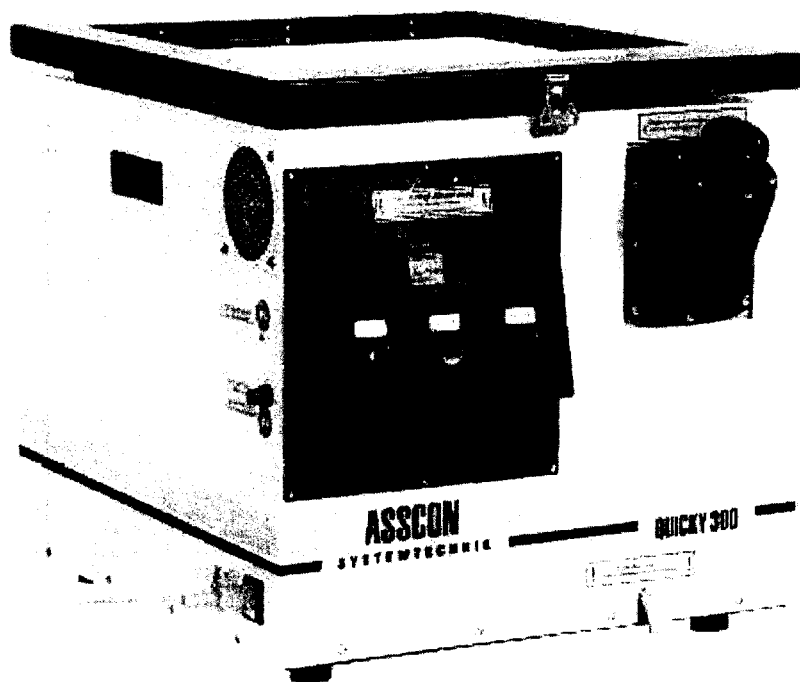


Condensation- Soldering Machine Quicky 300

Operating instructions



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Please, study this manual prior to using the Condensation System and retain it for reference near your equipment.

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1 Prior to Start-up

1.1 Description of the Process

The Condensation-Soldering Process, also known as Phase-Phase Soldering Process, entails the use of an inert, electrically non-conductive liquid that is raised to its boiling point temperature. Above the liquid a saturated, chemically inert vapor zone is created whose temperature is identical to the boiling point of the process medium in use. Once an electronic assembly is entered into the saturated vapor zone, vapor condenses on the assembly's surface until it has reached the temperature of the vapor. Any solder paste with a melting temperature below the vapor temperature is then already molten.

Modern Condensation--Soldering Systems produced by ASSCON have been developed on a single-phase -- Principle and do not use any CFC-containing chemicals.

Because of the physical principals of vapor condensation the user - may without major effort - obtain exceptional soldering results.

The major advantages of Condensation--Soldering are:

- Heating process in inert vapor zone is free of oxidation without the use of nitrogen.

- Reproducible process conditions

- No overheating of electronic assemblies

- No shadowing effect, totally homogeneous heating of assemblies

- Heating of assemblies not affected by shape or color of the product

- Because of the low surface tension of the vapor at the boiling point the vapor enters even into the smallest cracks. Thus it is possible to reproducibly solder 'hidden' areas as e.g. BGA's

- Totally reproducible soldering profile even for different assemblies, as the heating process is self-regulating due to its physical properties.

- No time-consuming establishment of temperature profiles

- Environmentally friendly process (no 'MAK' values) [MAK – according to German DIN]

- No heat radiation due to optimal insulation of the system

- Short heat-up period

- Small footprint

- Convenient microprocessor control

- Independent of cooling water due to integrated cooling water tank

- May be used to remove components in conjunctions with optional de-soldering tool

1.2 Description of the Process

The pieces to be soldered will be brought to soldering temperature by a condensation of vapor that is directly proportional to the local temperature difference and hence extremely even. Because heating takes place from the beginning by vapor condensation, the process is entirely free oxidation. The boiling point of the liquid defines the soldering temperature.

Producing the vapor:

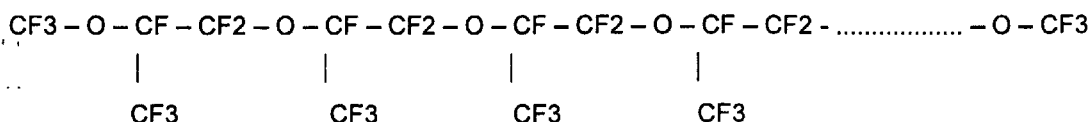
The soldering zone contains an inert liquid, which is brought to its boiling point by means of electrical heaters. Once the boiling point has been reached, the liquid does not gain in temperature. Any further energy supplied will be used to produce vapor (enthalpy of evaporation). A saturated, chemically inert vapor zone is created, whose temperature is identical to that of the boiling point of the liquid.

Vapor condenses on the surface of the product, as its temperature is lower than that of the vapor. Condensation stops as soon as the temperature of the product equals that of the vapor. Solder alloys whose melting temperatures are lower than the vapor's will have melted. The product will then be lifted from the process chamber by means of a crank.

1.3 The Heat Transfer Medium

ASSCON uses high-boiling Perfluoropolyethers manufactured by AUSIMONT. They are marketed under the trade name "GALDEN"™.

GALDEN™ – Perfluoropolyethers are liquid polymers that consist entirely of carbon (C)-, fluor (F)- and oxygen (O)-atoms. Those bonds within the molecule that C=C- and C-F-bonds are extremely sturdy. They are counted among the most stable bonds within the entire carbon chemistry. The fluor atoms bonded onto the central polymer chain protect perfectly the skeleton of the carbon and thus protect the more vulnerable C-C-bonds against chemical and thermal attack.



The liquid polymers of the Galden™ – series are all constructed according to this principle. The exhibit quite extraordinary properties:

- High thermal stability
- Excellent material compatibility
- High resistance against reactive chemicals
- Good dielectrical properties
- Low vapor pressure
- No flash point
- High vapor density

- Excellent heat transfer coefficient
- Low surface tension, good wetting properties
- Not classified as a dangerous material according to labor protection law
- No chemical activity (perfluorinated, i.e. no H- or Cl-atoms)
- No ozone depletion potential

Safety

The safety of the condensation process resulting from these properties has occasionally been questioned. However numerous studies have confirmed the positive properties beyond any doubt.

Galden™-Polymers do not burn and are extraordinarily inert towards all chemicals up to very high temperatures. They do not react with acids, bases, or strong oxidating agents. They are compatible with all known plastics, metals and elastomers. When used according to the relevant recommendation, i.e. under normal pressure and at their boiling point, all GALDEN™ products are thermally stable.

The vapor zone, due to its high density, creates an inert area that protects the assembly reliably from oxidation. The oxygen present in the molecules is chemically bonded and not available for reactions.

Galden™-Polymers have been examined for toxic breakdown products in many tests and also under process conditions. No toxic by-product has ever been detected.

The biological inertness has been proven repeatedly by relevant toxicological tests.

Thus the results of all acute and sub-acute oral and inhalation tests with rats showed a normal development of body weight. All animals survived even very high dosages (25g/kg oral), no behavioral changes were registered and the examination of all organs found no abnormalities.

All skin irritation- and eye inflammation tests on rabbits showed no evidence of formation of erythemas or edemas. Pure liquids were endured without symptoms.

A test for mutations employing microbes also yielded negative results, i.e. did not produce any signs of mutational actions.

Skin sensibility tests on 30 volunteers also came up without any indication of problems.

It is thus not surprising that Perfluoropolyethers are essential components – also because of their excellent ability to produce thin films – in expensive cosmetics.

Maybe the most impressive proof of the confidence one sets into the biological inertness of these compounds is the use of these liquids as blood replacements to transport oxygen. This research has been initiated by the recognition of the high ability to dissolve gases: a mouse survived in such a liquid like a fish does in water.

Further uses of these molecules are:

- As greases in vacuum and high-temperature applications.
- As protective coatings for buildings.
- As release agents.
- As test liquids in burn-in tests.
- Bases for creams and cosmetics.
- Cooling agent for high-performance computers.
- Blood substitute in medicine.

Heat Transfer Coefficients for different Heat Transfer Methods

Heat Transfer Coefficient [$\text{W m}^{-2} \text{K}^{-1}$]			
Natural Convection			
Water		100	to 1000
Gas	3	to	30
Infra-red – Soldering			
Heat Radiation	50	to	100
Soldering with forced convection			
Air	40	to	120
Nitrogen	39	to	119
Condensation – Soldering			
Condensing vapor of a GALDEN liquid polymer	500	to	700

1.4 Description of the Equipment

1.4.1 System Concept

The entire system is made of 305 stainless. Access to the different units of the system is possible from its front.

1.4.2 System's Control Unit

The system's control unit is located close to the manual cooling. It is housed in an integrated control box, which is manufactured following presently valid norms. This unit contains all switching, regulating and control elements for all the functional units. The appropriate switches and sensors are found in the system proper. Prior to delivery, the unit is subjected to a high-voltage test. A Micro SPS conducts the process control and management with error report structure.

1.5 Safety Features

1.5.1 External Heating

Heating of the process container is accomplished by large-dimension area-heaters that are pressed flat against the outer face of the heated surface. The maximum temperature of the heaters is monitored.

1.5.2 Process Vessel

The process vessel is made of stainless steel and fixed to the base by high-temperature sealing material. The entire unit is externally insulated in its heated section. No part of the process chamber will see temperatures above 40 °C. The energy loss is minimized and any burn hazard for users is prevented.

1.5.3 Process Chamber.

The process chamber is manufactured in 305 stainless. Cleaning is quick and possible without injuring oneself. A sensor monitors the position of the cover of the upper process chamber. Whenever the cover is open, the use of the unit is not possible.

The cover will be monitored by a sensor. By opening the cover before the end of the soldering cycle, the machine will be switched off. A start with an open cover is impossible.

Control of the height of vapour blanket

The height of the vapour will be monitored via a sensoric system. A thermo couple is placed under the cooling pipe inside the machine and the connected switch on the front side. If the maximum height and the temperature is reached, the heaters switch off.

1.6 Cooling System

When manual cooling with fresh water is used, the front displays a filling nozzle. Through it the required amount of distilled water must be entered until the high mark is reached. The amount of cooling water required for each soldering process is kept ready in a closed cooling system. After the soldering process is completed, this water will be used to cool the medium. The integrated valve opens and the water runs from the storage container via a hose into the cooling water tank.

The cooling water storage reservoir must be filled anew for each soldering process.

Attention: Only distilled water may be used as cooling water. Any damage of the system due to calcification voids the warranty.

1.6.1 Monitoring the Level of Cooling Water

The level of the cooling water is controlled via a floating switch. Is the level too low, the unit will not start or the heaters will switch off immediately.

1.7 Transport Damages

On reception, please, check the unit for damages due to transport conditions. Visible damage must be reported to the shipping agent in charge and entered into the relevant documentation. Hidden transport damages found only later must immediately be reported - in writing - to the shipping agent and the manufacturer.

1.7.1 Transport of the Unit

When transporting the unit, do not tilt it. If the unit has to be transported longer distances, the work piece carrier must be secured in its upper position by means of cable ties. Otherwise the wires could be damaged. Furthermore, the unit should be fixed to a base plate that prevents any tipping or sliding (palette or similar).

Attention: Transport the unit only in cold condition!

1.8 Set-Up and Start-Up

The system has to be placed on a level surface and in a room with normal temperature. If the environmental conditions deviate from the normal (e.g. extremely high humidity, extreme temperature variations etc.) we recommend contacting the manufacturer prior to set-up and start-up.

After unwrapping of the unit, the items securing the different parts within the system during transport must be removed. When removing the cable ties, please take care not to damage the wires of the work piece carrier.

The hose for the cooling water must be secured with the hose fastener provided, after it has been mounted on the respective tube.

The free end of the hose must be fed into a vessel that can hold at least 5 Liters. It also should be secured there against escaping from the vessel.

The reservoir for the cooling water must be filled to the rim with distilled water.

Prior to starting the process, the process liquid must be dumped in. The cooling coil at the bottom must always be covered.

The start-up of the system and training of personnel is carried out by employees of ASSCON Systemtechnik-Elektronik GmbH or its authorized agents.

1.9 Filling with liquids

- Quicky 300: 1kg

ATTENTION! Take care on the machine, that the fluid level is high enough. The cooling tube must be covered with the process fluid.

- Quicky 300 with manual cooling: approx. 3 liters distilled water.

1.9.3 Connection

To operate the unit with manual cooling you need a safety socket [German Standard] for 240 V. Protection of the electrical circuit via a ground fault detector must be installed.

On the lower left side you find a cold-contact connection that is protected by a medium slow 10A-fuse. In the case of a short please check it and if necessary, replace it.

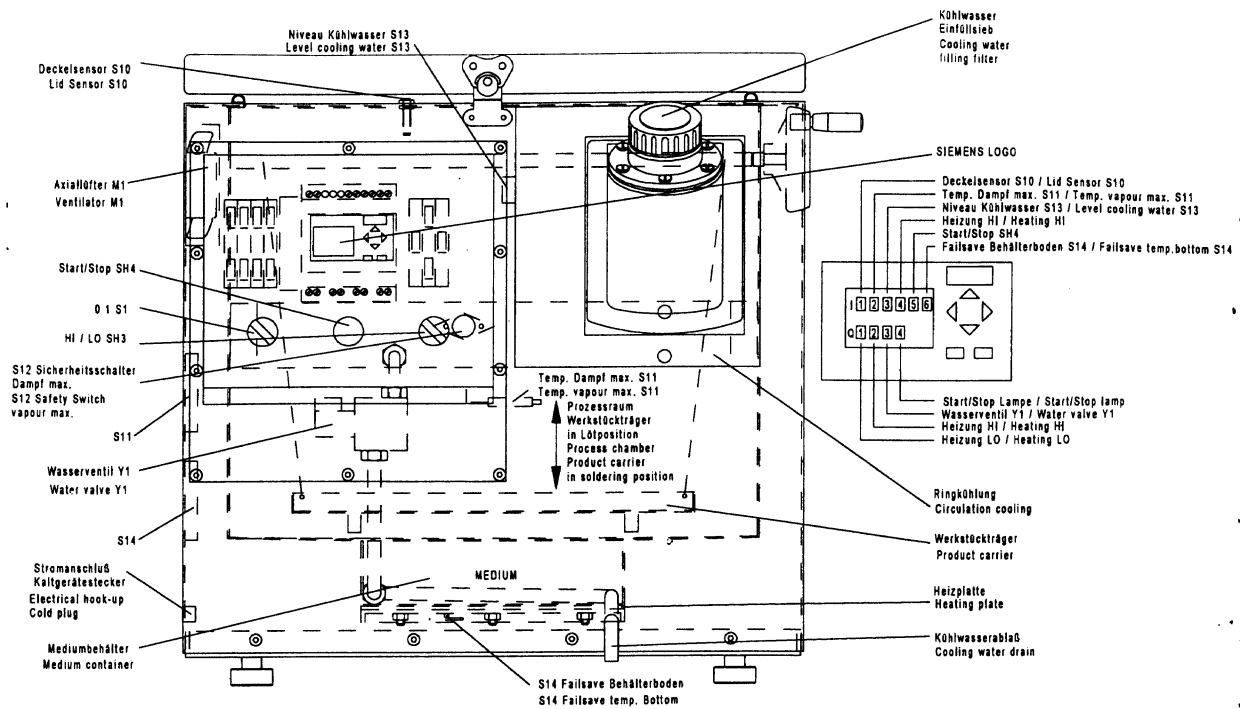
1.10 Adjusting the Sensor of the Vapor Blanket

The unauthorized tampering and thus damage to the test seal voids any warranty. We thus recommend that you always contact the manufacturer prior to making any changes.

The vapor blanket sensor S11 responsible for the shut-off of the soldering process has been adjusted at our facility for process liquids with boiling points of 200 degree Celsius and above. When a medium with lower boiling point is to be used or the sensor is replaced, the switching point has to be changed according to the following procedure:

1. Attach a thermo-element at the tip of the vapor blanket sensor S11
2. When changing to a lower boiling medium remove the old medium thoroughly from the system and then fill in the new process liquid.
3. Make the system ready for operation (fill desired medium, fill water, close cover and secure, take work piece carrier into lower position).
4. Through the hole on the left side of the housing turn the brass piece clockwise to its stop (= 300°C)
5. Heat the system on level 2.
6. As soon as the meter shows the boiling point of the medium wait an additional 60 seconds.
7. Turn the brass piece with a screwdriver counterclockwise until you hear a clear clicking noise, which indicates the opening of the switch. You may also check the state of the switch on the display.
8. The adjustment is now finished.
9. Check the adjustment of the switch by another soldering process by ensuring that the system switches off via its vapor blanket switch when the process temperature is reached.

2 Operating the System



2.1 Process Settings

A typical process sequence may look as follows:

1. Opening of the unit's cover and placing the assembly onto the work piece carrier. (upper position)
2. Closing of cover and filling of unit with distilled water until the floating switch S13 (display indication I 3 must light) is triggered. The water must reach the lower end of the thread of the filling neck.
3. Manual lowering of the conveyor to soldering position (totally down).
4. Set heating switch S3 to required energy level (HI or LO).
5. Start process by pushing pressure switch SH4 (start/stop) (lamp in button start/stop starts blinking).
6. After heat-up of the unit the saturated vapor starts condensing on the assembly and transfers the vapor's thermal energy to the PC board. Oxidizing of the assembly is impossible, as the vapor is chemically inert and no oxygen is present in that zone. The assembly's surface is heated to the temperature of the vapor. This temperature is defined by the boiling point of the liquid in use and hence can never be surpassed.
7. After the temperature of the assembly has been reached, the vapor continues to rise. As soon as the vapor reached the vapor blanket switch, the heaters are shut off and the valve for the cooling water opens. The soldering process may also be stopped manually 30 seconds after has been achieved on the entire assembly. Manual stop is initiated by pushing the soldering button once more.
8. The vapor blanket collapses after the cooling valve has been opened. The condensate remaining on the assembly evaporates without residue due to the accumulated energy within the assembly.
9. After the cooling cycle has been completed, the lamp in the soldering button switches to uninterrupted light.
10. Manual lifting of the conveyor in loading position (fully up).
11. Opening of the cover and removing the assembly.

Attention: Use gloves (provided), as assembly is still hot.

2.2 General Operating Hints

- When loading the work piece carrier care should be taken not to exceed the maximum dimensions set by the manufacturer and the maximum allowable weight. The assembly should not hang over the side of the work piece carrier nor protrude below it.
- The cover of the unit should only be opened when loading or unloading of product is required. This will ensure lowest losses of medium.
- The user must ensure that a minimum level of medium is provided. The cooling coil at the bottom of the process tank must be covered by medium.
- Only distilled water must be used for cooling. After cooling the water may be reused several times.

3 Safety Rules

To ensure problem free operation of the unit, the following safety rules should be followed:

- **Under no circumstances must the unit be opened and anyone reach in when hot. The vapor is totally transparent and leads to extremely serious burns.**
- **Unload assemblies only from the highest carrier position.**
- **Never run the unit without process medium.**
- **When unloading any assembly use the cotton gloves provided.**
- Only trained personnel should operate the unit.
- The work piece carrier and the assembly unloaded from the unit are still hot. **Caution burn hazard!**
- Malfunctions and defects on the unit must be remedied immediately.
- Never operate the unit if seals or the glass of the observation window is damaged.
- The unit must only be opened once completely cooled down.
- Only by trained and qualified personnel must carry out maintenance.
- When maintenance is carried out on electrical or mechanical parts, power must be cut to the unit.
- Under certain process conditions or during malfunctions of the water supply system the drainage tube of the cooling water may temporarily reach approximately 70 °C. In such cases the tube should only be touched wearing gloves.

4 Error Identification

4.1 Process Errors

Unit does not start.

- No or not enough cooling water. Float switch defective.
- Temperature sensor attached to unit's housing or vapor blanket sensor has not yet been set back. Sensor defective.
- Cover of unit not closed. Sensor defective.
- Heating defective.
- Safety fuse has triggered.
- Failsafe switch monitoring maximum temperature heated surface triggered. Release sensor.

5 Temperature Measurements on PCBs

To establish a temperature profile appropriate assemblies should be furnished with thermocouples. The leads may be fed through the cover seals to the external instrument.

To obtain realistic results the thermocouples should be covered by SMD adhesive or thermally conductive silicon.

6 Maintenance and Check-up

Except for a routine check of the electrical and mechanical system as to their proper performance or damage only cleaning of the interior is required as maintenance.

Attention: generally, trained and authorized personnel should only carry out work for maintenance. When working on the electrical system of the unit disconnect power by pulling the main plug.

6.1 Quality of Cooling Water.

Only distilled water must be used to cool the unit.

7 Hints when Soldering

7.1 Solder Defects

7.1.1 Solder Balls

Several different causes may be responsible for the occurrence of solder balls:

- The temperature gradient during pre-heating is too high. The solvent in the paste evaporates explosively and throws solder balls from the paste. Choose heating level 1.
- Paste has been printed onto the solder mask. (Printing error or stencil incorrect. Good results are received if the apertures are reduced by approximately 10 to 15 %)
- The paste used is too old or of bad quality or does not meet requirements.
- The stencil's or the screen's underside are dirty. Paste residues are left on the PCB's surface.
- Bad solderability of pads or component metallization inhibit wetting. Part of the paste remains on the assembly as solder balls.
- When mounting the pressure placing components into the paste is too high.

7.1.2 Wicking

Wicking refers to the rise of solder on the leads of components. The solder connection between the lead and the pad is not established.

1. The main cause of wicking is bad solderability of the pads of the assembly.

7.1.3 Tombstones (Draw-bridging)

Tombstoning describes the movement into (near) perpendicular position of certain bi-polar components (e.g. SMD- condensers and resistors). The solder paste does not melt evenly and wetting and surface tension acting on one side of the component early will tilt it.

The main causes for the tombstoning are:

1. Layout of the PCB has not (or only partly) been optimized for component geometry.
2. A bad or inappropriate solder paste is used.
3. Paste printing is uneven/or badly positioned.
4. The paste thickness is too thin. (Optimum thickness approx. 0.15 mm)
5. The apertures of the stencil are not reduced. (Optimum reduction 10 to 20%)
6. The placement accuracy is insufficient.
7. The metallization of components or pads is insufficient.

In rare cases it may happen that the solder paste has not been dried enough. Solvent may explosively evaporate and such 'mini explosions' can affect components. When proper dwell times and suitable solder paste is chosen such occurrences are practically never observed.

The causes for tombstoning most often encountered are either badly optimized pad geometries or too much or too paste thickness.

1. Pads should not be placed too far apart. Otherwise the surface tension of solder may pull the component to one side and no solder connection can establish itself then on the other side. However, pads should only extend below the component only to the extend, which allows a proper solder connection (meniscus) to be formed. The further the solder joints extend under the component, the harder will be any visual inspection.
2. A further role when laying out the pad geometry is played by the metallization of the solderable areas of components. Contrary of what we find with SMD-resistors, SMD-condensers show metallization on their side and front. Wetting the sides provides a certain counter-action to the force extolled by the wetting of the frontal areas. Thus condensers are not as prone to tombstoning as resistors.

7.2 Double-Sided PCBs

Using condensation soldering when processing double-sided assemblies is no different than the traditional methods of radiation or gas convection.

Heavy components placed on the bottom of the assembly must be glued if their mass/solderable are proportion requires it.

The use of adhesives can be avoided if, during layout, care is taken to place such components on the topside.

If heavy components have to be glued, special adhesives are available that cure at the temperatures experience in condensation environments. Documentation of such SMD adhesives is available on request from ASSCON.

7.3 Assemblies do not

- The dwell time in the soldering area is too short.
- The solder paste has a melting point, which lies above the boiling point of the liquid in use.

7.4 Choice of Solder Paste

The melting point of the solder paste used must be lower than the boiling temperature of the process medium in the unit.

When choosing a solder paste, the mildest activation or no-clean paste may be used as the soldering conditions are ideal (0 PPM residual oxygen) mildest. In general, all commercially available paste can be used. However, in individual cases one recognizes that pastes, despite of the fact that they are formulated with the same alloy, apply and solder quite differently. It is wise to test for specific important properties such as printing performance or adhesion of components.

7.5 Washing and Cleanliness of the Assembly

Whenever pastes with mildest activation or 'no-clean' pastes are used washing of assemblies may be dispensed with in most cases.

After condensation, any flux residues may be cleaned with standard cleaning methods, if required. Cleaning is usually much easier as residues are not baked onto the PCB surface.

Products processed in condensation systems generally display very minute contamination of their surfaces.

Contrary to actions in gas convection systems where volatile parts of the flux and solvent are distributed all over the assembly by the turbulent gas flow, in condensation system the product passes through a highly clean distilled vapor. No additional contamination of the assembly during heating is possible.

8 Warranty

The warranty period for the soldering system extends for 12 months after delivery.

The warranty is voided if the unit is operated not using distilled water, without process medium or changes are made to the unit, on factory settings or parts without the written consent of the manufacturer.

The general business conditions of ASSCON Systemtechnik-Elektronik GmbH apply or for OEM spare parts those of the respective vendor.