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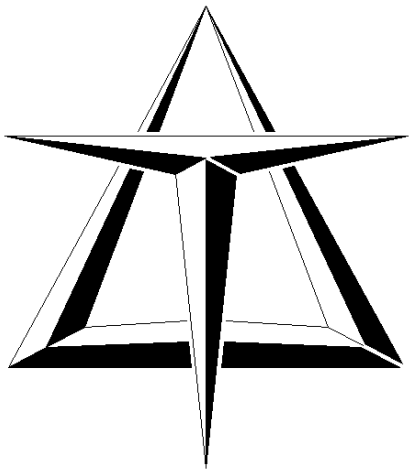
NU/ERA®

WAVE SOLDERING MACHINES



Since 1952

CONTENTS

INTRODUCTION

Technical Devices Company is the largest US owned manufacturer of wave soldering equipment. Since 1952, Technical Devices has been supplying the electronics industry with the highest quality production equipment, and has an enviable reputation for after-market service and product support. This document will provide you with an introduction to the superior technology and design incorporated into our wave soldering equipment.

The NU/ERA® Wave Soldering Machines have been designed to provide the lowest soldering defects of any wave solder machine manufactured in the world. The NU/ERA® design also not only reduces maintenance to a minimum, but also reduces the time required for maintenance procedures to be performed.

For further information about the NU/ERA® Wave Soldering Machines, please contact our factory at (310) 618-8437.

FEATURES of the FLUXER:

* TITANIUM FLUX TANK

* STAINLESS STEEL DRAIN VALVE

* CERAMIC FLUX STONE ASSEMBLY

* IN-LINE AIR FILTER AND MOISTURE TRAP

* ADJUSTABLE HEIGHT FLUXER ASSEMBLY

* ADJUSTABLE AIR PRESSURE REGULATOR

* ADJUSTABLE AIR VOLUME NEEDLE VALVE

* ANALOG AIR PRESSURE GAUGES

* ELECTRIC SOLENOID VALVE CONTROLLED BY AIR ON/OFF POWER SWITCH

ADVANTAGES of the FLUXER:

* Quick disconnect air supply hose.

* The entire tank, flux stone, and duct assembly slides out of the machine for easy maintenance and cleaning.

* Optional wave fluxer is interchangeable with standard foam fluxer.

* A stainless steel drain valve and a polyurethane hose are provided for draining flux from the tank while still in position.

* A ceramic flux stone is provided for more consistent bubble formation.

* The tank is oversized in width so that a Flux Density Controller can be added at anytime.

* The entire flux tank sits on an elevator that can be manually raised or lowered for a precise PCB-to-foam wave interface.

* The entire assembly consists of only 3 pieces; the tank, the stone, and the duct. They fit inside one another, and are readily accessible. No tools are required for removal.

Technical Devices also offers various optional spray fluxing equipment.

FEATURES of the PREHEATER HOT AIRKNIFE:

* INTEGRAL PART OF THE PREHEATER - NO ADDITIONAL HEAT SOURCE REQUIRED

* BLOWER UNIT INCLUDED - NO ADDITIONAL AIR SOURCE REQUIRED

* AUTOMATICALLY TURNS ON/OFF WITH THE PREHEATER

PROCESS ADVANTAGES of the PREHEATER HOT AIRKNIFE:

* The Preheater Hot Airknife scavenges the residual heat from the bottom side of the preheater to provide its heat. There is no additional heat source required. The Air-knife is an actual warm air stream. Its temperature will vary proportionately to the temperature of the preheater. This warm air stream preconditions the PCB and it's thermally sensitive components prior to entering the preheat section.

* The Hot Airknife generates a true "Shearing Effect" on the flux. This is because the air passes through a channeled slot rather than a tube drilled with holes. By flowing a Low Pressure and High Volume of air through a continuous "Focused Channel" we are able to achieve consistent and even fluxing of the board without disturbing the components.

* The use of a Hot Airknife at the front end of the preheater has 5 Important Advantages. The Hot Airknife will:

1. Shear off excess flux.

2. Blow flux up through the plated through holes and around any leads protruding through the board as well as around SMD bodies. This helps in the formation of better topside fillets and eliminates potential SMD skips.

3. Insure an even and complete coating of flux on the bottom of the board.

4. Start to heat and activate the flux as well as initiate the evaporative process of the water or volatiles in the flux.

5. Begin to heat the PCB prior to entering the preheater. This begins the "TOTAL THERMAL DYNAMIC PROCESS CONTROL" aspects of the NU/ERA: Initiating a positive thermal gradient thereby thermally preconditioning the PCB and its potentially thermally sensitive components prior to entering the hot preheat zone.

FEATURES of the PREHEATER:

* LOW WATT DENSITY, BLACK BODIED I.R. EMITTERS

* INDIVIDUAL, 1 INCH WIDE STRIP EMITTERS ARE USED; 3, 4, OR 6 FOOT LONG, DEPENDING ON MACHINE MODEL

* INDIVIDUAL ON/OFF CONTROL FOR EACH EMITTER ON THE NU/ERA MODELS, SETS OF TWO OR THREE ON THE MP MODELS

* INTEGRAL HOT AIRKNIFE

* PID CLOSED-LOOP CONTROL PROVIDES QUICK RESPONSE AND ACCURATE PROCESS CONTROL

* DIGITAL READOUT OF THE TEMPERATURE FOR EASE OF REPEATABILITY AND VERIFICATION OF ACCURACY

PROCESS ADVANTAGES of the PREHEATER:

The preheater is physically configured as a continuous radiating surface, comprised of 1" wide strip heaters side-by-side. This provides a uniform heated surface with a lower surface temperature, and allows for 98% of the radiated energy to reach the circuit card. This is accomplished because the lower heater surface temperatures allow the circuit board to be positioned closer to the radiating surface.

In general, long wavelength infrared is less color sensitive and better absorbed than short wavelength infrared. Its temperature determines the wavelength produced by a radiant source. Lower temperatures produce longer wavelengths. Due to its large heated area, Technical Devices' preheater operates at the lowest temperature and provides the longest wavelength infrared energy possible for given watt density. The result is more uniformly heated circuit boards, more efficient use of energy, and less energy transmitted through, and reflected from, the circuit board.

Line sources of heat, such as metal tubulars, quartz tubes and lamps, rely on reflectors that redirect 50% of the radiated energy towards the product. These reflectors become oxidized with time and coated with vaporized flux products. This dramatically reduces the efficiency of the preheater. The full surface radiant emitters employed in the Technical Devices' preheater are coated with high emissivity black paint. They function as black body radiators, do not use reflectors, and do not loose efficiency with time and use.

The full surface preheater offers the advantage of precise width control in 1" increments. There is independent on/off control of each 1" wide emitter strip. The ability to control the width of the preheat allows the width of the PCB to be the determining factor for the number of preheat emitters necessary to accommodate each individual job set-up. This means the NU/ERA is flexible and efficient; only the amount of energy necessary to cover the width of the circuit card is utilized. Tubular and quartz heaters provide little or no width control.

The Technical Devices radiant emitter is controlled by a thermocouple that is welded to the stainless steel emitter sheath. Other systems use sensors located in the air that measure neither board nor heater temperature. They must measure in this manner due to the gradual deterioration of their efficiency.

A closed loop solid-state PID controller for continuous feedback and correction controls the system. The application of the above stated method of heat sensing and control reduces the control cycle and enables an unprecedented temperature control of ± 3°F. The precision that this level of temperature control provides is crucial in achieving the process consistencies required by military and SMD material specifications.

PROCESS ADVANTAGES of the PREHEATER (continued):

The factory set preheater position is such that there is a greater distance between the preheater and PCB at the entrance end of the preheater; every foot of preheat reduces the preheat-to-PCB clearance by approximately 0.125 inches. With the preheater positioned in this manner, it carries a positive ramp relative to the angle of the conveyor. This means, as the PCB travels through the conveyor it is constantly getting closer to the preheater producing a virtually linear thermal profile. The angle and height of the preheater is adjustable to enable virtually infinite thermal profile manipulation.

- The NU/ERA® preheater fits flush up against the entrance side of the solder pot. This is very important, as it eliminates the air gap between the preheater and the solder pot, insuring the board does not suffer a significant thermal loss prior to entering the solder wave. If there were an air gap between the preheater and the solder pot, the components may begin to cool instead of receiving heat. At this instant the components are acting as heat generators instead of heat receptacles, due to the ambient temperature suddenly being lower than their own body temperature. This further increases the temperature delta between the bottom side SMD's and the first solder wave temperature. As this delta increases, the risk of THERMAL STRESS is increased

The entire preheater assembly is on wheels enabling it to be easily moved on the machine deck for cleaning and/or maintenance. It has a long, flexible liquidtite electrical conduit that allows for the removal of the preheater assembly from the machine chassis, without disconnecting the wiring.

In addition, there is no gap between preheater modules on multiple – module systems as seen on competitive machines. This provides for a constant temperature rise through the entire approach.

AVAILABLE OPTIONS

* TOPSIDE TUNNEL (Generally suggested for the 4 –6 Layer PCB.)
* TOP SIDE BLACK BODY I.R. PREHEATER (Generally suggested for 6 or more layer PCBs.)
* TOP SIDE CONVECTION PREHEATER – Identical to our topside black body I.R. Preheater with the addition of two blowers. These blowers gently force air back sown into the preheat chamber creating a very uniform atmosphere.

FEATURES of the SOLDER POT AND PUMP (S):

* LIFETIME WARRANTY ON THE PUMP HOUSINGS AND PROPELLER ASSEMBLIES

* NO BEARINGS IN THE SOLDER

* LOW SOLDER TEMPERATURE PUMP PROTECTION

* SOLDER WAVE HEIGHT CONTROLLED THROUGH VARIABLE SPEED MOTOR CONTROL

* ACCURATE WAVE HEIGHT PROCESS REPEATABILITY

* AUTOMATIC ON/OFF 7-DAY SKIP TIMER FOR THE SOLDER HEATERS

* PID CLOSED-LOOP TEMPERATURE CONTROLLER (S)

* DIGITAL SOLDER TEMPERATURE READOUT (S)

* LEAST DROSS FORMATION OF ANY MACHINE ON THE MARKET

PROCESS ADVANTAGES of the SOLDER POT and PUMP (S):

The NU/ERA® is available with the DANCER® Dual Wave, Dual Temperature Control System. Up to 50 ^{o}F Delta between the Dancer and Laminar wave temperatures on the Dancer System can be achieved. The typical operating temperatures for the Dancer / Laminar Waves are 470 and 500 ^{o}F respectively, providing a more consistent thermal profile. This is more critical in SMD wave soldering than in through-hole wave soldering, yet it is important in both cases.

The NU/ERA® solder pumps use propellers instead of impellers. Our low speed propeller design lifts solder in to the pump and gently pushes solder up through the inner duct, until it flows smoothly over the top duct. Other pumps use impellers that rotate at high speeds, thereby accelerating the solder to a high velocity as it enters the ducting. More baffling is necessary to smooth out the solder flow, increasing the difficulty and amount of time required for maintenance.

THERMAL DYNAMICS

* By having independent solder wave temperatures, the first wave that the PCB comes in contact with, the Dancer, can be lowered in temperature to reduce the risk of Thermal Stress. The second wave, the Laminar, can then be operated at the optimum temperature for solder peel-back, approximately 500 ^{o}F with SN63/37. Thus, there is no compromise between component integrity and optimum solderability as there is with any wave soldering system that does not offer independent solder temperature control.

* The distance between the two waves in the pot is also critical for the enhancement of the heating and the wetting action of the pads and also in the formation of better topside fillets through proper thermal dynamics. This especially holds true with more thermally difficult boards, in particular, multi-layer boards.

* The Dancer System has a medium distance between the two waves. This means that when the PCB exits the first wave it travels 3.5 to 4.0 inches before it makes contact with the solder of the second wave. This distance allows the heat of the solder in contact with the component lead to transfer through conduction to the topside of the board. This has proven to be a very successful and effective method of over-coming Thermal Barriers that are often created by heavy ground and/or power planes, and enables full topside fillets by providing proper Thermal Dynamics.

PROCESS ADVANTAGES of the SOLDER POT and PUMP (S) (Continued):

* On units that have a short distance between the waves (any distance less than 2.0 to 2.5 inches of travel between the contact of the solder waves), the time between the waves is not long enough for maximizing the thermal rise gained by the dwell effect that takes place between the two waves.

* Conversely, on units with a long distance between the waves (any distance greater than 4.5 to 5.0 inches of travel between the contact of the solder waves), the time between the waves is so great that the thermal rise is optimized and then lost. This means that the component leads above the board achieve the optimum heat and then loose it before entering the second wave.

* Thus, a medium distance between waves will give you the highest yield in Thermal Dynamic benefit in the use of dwell time for improving topside fillets.

* Because of the efficiency in the transfer of heat by properly positioned waves you can lower the preheat temperature or speed up the conveyer. The overall effect is...

1) AVOID OVERHEATING - When you use a lower preheat temperature, you use less preheat energy and avoid overheating parts and components on the PCB.

2) REDUCE THERMAL GRADIENTS - Using a reduced preheat temperature means less thermal gradient will occur through out the PCB.

3) LOWER PCB TEMPERATURE - When the conveyor speed is increased, while maintaining the same preheat temperature, the overall effect is increased throughput and decreased heat to the PCB.

4) WIDER PROCESS PARAMETER WINDOW – less likely to burn flux.

WAVE DYNAMICS

* One of the most beneficial features of the NU/ERA® wave generating system is the adjustable characteristics of the waves. Because of Technical Devices superior wave dynamics, stable wave profiles can be achieved at various wave heights and shapes. This allows the operator to set the proper wave dynamics for each individual board, enabling optimum soldering flexibility.

* All NU/ERA® models have Technical Devices' exclusive "Step-Wave", to produce "Variable Wave Dynamics". The wave dynamics can easily be altered by merely increasing or decreasing the solder pump speed.

PROCESS ADVANTAGES of the SOLDER POT and PUMP (S) (Continued):

VARIABLE WAVE DYNAMICS

FLAT or PASSIVE WAVE - Produced by operating the wave at low solder pump RPM. In appearance it is virtually flat across its top surface, with a slight downward angle toward the exit side.

The FLAT WAVE offers the following benefits:

1) LONGEST POSSIBLE SOLDER DWELL TIME - The flatter the wave, the greater the solder contact area. The FLAT WAVE profile is normally achieved at low wave heights, consequently, the conveyor will be at a relatively low height. With the conveyor in this position a lower angle of interface to the solder will be produced (as low as 4 degrees), again contributing to a larger solder contact area.

2) MATCHED SOLDER EXIT VELOCITY WITH CONVEYOR SPEED (at speeds greater than 2 feet per minute)- When the solder exit velocity equals the speed of the PCB as it is passing through the solder, potential flags are eliminated and icicles are greatly reduced, if not completely eliminated.

3) NATURAL SOLDER PEEL-BACK - The FLAT WAVE profile produces a passive flow of solder. This allows the solder to peel-back from the bottom of the PCB in a natural manner.

4) LOW DROSS - This wave profile flows solder at a relatively low speed, which provides a very smooth reentry of the solder back into the solder bath. Thus, reducing the prime contributory factor to dross formation in the solder pot - turbulence at solder reentry.

AGGRESSIVE WAVE - Produced by operating the wave at relatively high solder pump RPM. In appearance, it has a rounded crest extending upward, above what would otherwise be the top surface of the solder, on the entrance side of the wave. The crest is formed from the FLAT WAVE by increasing the pump RPM. It is variable in its height and width - up to 0.375" in height and up to 1.5" in width.

This aggressive wave was designed and developed for the specific purpose of enhancing the solderability of PCBs that was not designed for wave soldering.

HOT AIRKNIFE – Technical Devices offers, as an option, a hot airknife after the Laminar Wave. This hot airknife assists in eliminating solder bridges caused by poor board design. The airknife gently blows hot air at the bottom side of the printed circuit board at the point where the board is exiting the laminar wave.

PROCESS ADVANTAGES of the SOLDER POT and PUMP (S) (Continued):

* DEFINITION: VERTICAL VELOCITY VECTORS is a reference to the directional force of the points of interface between the solder wave and the PCB. I.E., the solder is flowing in a vertical direction when it contacts the PCB.

The AGGRESSIVE WAVE offers the following benefits:

1) RELIEVES EXCESS SOLDER - Excess solder on the bottom side of the PCB is typically a result of a mechanical resistance on the surface of the PCB, just behind the excess. The excess occurs because the solder was physically not allowed to peel off of this point of the PCB at the correct point of exit from the solder wave. Thus, the PCB travels far enough from the heat source, the solder wave, that an excessive amount of solder clings to the PCB rather than wetting and releasing properly. The AGGRESSIVE WAVE relieves excess solder by interfacing the PCB with its "Vertical Velocity Vectors". In so doing, it drives the excess solder from the bottom of the PCB with a mechanical sheering effect.

2) ADJUSTABLE SOLDER DWELL TIME - The length of time that the PCB is in contact with the solder may be varied by altering the wave shape.

The wave shape may be varied by increasing or decreasing the pump speed. Starting with a Flat Wave, increasing the pump speed will cause a crest to appear on the top surface of the wave at the PCB entrance side. The crest will increase in height above the flat surface of the wave proportionately with the increase in pump speed. It will also decrease in width as it increases in height. This provides the means of varying the potential solder contact area, or solder dwell time.

TO INCREASE OR DECREASE SOLDER DWELL TIME

A) Increase or decrease the pump speed without changing the conveyor height
B) Lower or raise the conveyor height without changing the pump speed
C) Decrease or increase the pump speed and lower or raise the conveyor

MAINTENANCE ADVANTAGES of the SOLDER POT and PUMP (S):

THE DRY WAVE

* The NU/ERA® utilizes a dry wave. The wave, when correctly adjusted, will achieve consistent, and reliable solder joints, with the potential for zero defects.

* The NU/ERA® Dry Wave System has been designed specifically to minimize dross production. Through extensive Research and Development, Technical Devices developed an exclusive dross inhibitive wave design.

* Our studies lead us to one predominant factor as the major dross-producing element of a wave soldering system--"Solder Reentry". Most of the dross produced in a wave soldering system occurs when the solder reenters the solder bath. Consequently, controlling the flow of the solder back into the solder bath will do more to reduce the occurrence of dross than any other single factor.

MAINTENANCE ADVANTAGES of the SOLDER POT and PUMP (S) (Continued):

SOLDER REENTRY

Controlling "Solder Reentry" can be broken down into two primary aspects:

1) TURBULENCE - Dross production will increase proportionately with the increase of turbulence that is present at the point of solder reentry into the bath.

2) VELOCITY - Turbulence at the point of solder reentry is increased as the solder's velocity increases. The occurrence of dross being driven down to the bottom of the solder pot and pumped into the solder wave increases directly with the augmentation of the solder's velocity upon reentry.

DESIGN ADVANTAGES

As a result of these findings, we added the following design advantages:

1) REDUCED the SOLDER WAVE-TO-BATH DISTANCE - This effectively reduced the solder reentry velocity for any given wave height, allowing better control and less turbulence of the solder upon reentry into the bath.

2) SOLDER REENTRY BAFFLE - The baffle hangs over the solder pot wall immediately in front of the entry side of the Laminar Solder Wave (easily removed for cleaning without tools). It is very beneficial in reducing turbulence at the point of solder reentry, and virtually eliminates the occurrence of dross being carried into the solder wave.

NOTE: Actual dross produced will vary depending on wave height, solder level and temperature, type of flux, production volumes, and board design.

EASE of MAINTENANCE FEATURES

ROLL OUT SOLDER POT - The entire pot and pump assembly is motorized and rolls out on a stand to enable full access for ease of maintenance. The stand can be folded up flat against the back of the machine when not in use.

CARTRIDGE HEATER ELEMENTS - Accessible from the rear of the pot, they are slid in to stainless steel tubes to allow easy removal and replacement, they can be removed regardless of the solder status. The heating elements are allowed to thermally expand and contract without buckling or bowing. The tubes themselves are welded to the pot at the rear wall (they are approximately 2 inches shorter than the solder pot). Support brackets are mounted in four locations along the length of the tubes.

L.E.D. SOLDER POT HEATER ELEMENT STATUS INDICATORS - Available as an option on all manually controlled NU/ERA's, and standard on the MP computer controlled models. An induced current is sensed as electricity flows through the individual heaters. If a heater fails, the flow of current stops, and the induced current stops. At this time, the LED, which is lit by the induced current, goes off, indicating which heater has failed.

FEATURES of the CONVEYOR SYSTEM:

* DIGITAL CONVEYOR SPEED READOUT

* TORQUE COMPENSATING CLOSED LOOP SPEED CONTROLLER.

* MOTORIZED CONVEYOR HEIGHT ADJUSTMENT

* FRONT PANEL CONTROL FOR CONVEYOR HEIGHT ADJUSTMENT

* CONVEYOR HEIGHT CONTROL REPEATABLE TO +/- 0.001 INCH

* QUICK CHANGE FINGERS (NO TOOLS REQUIRED)

* NO METAL-TO-METAL CONTACT BETWEEN FINGERS AND RAILS

* TEFLON WEAR STRIPS

* ABILITY TO INTERMIX "V" AND "L" SHAPED FINGERS

ADVANTAGES of the CONVEYOR SYSTEM:

The conveyor rails are made from a single section hard-anodized aluminum extrusion, which is designed to enhance the absorption and transfer of heat uniformly throughout its length. This design provides for straightness and parallelism in the conveyor system. An absolute deviation of only +/ - .005 from the true parallel is guaranteed.

The lead screws are fitted with precision balls and are supplied in matched pairs, having a runout of no more than 0.002 per 12 inches of travel between rails.

The conveyor system is solidly attached to the main frame of the solder machine by fixed supports at the entrance end, and pivoting supports at the exit end. This allows for linear expansion of the rails due to heat.

The conveyor is driven directly from the drive motor through a pair of fixed gears, sleeved spline shafts, and harmonically balanced U-joints.

There is a motorized height adjustment for the conveyor, actuated through a switch located on the front panel.

The titanium conveyor fingers are riveted to injection molded, fiber filled Teflon guide blocks. These blocks ride on an extruded surface inside the conveyor rail, and are driven by a roller chain. The chain rides on top of the finger guide blocks, never contacting any metal surfaces. The finger/guide block can be quickly disconnected and replaced, without the use of tools. A +/- .003 tolerance between finger " V's" and rails is assured for consistent, accurate PCB-to-wave interface. **This is the tightest tolerance in the industry.**

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