fry Top	Worktop	4.625	12008954	2	9.25	2 x 1.60	12017204	28	2 x 1.10	12008800	28
	Oven	8.6	12048301	1	8.6	2.35	12024248	28	1.50	12009579	22
Grill	Worktop	11	12117331	2	11	2.55	12008824	20	1.65	12008793	25
Boiling Pan M-G910	Worktop	10	12093272	2	20	2 x 2.40	12008795	30	2 x 1.55	12008797	22
Boiling Pan M-G915	Worktop	12	12093272	2	24	2 x 2.70	12009212	30	2 x 1.75	12017441	22
Boiling Pan M-G920	Worktop	12	12093272	2	24	2 x 2.70	12009212	30	2 x 1.75	12017441	22

Boiling Pan M-G910BM	Worktop	12	12093272	2	20	2 x 2.40	12008795	30	2 x 1.55	12008797	20
Boiling Pan M-G915BM	Worktop	12	12093272	2	24	2 x 2.70	12009212	30	2 x 1.75	12017441	22
Tilting Bratt Pan 1 mod.	Worktop	18	12095741	1	18	3.40	12152563	25	2.10	12008794	25
Tilting Bratt Pan 1 ½ mod.	Worktop	25	12098345	1	25	3.90	12017545	10	2.50	12008803	25
Pasta Cooker	Worktop	16	12103117	1	16	3.20	12008749	26	2.00	12008812	22

19.4.9. TABLE OF INJECTORS



MATERIAL: EXAG. 13 e/c DIN 1763 Ms.58F44 (LATON)

Ø D	Nú CLASI.	Ø D	Nú CLASI.
0.80	U322401 ***	2.90	12008801
0.85	U052400 ***	2.95	12017459
0.90	12008961	3	9483100
0.93	9131600	3.05	9207700
0.95	12009213	3.10	12000123
1	12008813	3.18	9131900
1.05	12008802	3.20	12009749
1.10	12008800	3.25	
1.15	12008807	3.30	9451000
1.20	9271300	3.35	
1.25	12039112	3.40	9273000
1.30	12008770	3.45	
1.35	12008809	3.50	
1.40	0631000	3.55	9214200
1.45	12008796	3.60	12009717
1.50	9105100	3.65	12017266
1.55	12008797	3.70	12008719
1.60	12017204	3.75	12017779
1.65	12008793	3.80	S164400 ***
1.70	12024249	3.85	
1.75	12017441	3.90	12017545
1.80	9429400	3.95	
1.85		4	12017462
1.90	9429500	4.05	
1.95	12008810	4.10	12009774
2	12008812	4.15	
2.05	9207500	4.20	
2.10	12008794	4.23	9424600
2.15	12008798	4.30	
2.20	12008765	4.35	
2.25	1011600	4.40	12009251
2.30	12017092	4.45	
2.35	12024248	4.50	12018619
2.40	0631600	4.55	12135937
2.45		4.58	12009718
2.50	12008803	4.65	
2.55	12008824	4.70	
2.60	12008760	4.75	
2.65	12000093	4.80	9145300
2.70	12009212	4.85	
2.75		4.90	12009763
2.80	12008799	4.95	
2.85	9511810		

Ø D	Nú CLASI.	Ø D	Nú CLASI.	Ø D	Nú CLASI.
5		6.30		8	
5.05		6.35		8...	
5.10		6.40		8...	
5.15		6.45		8.60	R322401
5.20		6.50		8...	
5.25		6.55		8...	
5.30		6.60		8...	
5.35	9424500	6.65		8.90	S402402
5.40		6.70		8...	
5.45	9424700	6.75		9	
5.50		6.80		9...	
5.55		6.85		9...	
5.60	9382	6.90		9...	
5.65		6.95		9...	
5.70		7		9...	
5.75	R295021 ***	7...		9...	
5.80		7...		9...	
5.85		7...		9...	
5.90		7...		9...	
5.95		7...		10	
6	9224200	7.50	9212400	10...	
6.05		7...		10...	
6.10		7...		10...	
6.15		7...		10...	
6.20		7...		10...	
6.25	U054300 ***	7...		10...	

N°	TITLE	QTY	CODE	MATERIAL	TREATMENT
-	TOBERA	-	12135936	LATON	

GENERAL TOLERANCES: ISO 2768-1 Very Coarse

	Fine	Medium	Coarse	Very Coarse
LINEAR <3mm	±0.05	±0.10	±0.15	
LINEAR 3-6mm	±0.05	±0.10	±0.20	
LINEAR 6-30mm	±0.10	±0.20	±0.50	
LINEAR 30-120mm	±0.15	±0.30	±0.80	
LINEAR 120-400mm	±0.20	±0.50	±1.20	
LINEAR 400-1000mm	±0.30	±0.80	±2.00	
LINEAR 1000-2000mm	±0.50	±1.20	±3.00	
ANGULAR <10mm	±1°	±1°30'	±3°	
ANGULAR 10-50mm	±30'	±1°	±2°	
ANGULAR 50-120mm	±20'	±30'	±1°	
ANGULAR 120-400mm	±10'	±15'	±30'	
ANGULAR >400mm	±5'	±10'	±20'	

GENERAL TOLERANCE FOR FORM AND POSITION: ISO 2768-2

FAGOR INDUSTRIAL

EGOSKETA

DESIGNED BY	VALIDATED BY	DATE	SHEET FORMAT	A4
A PLAZA	J HERRAST	08/04/2016	DESIGN CENTER	ONA
			MAT STATUS	
			DOC STATUS	DI
			SHEET	1 / 1
			SCALE	2:1

12135936	REVISION	-	PROPOSED BY:	-	ISSUE DATE:	

20. STEAM HEATING

Steam is water in the gaseous phase, which is formed when the water boils or evaporates. At lower pressures, such as in the upper atmosphere or at the top of high mountains, water boils at a temperature lower than the 100 degrees Celsius (212 °F) at standard pressure. If it gets hotter than that, it turns into superheated steam.
Steam is traditionally created by heating a boiler through the combustion of coal and other fuels, but it is also possible to create steam with solar energy.
Water vapour that includes water droplets is described as wet steam. As the wet steam heats up further, the droplets evaporate and, at a sufficiently high temperature (which depends on the pressure), all the water evaporates and the system is in vapour-liquid equilibrium.
Superheated steam is steam at a temperature above its boiling point for the pressure, which only occurs when all the liquid water has evaporated or been removed from the system.

20.1. BOILING POINT OF WATER

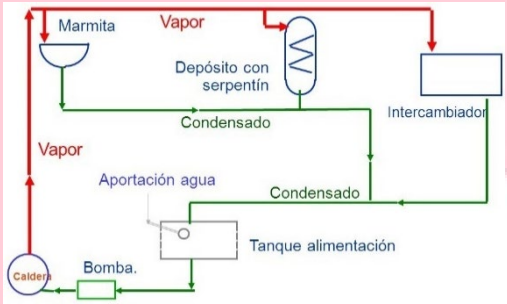
Altitud (m)	Aumento del tiempo de cocción	Tiempo en la paella
0	0	15 min
333	8%	16 min
667	16%	17,5 min
1000	24%	18,5 min
1333	32%	19,5 min
1667	40%	21 min
2000	47%	22 min
2333	55%	23,5 min
2667	63%	24,5 min
3000	71%	26,5 min
3333	79%	27 min
3667	87%	28 min
4000	95%	29 min

Altitud sobre el Nivel Del Mar [m]	Presión Atmosférica [kPa]	Punto de ebullición a Presión Atmosférica [°C]
0	101	100
500	95	98
1000	89	96
1500	84	95
2000	79	93
2500	74	92
3000	69	90
3500	65	88
4000	61	86

The normal boiling point of water is 100° C because this is the temperature at which water vapour pressure is 760 mmHg, or 1 atmosphere. This means that under normal conditions, when the pressure of the atmosphere is approximately 760 mmHg, water has a boiling point of 100° C. At 10,000 feet above sea level, the pressure of the atmosphere is only 526 mmHg. At this pressure the boiling point of the water occurs at a temperature of 90° C. The standard boiling point has been defined by IUPAC since 1982 as the temperature at which boiling occurs at a pressure of 1 bar.
The formal definition of boiling point is “the temperature at which the vapour pressure equals the ambient atmospheric pressure". Colloquially, it is said to be the temperature at which the matter changes from the liquid state to the gaseous state. Therefore, cooking times may vary depending on altitude.

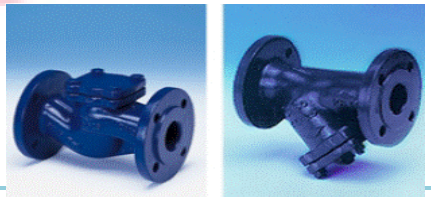
20.2. STANDARD STEAM CIRCUIT

EXPANSION VALVE



It is advisable to install an expansion (safety) valve, a shut-off valve and a filter before connecting steam to the equipment.

SHUT-OFF VALVE



FILTER

20.3. SAFETY VALVES

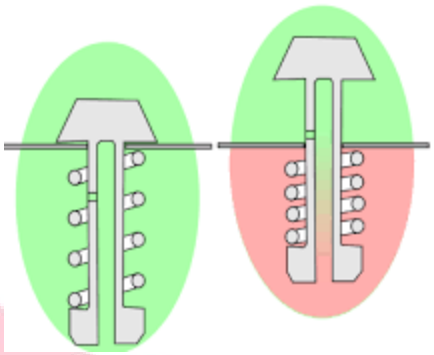
A steam safety valve is a piece of safety element that is used in order to prevent the equipment from exceeding the maximum pressure.
The valves are characterized by a very fast and complete opening, which is not proportional to the increase in pressure. These are usually spring valves and have a manual opening mechanism for testing purposes.
The set pressure is the pressure that causes the valve to trip. The set pressure of the valve must not exceed the maximum allowable working pressure.
An overpressure event is when the pressure increases above the set pressure, causing the valve to fully open.
The closing pressure is the pressure at which the valve closes.
The discharge capacity is the difference between the set pressure and the closing pressure.
There are two types of steam safety valves:

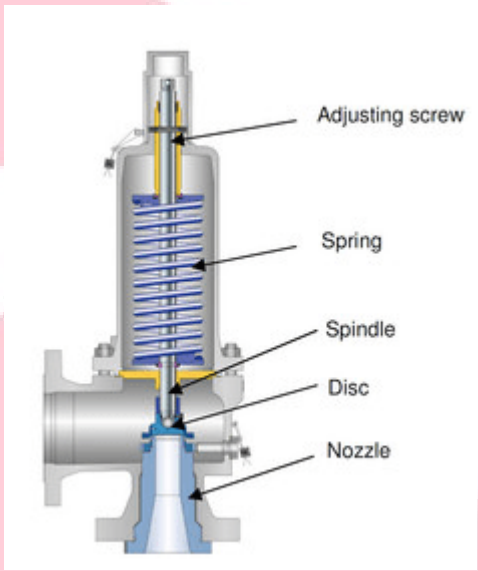
- **Instantaneous:** Easy to open. Used in steam boilers, reheaters and overheaters.
- **Relief:** Automatic and proportional opening. Used in water boilers, overheaters and hot water.

Safety valves can also have the following differences:

- **Low lift**
- **High lift**

Each valve is made up of different parts.





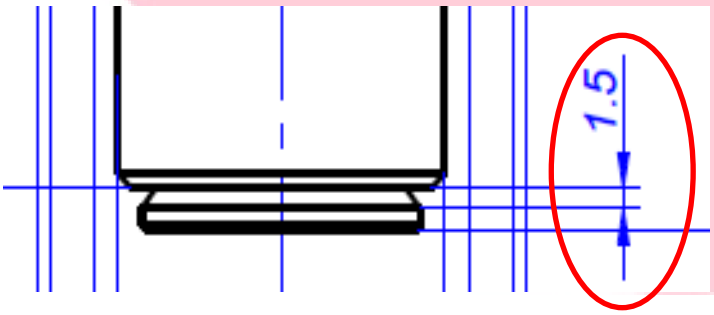
PRESSURE EQUIPMENT SAFETY VALVE

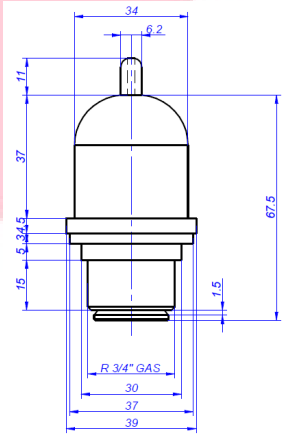
BAIN MARIE LINER SAFETY VALVE

PRESSURE GAUGE

20.3.1. BAIN MARIE LINER WORKING VALVE

The working valve of the Bain Marie liner of the indirect heating boiler (BM model boiler) has a specific regulation that must be respected. The closing cylinder must have an opening of 1.5 mm when not in use.



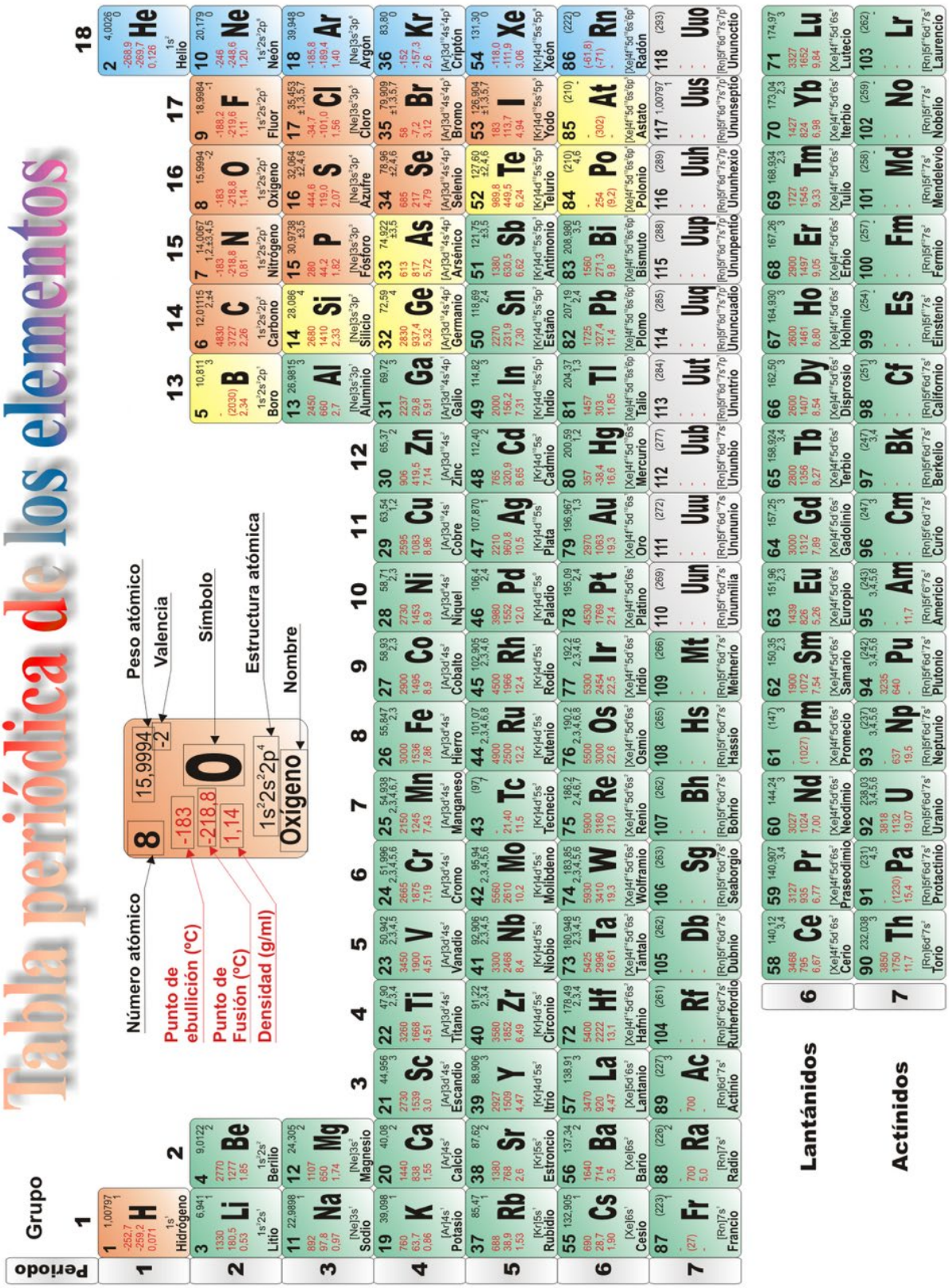


21. WATER VAPOUR PRESSURE

Tabla 1. Presión de vapor del agua líquida entre 0 °C y 373 °C

T / °C	P / mmHg	P / hPa	T / °C	P / mmHg	P / hPa	T / °C	P / mmHg	P / hPa
0	4.5840	6.1115	47	79.709	106.27	95	634.61	846.08
0.01	4.58780	6.11657	48	83.834	111.77	96	658.34	877.71
1	4.9286	6.5709	49	88.147	117.52	97	682.78	910.30
2	5.2954	7.0599	50	92.648	123.52	98	707.98	943.90
3	5.6861	7.5808	51	97.343	129.78	99	733.95	978.52
4	6.1021	8.1355	52	102.24	136.31	100	760.00	1013.3
5	6.5449	8.7258	53	107.35	143.12	101	787.57	1050.0
6	7.0158	9.3536	54	112.67	150.22	102	815.86	1087.7
7	7.5164	10.021	55	118.23	157.62	103	845.12	1126.7
8	8.0482	10.730	56	124.01	165.33	104	875.06	1166.7
9	8.6130	11.483	57	130.03	173.36	105	906.07	1208.0
10	9.2123	12.282	58	136.29	181.71	106	937.92	1250.5
11	9.8483	13.130	59	142.82	190.41	107	970.60	1294.0
12	10.522	14.028	60	149.61	199.46	108	1004.42	1339.12
13	11.237	14.981	61	156.67	208.88	109	1038.92	1385.11
14	11.993	15.990	62	164.02	218.67	110	1074.56	1432.63
15	12.795	17.058	63	171.65	228.85	111	1111.20	1481.48
16	13.642	18.188	64	179.59	239.43	112	1148.74	1531.53
17	14.539	19.384	65	187.83	250.42	113	1187.42	1583.10
18	15.487	20.647	66	196.39	261.83	114	1227.25	1636.20
19	16.489	21.983	67	205.28	273.68	115	1267.98	1690.50
20	17.546	23.393	68	214.51	285.99	120	1489.14	1985.36
21	18.663	24.882	69	224.09	298.76	125	1740.93	2321.05
22	19.841	26.453	70	234.03	312.01	130	2026.10	2701.24
23	21.085	28.111	71	244.33	325.75	135	2347.26	3129.42
24	22.395	29.858	72	255.02	340.00	140	2710.92	3614.26
25	23.776	31.699	73	266.11	354.78	145	3116.76	4155.34
26	25.231	33.639	74	277.59	370.09	150	3570.48	4760.25
27	26.763	35.681	75	289.49	385.95	175	6694.08	8924.71
28	28.376	37.831	76	301.82	402.39	200	11 659.16	15 544.27
29	30.071	40.092	77	314.58	419.41	225	19 123.12	25 495.40
30	31.855	42.470	78	327.80	437.03	250	29 817.84	39 753.85
31	33.730	44.969	79	341.48	455.27	275	44 580.84	59 436.23
32	35.700	47.596	80	355.63	474.14	300	64 432.8	85 903.3
33	37.769	50.354	81	370.28	493.67	325	90 447.6	120 587
34	39.942	53.251	82	385.43	513.87	350	124 001.6	165 321.9
35	42.221	56.290	83	401.10	534.76	360	139 893.2	186 508.9
36	44.613	59.479	84	417.30	556.35	365	148 519.2	198 009.3
37	47.121	62.823	85	434.04	578.67	366	150 320.4	200 410.7
38	49.750	66.328	86	451.33	601.73	367	152 129.2	202 822.3
39	52.506	70.002	87	469.21	625.56	368	153 960.8	205 264.2
40	55.391	73.849	88	487.67	650.17	369	155 815.2	207 736.5
41	58.413	77.878	89	506.73	675.58	370	157 692.4	210 239.2
42	61.577	82.096	90	526.41	701.82	371	159 584.8	212 762.2
43	64.886	86.508	91	546.72	728.90	372	161 507.6	215 325.8
44	68.349	91.124	92	567.68	756.84	373	163 468.4	217 939.9
45	71.968	95.950	93	589.31	785.68	373.946	165 452.0	220 584.5
46	75.749	100.99	94	611.61	815.41			

22. PERIODIC TABLE OF THE ELEMENTS



23. TEMPERATURE EQUIVALENCE

TABLA PARA CONVERSIÓN DE TEMPERATURAS

Entrando en la columna central (referencias) con la temperatura conocida (°F o °C) léase la que se desee obtener, en la correspondiente columna lateral. Ejemplo: 26 °C (columna central) son equivalentes a 78,8 °F ó bien 26 °F (columna central) son equivalentes a -3,3 °C

°C	Refe-rencias	°F	°C	Refe-rencias	°F	°C	Refe-rencias	°F
-23,3	10	14,0	20,0	68	154,4	249	480	806
-20,6	5	23,0	21,1	70	158,0	260	500	932
-17,8	0	32,0	22,2	72	161,6	271	520	968
-16,7	2	35,6	23,3	74	165,2	282	540	100 4
-15,6	4	39,2	24,4	76	168,8	293	560	104 0
-14,4	6	42,8	25,6	78	172,4	304	580	107 6
-13,3	8	46,4	26,7	80	176,0	315	600	111 2
-12,2	10	50,0	27,8	82	179,6	326	620	114 8
-11,1	12	53,6	28,9	84	183,2	338	640	118 4
-10,0	14	57,2	30,0	86	186,2	349	660	122 0
-8,9	16	60,8	31,1	88	190,4	360	680	125 6
-7,8	18	64,4	32,2	90	194,0	371	700	129 2
-6,7	20	68,0	33,3	92	197,6	382	720	132 8
-5,6	22	71,6	34,4	94	201,2	393	740	136 4
-4,4	24	75,2	35,6	96	204,8	404	760	140 0
-3,3	26	78,8	36,7	98	208,4	415	780	143 6
-2,2	28	82,4	37,8	100	212,0	426	800	147 2
-1,1	30	86,0	49	120	248	438	820	150 8
0,0	32	89,6	60	140	284	449	840	154 4
1,1	34	93,2	71	160	320	460	860	158 0
2,2	36	96,8	83	180	356	471	880	161 6
3,3	38	100,4	93	200	392	482	900	165 2
4,4	40	104,0	100	212	413	493	920	168 8
5,6	42	107,6	104	220	428	504	940	172 4
6,7	44	111,2	115	240	464	515	960	176 0
7,8	46	114,8	127	260	500	526	980	179 6
8,9	48	118,4	138	280	536	538	100 0	183 2
10,0	50	122,0	149	300	572	565	105 0	192 2
11,1	52	125,6	160	320	608	593	110 0	201 2
12,2	54	129,2	171	340	644	620	115 0	210 2
13,3	56	132,8	182	360	680	648	120 0	219 2
14,4	58	136,4	193	380	716	677	125 0	228 2
15,6	60	140,0	204	400	752	704	130 0	237 2
16,7	62	143,6	215	420	788	734	135 0	246 2
17,8	64	147,2	226	440	824	760	140 0	255 2
18,9	66	150,8	238	460	860	787	145 0	264 2
						815	150 0	273 2

24. PRESSURE EQUIVALENCE

TABLA DE EQUIVALENCIAS ENTRE UNIDADES DE PRESIÓN

bar	mbar	N/m^2 (Pa)	KN/m^2 (KPa)	mm Hg (0ºC) *torr*	mm H_2O (0ºC)	Kg/cm^2 atm (técnica)	inch Hg (0ºC)	inch H_2O (4ºC)	psi $lb/inch^2$	atm (estándar)
1	1.000	1×10^5	100	750,062	10,197 2	1,019 72	29,53	401,463	14,5038	0,986 923
1×10^3	**1**	1×10^{-2}	0,10	0,750 062	10,1972	$1,019\ 72 \times 10^{-3}$	0,029 53	0,401 463	0,014 501	$9,869\ 23 \times 10^{-4}$
1×10^{-5}	1×10^{-2}	**1**	1×10^{-3}	$7,500\ 62 \times 10^{-3}$	$1,019\ 72 \times 10^{-2}$	$1,019\ 72 \times 10^{-3}$	$2,953 \times 10^{-4}$	$4,014\ 63 \times 10^{-3}$	$1,450\ 38 \times 10^{-5}$	$9,869\ 23 \times 10^{-5}$
1×10^{-2}	10	1.000	**1**	7,500 62	$1,019\ 72 \times 10^{-4}$	0,010 197	0,295 3	4,014 63	0,145 038	$9,869\ 23 \times 10^{-3}$
$1,333\ 22 \times 10^{-3}$	1,333 22	133,322	0,133 322	**1**	0,101 97	$1,35951 \times 10^{-3}$	0,039 37	0,535 240	0,019 337	$1,315\ 79 \times 10^{-4}$
0,098 66	98,066 5	$9,806\ 65 \times 10^3$	9,806 65	73,555 9	**1**	0,1	2,895 9	39,370 1	1,422 33	0,096 784
0,980 665	980,665	$9,806\ 65 \times 10^4$	98,066 5	735,559	10	**1**	28,959	393,701	14,223 3	0,967 841
0,033 864	33,864	3.386,39	3,386 39	25,4	0,345 316	0,034 532	**1**	13,595 1	0,491 154	0,033 421
$2,490\ 89 \times 10^{-3}$	2,490 89	249,089	0,249 089	1,868274	$2,54 \times 10^{-2}$	$2,54 \times 10^{-3}$	0,073 556	**1**	0,036 13	$2,458 \times 10^{-3}$
0,058 95	68,947 6	6894,76	6,894 76	51, 714 9	0,703 07	0,070 307	2,036 02	27,68	**1**	0,068 046
1,013 25	1013,25	$1,01325 \times 10^5$	$1,013\ 25 \times 10^2$	760	10,332 3	1,033 23	29,921	406,78	14,695 9	**1**

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Service Manual