

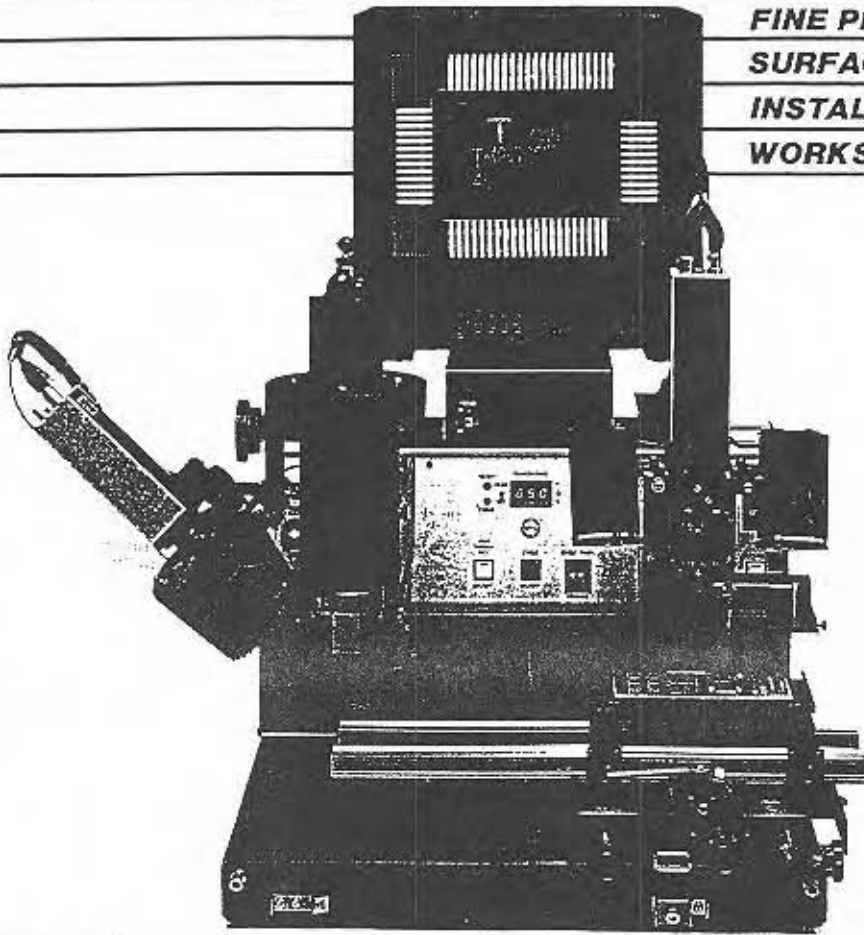
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INCORPORATED

CRAFT[®] 25/25E

**FINE PITCH
SURFACE MOUNT
INSTALLATION/REPAIR
WORKSTATION**



**OPERATION/
MAINTENANCE
MANUAL**

CRAFT® 25/25E

MANUAL NO. 5050-0219
REV. C

GENERAL INFORMATION

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CRAFT 25 GENERAL INFORMATION

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CRAFT 25 GENERAL INFORMATION

INTRODUCTION

The CRAFT 25 represents a major new advancement in Surface Mount Technology (SMT) work stations. With its advanced "Two-Head" system, the CRAFT 25 provides the best view of component leads and substrate lands for perfect alignment and placement of any type of component.

The the placement station, extended lead Surface Mount Devices (SMDs) are targeted and aligned with the precise X, Y, THETA controlled work platform aided by an unobstructed top view (using video camera, stereo microscope or lens) in which all four sides of the component are seen at once. After placement with the precise Z—axis controlled vacuum pick, the precision indexing table brings the work over to the reflow head where the component is perfectly aligned under the nozzle ready to be reflowed.

For PLCCs, LCCs and similar components, alignment and placement is best achieved with a 45 degree view from vertical of the leads and lands provided at the reflow head by a video camera or stereo microscope.

For component removal or installation, the CRAFT 25 provides total reflow process development and control. Utilizing either shop air, inert gas or the self-contained air blower, pressure/flow rate is easily controlled and maintained at optimum levels for the particular task at hand. Closed-loop, gas/air temperature control with digital "set" and "read" capability allows easy adjustment and repeatability of optimum reflow temperatures and (in conjunction with a selected flow rate) ramp-up rates. Reflow cycle time control, adjustable in one second increments, provides consistent, repeatable results in successive reflow operations.

Based on extensive thermal analyses in PACE's laboratories, the CRAFT Process Development Chart has been created to aid in the development of customized reflow processes for your particular SMD tasks.

CRAFT 25 GENERAL INFORMATION

SPECIFICATIONS

POWER REQUIREMENTS:

CRAFT 25 (DOMESTIC VERSION)—115 VAC, 60 HZ, 12.8 AMPS, 1500 WATTS
CRAFT 25E (EXPORT VERSION)—230 VAC, 50 HZ, 6.5 AMPS, 1500 WATTS

PHYSICAL PARAMETERS:

23" H × 20" W × 22" D
(58 cm. H × 51 cm. W × 56 cm. D)
WEIGHT—67 lbs. (30.4 kg.)

CIRCUIT BOARD CAPACITY:

STANDARD: 9" W × 18" L (23 cm. W × 46 cm. L)
WITH EXTENDED RAIL OPTION: 18" × 18" (46 cm. W × 46 L)

COMPONENT CAPACITY:

1.8" × 1.8" maximum
(4.6 cm. × 4.6 cm.)

PRODUCT APPLICATION

The following sections of this manual will familiarize you with the parts and operation of the unit. This product is very versatile however, and may be used to satisfy a variety of application requirements. If you require assistance in the use of this product in your particular application, contact your local authorized PACE dealer or call PACE Applications Engineering at (301) 490-9860.

ACCESSORIES

AVAILABLE OPTIONS

The options listed below are items which may be purchased to enhance the capabilities of the CRAFT 25 system. Each of the items listed are configured for easy connection to the CRAFT 25 unit using the instructions listed in this manual. See the "TABLE OF CONTENTS" for location of the instructions and part number listing of each option.

MICROSCOPE

1. 4X MICROSCOPE—(P/N 6018-0048) May be mounted on either Station 1 (Reflow Station) and/or Station 2 (Placement Station) for viewing of component and PCB land area. 4X power is obtained by using 10X eyepieces with a built in 0.4X objective lens ($0.4 \times 10X = 4X$). Requires purchase of Reflow Head Microscope Mount when used on Reflow Station.
2. REFLOW HEAD MICROSCOPE MOUNT—(P/N 6018-0049) Allows the 4X microscope to be mounted on Station 1 (Reflow side) of the CRAFT 25 unit. No mount is required for attachment to Station 2 (Placement side).
3. 20X EYEPIECES—(P/N 1106-0033) Used on the 4X microscope to change the power to 8X ($0.4X \text{ objective} \times 20X \text{ eyepieces} = 8X$).
4. 2.5X OBJECTIVE LENS KIT—(P/N 6018-0050) Screws onto microscope and focus mount. Increases magnification by 2.5 times (e.g. $2.5 \times 4X = 10X$) and repositions Microscope for proper focus.

LIGHTING SYSTEM

1. DUAL HALOGEN LIGHTING SYSTEM (P/N 7007-0011)—Provides a dual light source for use with video and/or microscope viewing systems. Can only be mounted to the CRAFT 25 system by using one of the mounts (video and/or microscope) listed above.
2. POLARIZER KIT (P/N 6018-0058)—Used with lighting system and Video camera to minimize viewing glare.

REMOTE CONTROL (P/N 6018-0047)

Allows the operator to remotely activate the CRAFT 25 heat cycle plus both Station 1 and Station 2 vacuum controls. The control may be placed at the operator's fingertips for greater convenience.

PREHEATING SYSTEM (P/N 8040-0001 (115 volt), 8040-0002 (220 volt))

HS-150/150E SYSTEM

A self-contained unit designed to provide auxiliary heat to the printed circuit board prior to and during removal or replacement of component(s). The unit may be set securely onto the CRAFT 25 work platform and is recommended to minimize thermal shock and to facilitate repair of multilayer or high power dissipation pc assemblies.

ACCESSORIES

AVAILABLE OPTIONS (Cont'd)

NOZZLES

1. **STANDARD NOZZLES**—A selection of standard nozzles are available for use on the CRAFT 25 system and may be ordered using the Standard Nozzle Replacement Parts List shown on pages 50 thru 52 of this manual.
2. **CUSTOM NOZZLES**—PACE can prepare special nozzle configurations to address any specific requirements not satisfied through the use of standard nozzles. Contact PACE directly at (301) 490-9860 (FAX # 301 498-3252) for assistance.

PCB CAPACITY ENHANCEMENT

1. **EXTENDED RAIL KIT**—(P/N 6993-0126) The CRAFT 25 is equipped to allow for rework of PCB assemblies with physical dimensions of up to 12 inches by 18 inches (30.5 cm × 46 cm). Extra length rails may be ordered as options to allow for rework of PCB assemblies as large as 18 inches by 18 inches (46 cm × 46 cm).
2. **PCB TEMPLATE KIT**—(P/N 6018-0064) Allows the user to support large PCB assemblies on the CRAFT 25 unit. Kit contains two board edge support rails with PCB tooling hole mounting capability and an adjustable center support.

SERVICE/MAINTENANCE

1. **Service/Maintenance Manual**—(P/N 5050-0261) Will assist the technician in performing preventive maintenance, corrective maintenance and temperature calibration on the CRAFT 25 system.
2. **Alignment Kit**—(P/N 6018-0053) Contains tools which allow the technician to easily check and adjust the alignment of the Reflow Head, Placement Pickup Assembly and Component Cubby with respect to each other.

VIDEO

PACE offers the following video mounting mechanisms as interfaces for attaching video cameras and monitors to the CRAFT 25 system.

1. **VIDEO MOUNT (Reflow stn.)**—(P/N 6018-0072) Used to mount a video camera to the Reflow Station (at a 90° angle to the workpiece) for observation of the placement process.
2. **VIDEO MOUNT (Placement stn.)**—(P/N 6018-0071) Used to mount a video camera to the Placement Station (at a 90° angle to the workpiece) for observation of the placement process.
3. **MONITOR MOUNT**—(P/N 6018-0044) A universal type metal bracket which permits the selected video monitor to be directly mounted onto the top center of the

ACCESSORIES

VIDEO SYSTEM

Listed below is the Video system which PACE provides for use with the CRAFT 25 and is easily attached to the unit.

COLOR SYSTEM

QTY. REQ. COMP. SYSTEM	DESCRIPTION	PART NUMBER
2	Color Camera	1107-0013
1	Color Monitor	1107-0007
1	Power Supply	7008-0177
2	Camera Kit	6018-0065
	Complete Color System (Domestic)	6018-0054
	Complete Color System (Export)	6018-0056
	Complete Color System (Export, Less Monitor)	6018-0061

ACCESSORIES

VIDEO CAMERA REQUIREMENTS

The following guidelines must be followed if the user of a CRAFT 25 system wishes to purchase a video camera system other than those recommended by PACE. Use the illustration as a guide for each of the parameters.

1. The lens mount of the Video Camera body must be centered 1.08 inches (2.74 cm.) from the camera mounting point.
2. The width of the Video Camera body must not exceed 2.75 inches (6.99 cm.).
3. The length from the end of the lens to the center of the camera mounting point shall not exceed 5.27 inches (13.39 cm.).
4. The camera mounting point shall have a 1/4-20 tapped hole.
5. The total combined weight of the camera and all attachments (including lights) must not exceed 4 lbs. (1.81 kg.).

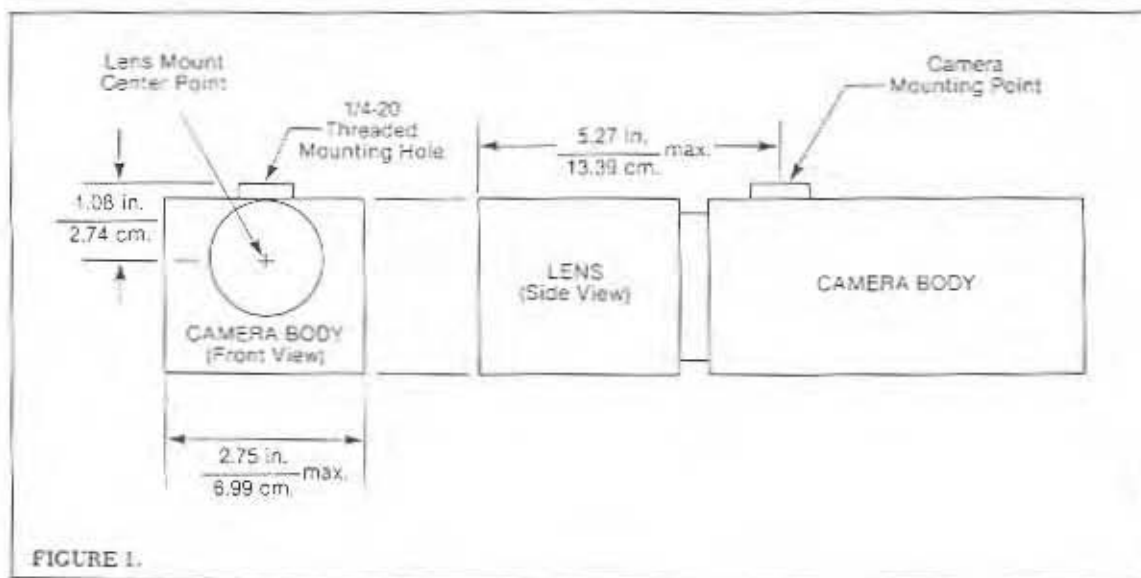


FIGURE 1.

CRAFT 25 SYSTEM IDENTIFICATION

BASE UNIT

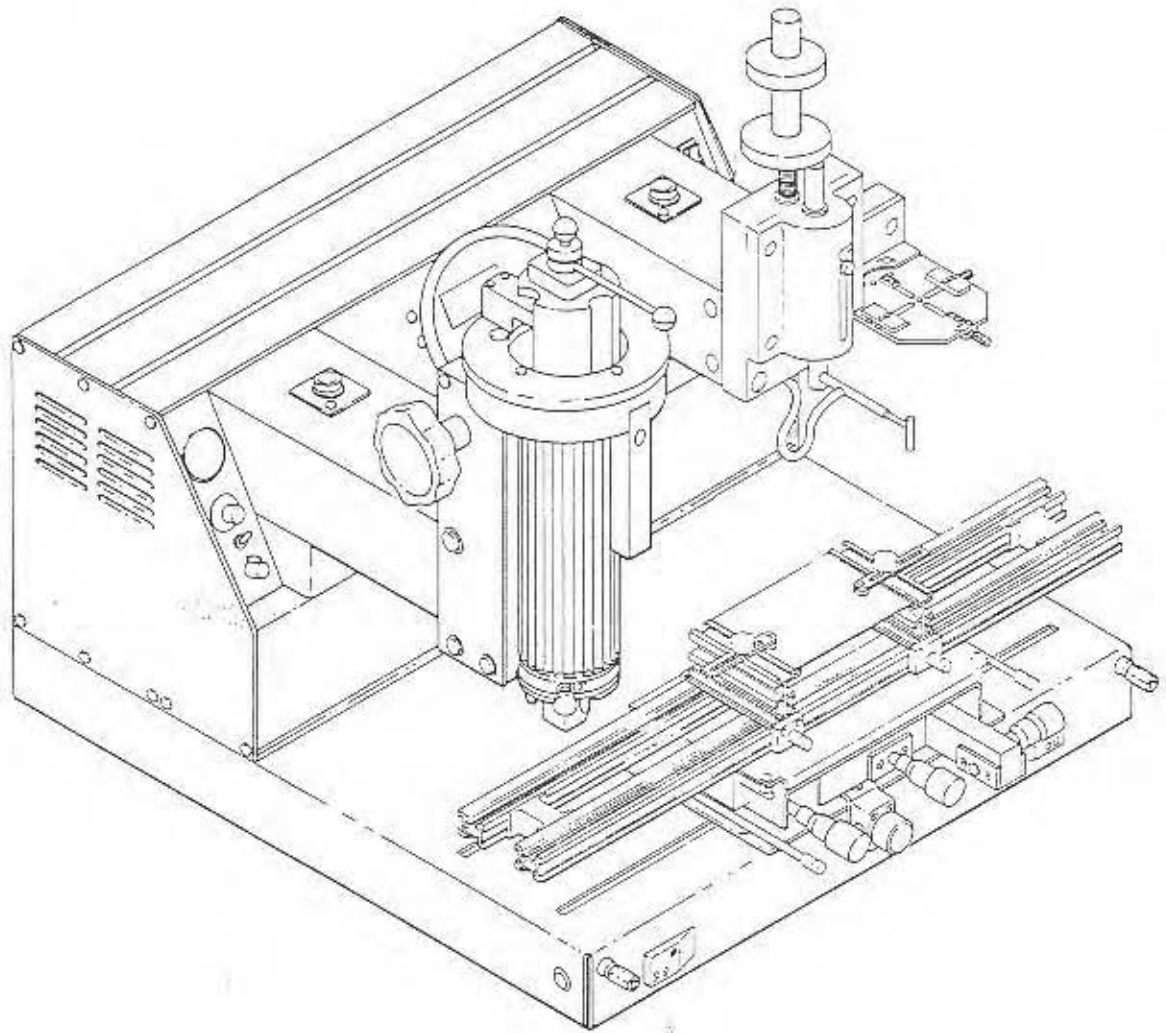


FIGURE 2.

CRAFT 25 SYSTEM IDENTIFICATION

CONTROL PANEL

1. MAIN POWER SWITCH—Provides input power to unit.
2. AUXILIARY VACUUM SWITCH—Activates vacuum for station 2 pickup device.
3. GAS/AIR PRESSURE GAUGE—Indicates air pressure level from compressed air or gas supply.
4. GAS/AIR PRESSURE CONTROL—Allows regulation of compressed air or gas pressure flow.
5. GAS/AIR BLOWER SWITCH—Allows selection of compressed air or internal blower supply to heater.
6. BLOWER SPEED CONTROL—Allows control of blower speed to regulate air flow to heater in blower mode.
7. READY LIGHT—Turns on when Heater achieves operating temperature and is ready for operation.
8. CYCLE LIGHT—Turns on when heater is in reflow cycle.
9. TEMPERATURE DISPLAY—Three segment display for heated air temperature readout. Temperature shown is air temperature at top of nozzle.
10. READ/SET SWITCH—Allows temperature display to show set temperature level in set mode or actual temperature in read mode.
11. °F/°C SWITCH—Provides either °F or °C readout on temperature display.
12. SET CONTROL—Allows user to set operating temperature of heater.
13. MAIN VACUUM PICK SWITCH—Push-push switch controls vacuum supply to station 1 pickup assembly.
14. CYCLE SWITCH—Push switch starts air flow through heater initiating reflow cycle. Deactivates air flow when pushed during a reflow cycle.
15. CYCLE TIMER—Manually resettable timer, controls duration of heat.

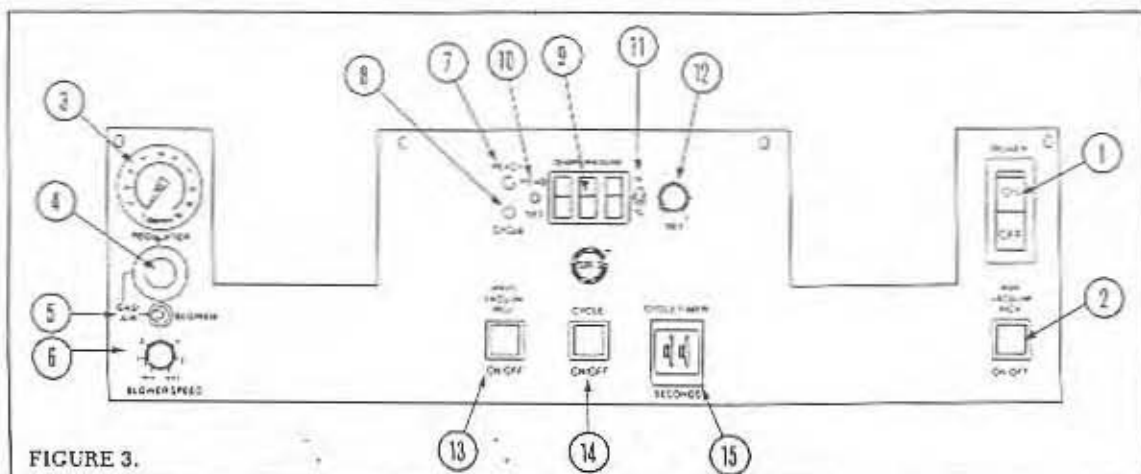


FIGURE 3.

CRAFT 25 SYSTEM IDENTIFICATION

WORK PLATFORM

Provides an adjustable surface to clamp printed circuit board assemblies for rework.

16. THETA ROTATION KNOB—Fine adjustment control which rotates platform about its center axis.
17. COARSE X-AXIS ADJUSTMENT SLIDE—Allows clamped pcb assembly to be shifted side to side easily and locked into place.
18. FINE X-AXIS ADJUSTMENT KNOB—Allows precision side to side movement of the work platform. Maximum travel of $\pm 3/8$ inch from center position.
19. COARSE Y-AXIS ADJUSTMENT SLIDE—Allows clamped pcb assembly to be shifted front to rear on the work platform and locked into place.
20. FINE Y-AXIS ADJUSTMENT KNOB—Allows precision front to rear movement of the work platform. Maximum travel of $\pm 1/2$ inch from center position.
21. CLAMP ASSEMBLY (2)—Locks printed circuit board assembly onto work platform.

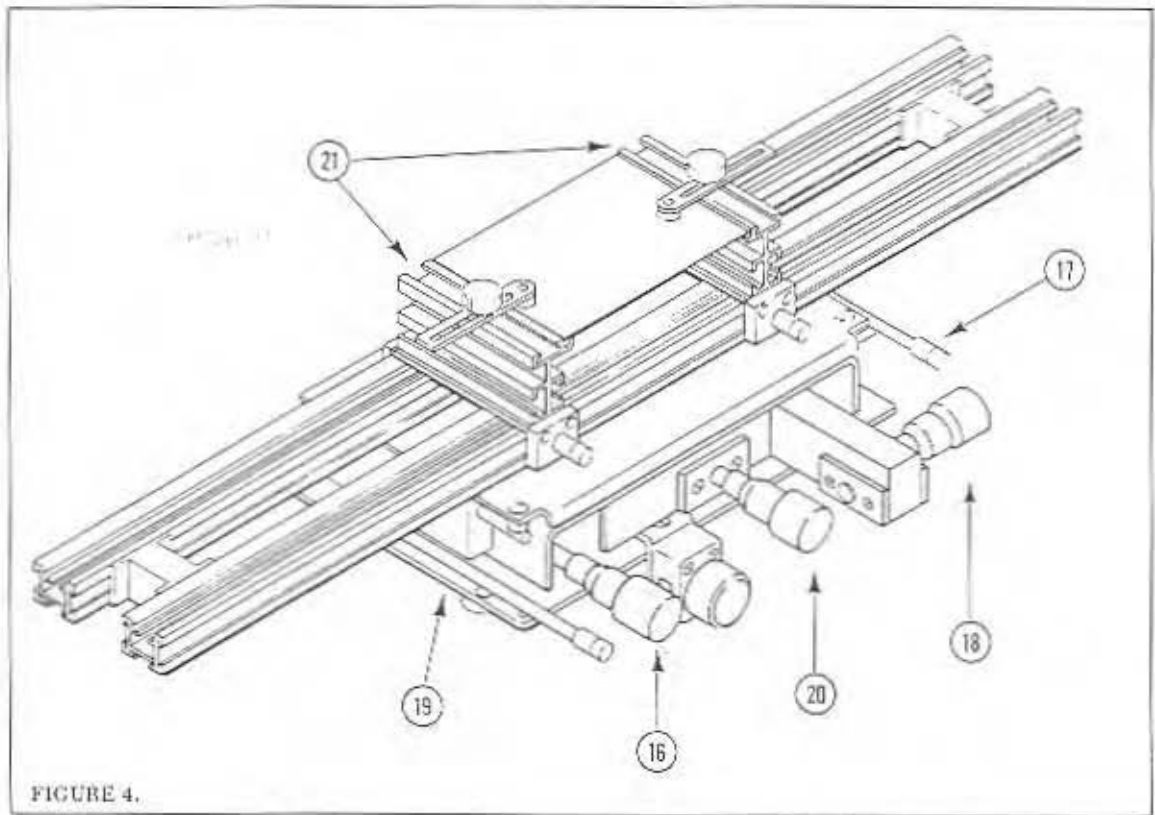
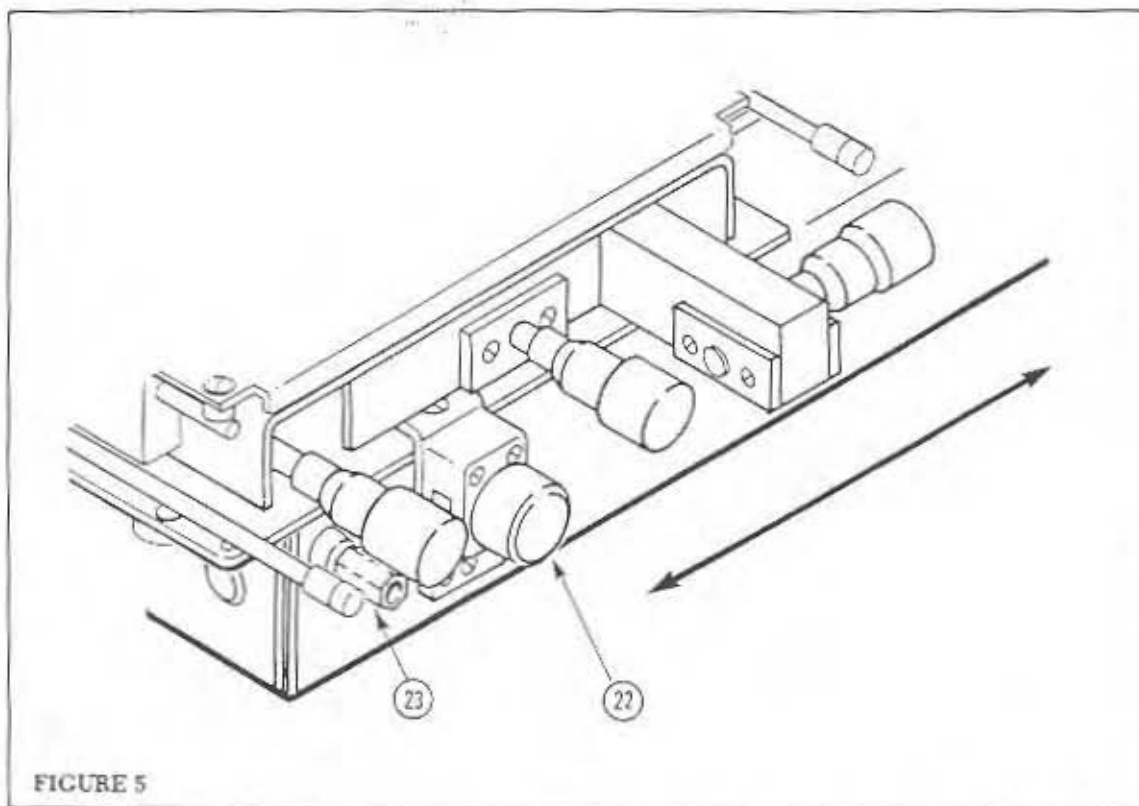


FIGURE 4.

CRAFT 25 SYSTEM IDENTIFICATION

INDEX ASSEMBLY

22. INDEX KNOB—Allows work platform to be moved between station 1 and station 2 and locked into place.
23. EARTH GROUND TERMINALS—Provide grounding points for connecting the CRAFT 25 system to the work piece to prevent static charges from damaging sensitive components or for attaching a wrist strap.

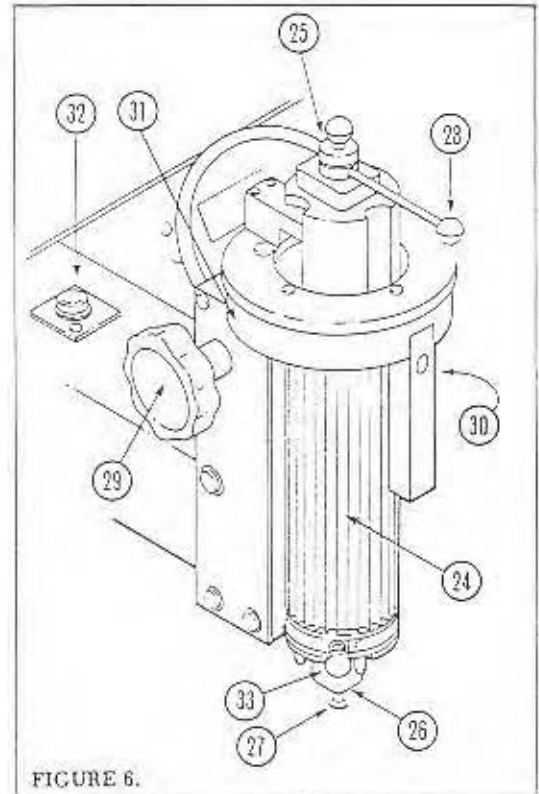


CRAFT 25 SYSTEM IDENTIFICATION

REFLOW STATION (STATION 1)

Station used for all PLCC and LCC repair functions plus component removal and reflow of all components.

24. HEATER ASSEMBLY—Supplies heated air or gas (directed through air nozzle) to simultaneously reflow all solder joints.
25. VACUUM PICKUP ASSEMBLY—Provides a means to lift or place components from or onto PCB.
26. NOZZLE ASSEMBLY—Directs heated air or inert gas from the heater assembly to the solder joint areas for either soldering or desoldering of components.
27. VACUUM PICKUP CUP—Provides positive holding of components for positioning during the replacement process and for lifting of the component during the removal process.
28. VACUUM PICK LOCKING LEVER—Locks the heater assembly and vacuum pickup assembly together for simultaneous movement and unlocks to allow independent movement.
29. Z-AXIS CONTROL—Controls z movement (2 inch max.) of heater and vacuum pickup assemblies.
30. NOZZLE CLEARANCE LIMITER—Limits downward movement of heater assy. Prevents nozzle from contacting PCB.
31. OPTICS ROTATION BEARING—Allows attached optic assemblies to be rotated in a 180° arc around the heater assembly for viewing of placement and reflow processes. Features position stops at 0° and ±90°.
32. LIGHTING OUTPUT RECEPTACLE—Connects power from the CRAFT 25 system to the optional Dual Halogen Lighting system.
33. NOZZLE RETENTION LEVER—Provides lock, release and Theta-Shear for Nozzle assembly.



CRAFT 25 SYSTEM IDENTIFICATION

PLACEMENT STATION (STATION 2)

Station used for placement of all gull-wing and flat pack type devices.

34. AUXILIARY VACUUM PICK ASSEMBLY—Provides a means to lift replacement component from component locating fixture and place on land pattern of the PCB undergoing repair.
35. Z-AXIS CONTROL WHEEL—Moves the vacuum pickup assembly in the Z direction to precisely lower components onto the PCB land area.
36. ACCESSORY MOUNTING SHAFT—Provides a means for attaching video, lighting and microscope options onto station 2.
37. LIGHTING OUTPUT RECEPTACLE—Connects power from the CRAFT 25 system to the optional Dual Halogen Lighting system.
38. COMPONENT LOCATING FIXTURE—Provides a method for holding a replacement component in proper position and orientation for pickup by the station 2 vacuum pickup assembly. Adjustable for components up to 2" × 2".
39. STOP COLLAR—Provides a resting surface for Video Mounts and includes a stop pin for positioning of Video camera over rework area.

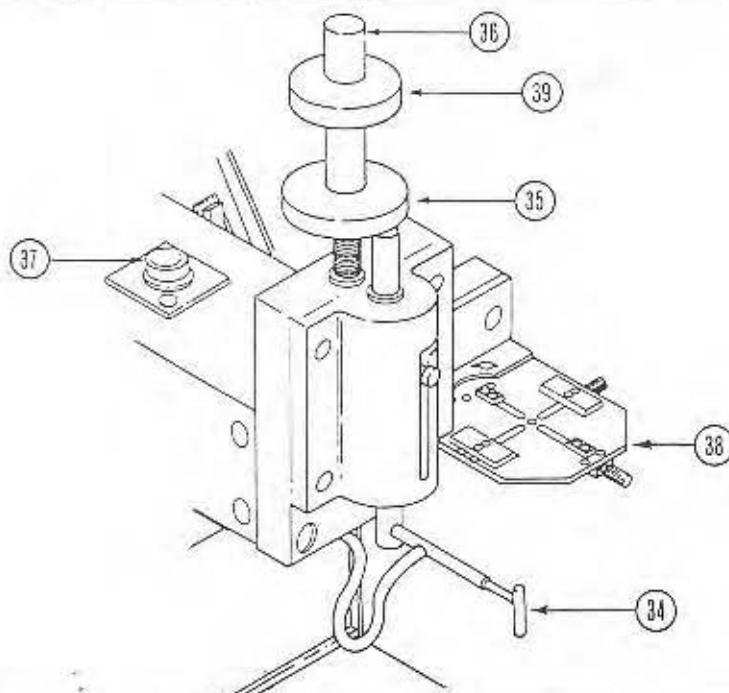
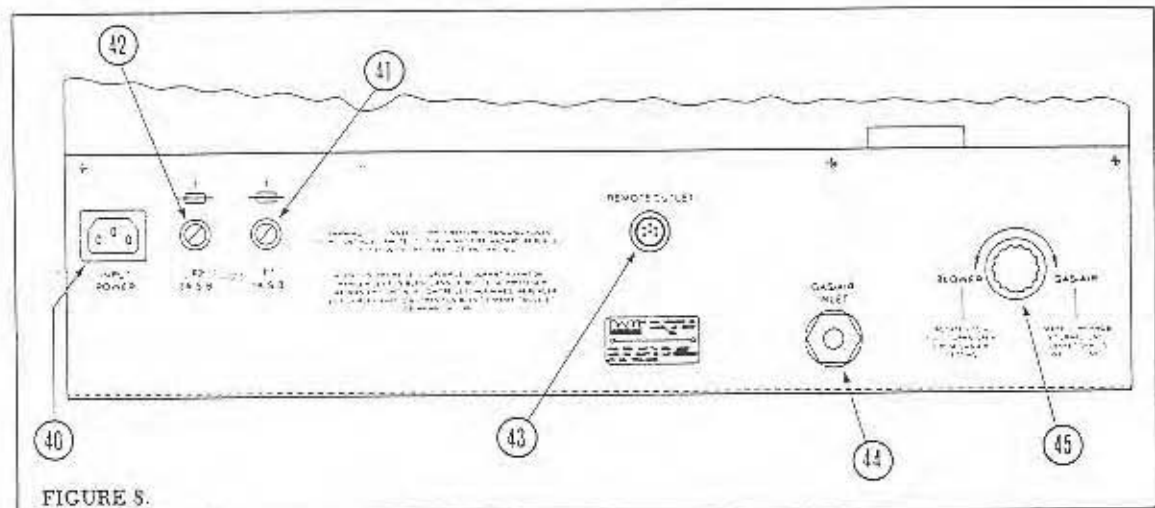


FIGURE 7.

CRAFT 25 SYSTEM IDENTIFICATION

REAR PANEL

40. AC POWER RECEPTACLE—Provides AC power to CRAFT 25 system from AC outlet through power cord.
41. LIGHTING POWER FUSE (F1)—Provides overload protection for Lighting power supply.
42. UNIT POWER FUSE (F2)—Provides overload protection for CRAFT 25 unit.
43. REMOTE OUTLET—An input for optional Remote Control activation of Cycle, Vacuum and Auxiliary Vacuum.
44. GAS/AIR INLET—Connector for attachment of compressed inert gas or filtered dry air supply.
45. BLOWER SUPPLY CUT OFF CONTROL—Used in conjunction with GAS/BLOWER switch. Allows air to enter blower in the "Blower" position and seals the air intake when used in the "Gas/Air" position.



OPTICS AND LIGHTING

46. STATION 1 OPTICS AND LIGHTING—Provides illumination and viewing of removal and placement functions. Views at an angle of 45 degrees to the pcb and swings on the mounting structure in an arc of 180 degrees which allows inspection of three sides of the component.
47. STATION 2 OPTICS AND LIGHTING—Provides illumination and viewing of placement function for gull-wing and flat pack type components. Views at an angle of 90 degrees to the pcb displaying the entire component (including leads).

CRAFT 25—SETUP

Perform the following procedure step by step, in order, to obtain proper results. Use figure 2, page 10 as a guide.

1. Remove the CRAFT 25 system from its shipping container(s), including all options such as lights and video monitor). NOTE: DO NOT USE THE TWO MOUNTING ARMS (REFLOW AND PLACEMENT STATION) TO LIFE UNIT OUT OF SHIPPING CONTAINER.
2. Set the CRAFT 25 unit onto a level work surface. Insure that power switch is in the "off" position.
3. Install all purchased options (i.e. video cameras and lights) at this time. Refer to "TABLE OF CONTENTS" for location of applicable instructions.
4. Check the Work Platform for freedom of movement. If platform cannot be moved freely, adjust the four (4) feet underneath the unit base. Check the Station 1 Heater Assembly for freedom of travel. Check the Lock mechanism and Vacuum Pickup assembly.
5. If the CRAFT 25 system is to be used with compressed air or gas, connect the supply line to the back of the unit.
6. Place the Read/Set switch in the set position and turn the Heater Temperature Control fully counterclockwise.
7. Insure that the Blower Supply Shutoff control (large black knob on rear of the unit) is turned fully clockwise when using the external air supply or fully counterclockwise when using the internal blower.
8. Plug power cable into AC supply.
9. Turn power switch on and test system see "OPERATION", page 22.

CRAFT 25 PROCESS DEVELOPMENT

INTRODUCTION

The CRAFT 25 system provides the user with the ability to perform non-destructive, repeatable, high quality, installation or removal operations on Surface Mount PC assemblies. The operator can adjust the parameters of gas/air temperature, gas/air flow rate, cycle time, nozzle configuration and pre/auxiliary heating (using the PACE HotSpot unit) to suit the "heatability characteristics" of the particular component and substrate mounting site. The PACE Process Development System allows the operator to determine "starting point" parameters for his particular application based upon the particular component and substrate. Using these parameters and the Process Work Sheet, initial trial runs are conducted with successive corrections made based upon observed results. Once optimal results are obtained, the corresponding final process parameters for that particular component and substrate mounting site are entered on the Process Control Chart for future reference. A summary of the required Process Development sequence is listed below.

PROCESS DEVELOPMENT SEQUENCE

1. Use the Process Development Chart to determine Baseline parameters.
 - a) Select the component type and size which matches your application.
 - b) Select the substrate type that matches your application. Enter the indicated Preheat and Reflow Temperature Baseline Parameters onto the Process Work Sheet.
 - c) Locate the two vertical Air Flow columns at their point of intersection with the horizontal row of the selected component. Enter the indicated Air Pressure and Blower Speed parameters onto the Baseline Parameters section of the Process Work Sheet.
 - d) Locate the point of intersection between the Substrate and the Component rows. Enter the indicated Reflow Time parameter on line #1 of the Process Work Sheet.
2. Enter the requested PC assembly and component designation onto the Process Work Sheet.
3. Complete the Baseline Time Parameter Computation section of the Process Work Sheet.
4. Complete the Process Testing section of the Process Work Sheet.
5. Enter the Established Process Guidelines (as determined by the process testing) onto the Process Work Sheet.
6. Sign and date the Process Work Sheet.
7. Enter the Established Process Guidelines onto the Process Control Chart.

CRAFT 25 PROCESS DEVELOPMENT

PROCESS DEVELOPMENT CHART

CRAFT[®] by PAGE

For Craft[®] Reflow Work Stations

COMPONENT					SUBSTRATE					
					EPOXY GLASS (FR-4)		FLEX	CERAMIC	POLYIMIDE	PCB MATERIAL
					1-3 Layer	4+ Layer				
COMPONENT OUTLINE	COMPONENT TYPE	OVERALL SIZE	AIR FLOW AIR PRESSURE	BLOWER SPEED	100%	50%	100%	100%	100%	PREHEAT AT TEMP (°C)
					30"	30"	30"	40"	30"	REFLOW TEMP (°C)
	P.C.C. (Leadless)	Less Than 5 x 5 inch (12 x 12mm)	25	Max	18	10	14	12	10	(SEC)
		Over 5 x 5 inch (12 x 12mm)	50	Max	20	12	20	16	12	
	LCC (Surface)	Less Than 5 x 5 inch (12 x 12mm)	35	Max	20	14	18	20	12	
		Over 5 x 5 inch (12 x 12mm)	50	Max	35	24	35	30	18	
	PLT (Pack)	Less Than 4 x 4 inch (10 x 10mm)	20	3	14	12	12	10	10	
		Over 4 x 4 inch (10 x 10mm)	30	3	30	25	25	34	15	
	QLPD (Pack)	Less Than 5 x 5 inch (12 x 12mm)	20	2	12	10	12	10	8	
		Over 5 x 5 inch (12 x 12mm)	30	2	20	18	18	25	14	
	SDC	150 inch (3 grams body)	20	2	15	12	12	14	10	
		50 (Large Outline)	25	2	12	10	10	10	8	

Use this chart to determine a base starting point for developers of your surface mount rework process. Select the Component Outline and Substrate which best matches your application. Enter the indicated settings onto a CRAFT[®] Process Work Sheet.

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FIGURE 9.

CRAFT 25 PROCESS DEVELOPMENT

PROCESS WORK SHEET

CRAFT[®] by PAGE

Use this work sheet to develop your rework process. Enter the base line parameters determined from the Process Development Chart onto line 1 and "Base Line Parameters" on this form. Follow the subsequent instructions step by step to insure optimum results.

PC Assembly I.D.: _____

Component Location or Designation: _____

Base Line Time Parameter

1. Enter Reflow Time parameter _____ sec.
 2. Add 2 seconds if fluxing is not allowed. + _____ sec.
 3. Add 2 seconds if high temperature solder is used. + _____ sec.
 4. Subtract 2 seconds if low temperature solder is used. + _____ sec.
- _____
5. Total Reflow Time Base Line (add 1 thru 4) _____ sec.
- _____

Base Line Parameters (from 5 and Process Development Chart)

Preheat Temp.	Air Pressure	Blower Speed	Reflow Temp.	Total Reflow Time (from 5)
_____°C	_____psi	_____	_____°C	_____sec.

Notes: _____

FIGURE 10.

To develop Final Process Specs. Run Removal and Replacement Cycles using Base Line Parameters. Increase or decrease Total Reflow Time in 2 second increments until optimum results are obtained. Important: If components are bonded, increase Total Reflow Time by 2 seconds for Removal Procedure **ONLY**.

Process Testing

Date	Reflow Time	Results	Initials

Established Process Guidelines

Preheat Temp	Preheat Time	Air Pressure	Blower Speed	Reflow Temp.	Total Reflow Time (from 5)
_____°C	_____sec.	_____psi	_____	_____°C	_____sec.

CRAFT 25 PROCESS DEVELOPMENT

PROCESS CONTROL CHART

CRAFT[®] by PAGE

SUBSTRATE		COMPONENT		HEATING				AIR FLOW		SPECIAL PROCEDURES
Designation	Material	Designation	Type	Preheat Temp °C	Preheat Time (min)	Rework Temp °C	Rework Time	Air Pressure	Blower Speed	
PROCESS MATERIALS		FLUX: Name _____ Type _____		Solder (or Paste) _____ Bonding Material _____				Other: _____		

FIGURE 11.

CRAFT 25 OPERATION

PREHEATING

Preheating of a printed circuit is normally required in the repair process whenever any one or more of the following situations exists.

1. Epoxy glass substrate with 4 or more layers.
2. Substrate with large ground planes.
3. Substrate of ceramic, polyimide or other high heat dissipative material.
4. PC assembly with large metal heat sinks.

Preheating of assemblies such as those listed above will accomplish the following objectives.

1. Minimize thermal shock by elevating the assembly temperature to a level closer to solder melt.
2. Minimize the heat cycle reflow time.
3. Overcome the heat dissipation characteristics of the assembly.
4. Avoid adjacent melts on densely populated assemblies.

The assembly undergoing repair must be heated for a time sufficient to saturate at the temperature required. Preheat temperatures normally used are 85-95°C (185-203°F) for glass substrates and 120°C (248°F) for ceramics and polyimides.

Although many different methods such as ovens and heated plates may be utilized to accomplish the required results, the user must employ a method which heats the assembly as evenly as possible and can be employed on the CRAFT 25 unit. The preheat temperature should also be maintained throughout the Removal/Replacement process. PACE recommends the use of the HotSpot (HS-150/E) unit for this purpose.

CRAFT 25 OPERATION

NOZZLE SELECTION

Selection of the proper nozzle assembly is essential to the performance of a quality repair. Each nozzle assembly is designed to insure that heated air or gas is focused directly onto the PCB land area. Listed on pages 50-52 are commonly used nozzles and the components for which they are normally used. Select the nozzle (part number stamped on the nozzle flange) configured for the component to be replaced. Contact your local PACE authorized dealer or call PACE Applications Engineering at (301) 490-9860 for assistance.

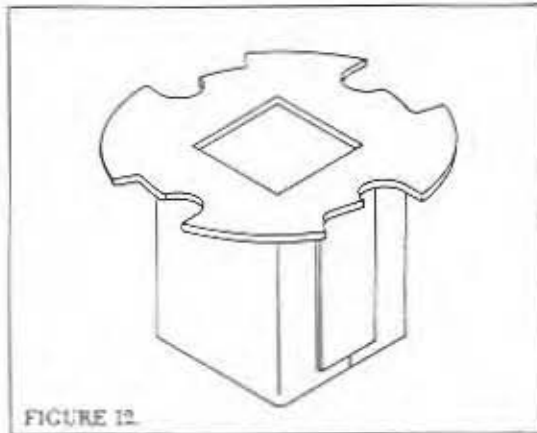


FIGURE 12.

VACUUM CUP SELECTION

Selection of the proper size vacuum cup is important for achieving an adequate holding force for each component. The cup selected should be as large as can be used without exceeding the body size of the component. Vacuum cups are consummable items which deteriorate over a period of time and are available in four sizes which can be ordered using the part numbers listed on page 45.

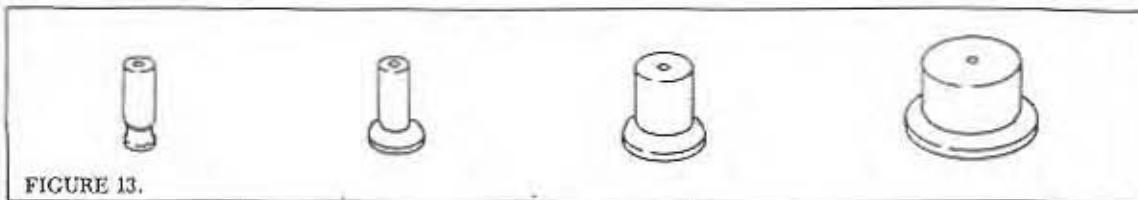


FIGURE 13.

CRAFT 25 OPERATION

NOZZLE CHANGEOUT

REMOVAL

1. With the Locking Lever in the locked position, raise the Heater Assembly to its' top-most position.
2. Using the right hand, place the Nozzle Chip Tool under the Nozzle Assembly.

WARNING

Never remove a heated nozzle with bare hands. Use the Nozzle Chip Tool.

3. With the left hand, move the Nozzle Retention Lever to the right. The Nozzle will be released from the Heater Assembly at this point.
4. Hold the Nozzle on the Nozzle Chip Tool and set aside to cool.

INSTALLATION

1. Select the proper Nozzle for your application; see "NOZZLE SELECTION" page 23.
2. If the Nozzle is rectangular in shape, orient the Nozzle for the most effective use with the assembly undergoing repair.
3. Holding the Nozzle in the right hand, line up the four notches on the nozzle flange with the four Alignment Posts on the bottom of the Heater Assembly. See figure 26.
4. Lift the Nozzle up over the four Alignment Posts and hold in place against the Heater Base.
5. With the left hand, move the Nozzle Retention Lever to the left to secure the Nozzle.

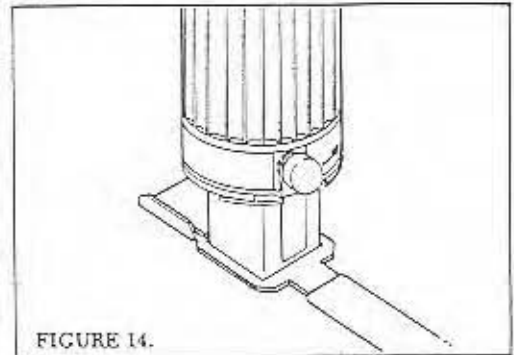


FIGURE 14.

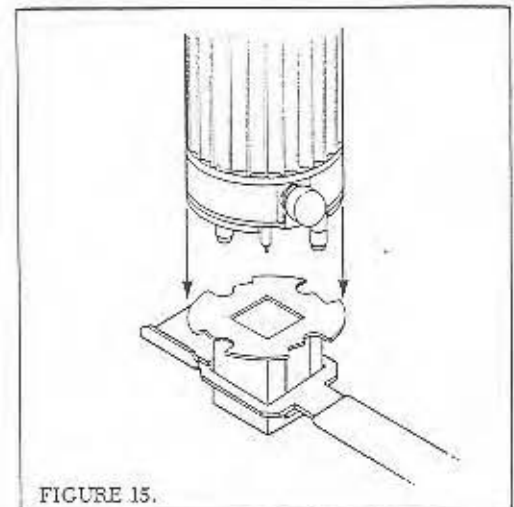


FIGURE 15.

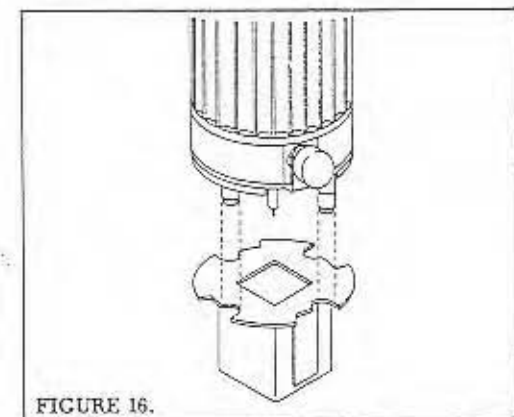


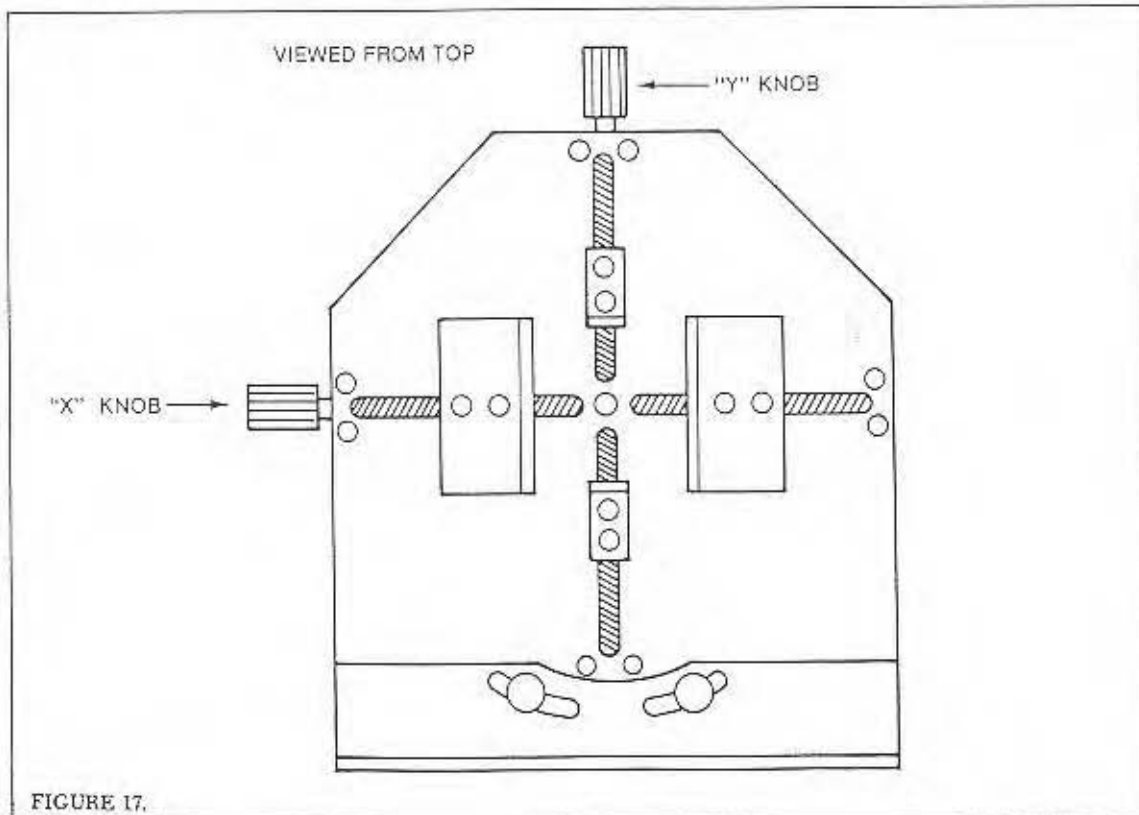
FIGURE 16.

CRAFT 25 OPERATION

COMPONENT FIXTURE

The CRAFT 25 component fixture has been designed to accommodate component sizes of up to 2" × 2" (5.08 cm. × 5.08 cm.).

1. Using the "X" and the "Y" adjustment knobs, adjust the component fixture opening larger than necessary to accommodate the component.
2. Place the component (properly oriented) into the component fixture.
3. Using the "X" and "Y" adjustment knobs, adjust the component fixture to fit the component. Proper adjustment will minimize movement of the component in the fixture and allow component removal using the auxiliary vacuum pickup.



CRAFT 25 OPERATION

COMPONENT REMOVAL

1. Insert proper Nozzle Assembly and Vacuum Cup onto the reflow station.
2. Set controls listed below to optimize performance. If a written process has been developed, set controls as specified. If a process has not been developed, refer to PACE "Process Development Guidelines" page 18.
 - a) air pressure (or blower speed)
 - b) temperature ($^{\circ}\text{C}$ or $^{\circ}\text{F}$)
 - c) cycle time
3. Raise Heater assembly to the topmost position.
4. Place PCB assembly onto Work Platform.
5. Apply flux (i.e. RMA flux) to the solder joints of the component to be removed.

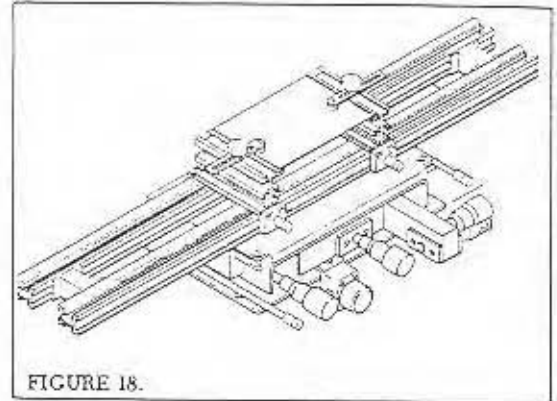


FIGURE 18.

6. With the Work Platform indexed under the reflow station, and the Slide Locking Lever in the unlocked position, adjust Work Platform to align component beneath Nozzle using the coarse "X" and "Y" adjustments. Lock Work Platform into place.

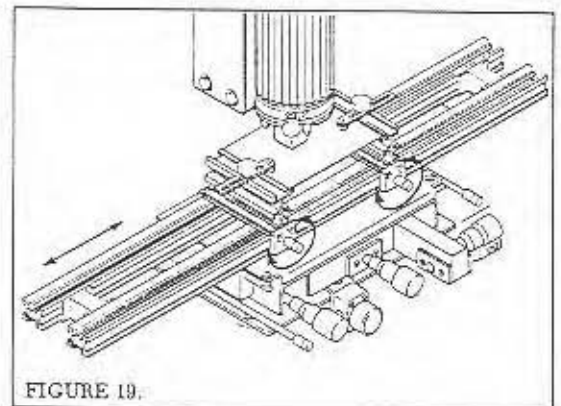


FIGURE 19.

CRAFT 25 OPERATION

COMPONENT REMOVAL (Cont'd)

7. With the Vacuum Pickup Locking Lever in the unlocked position, raise the Heater Assembly to a point at which the Vacuum Cup extends below the Nozzle.
8. Move the Vacuum Pickup Locking Lever to the locked position.

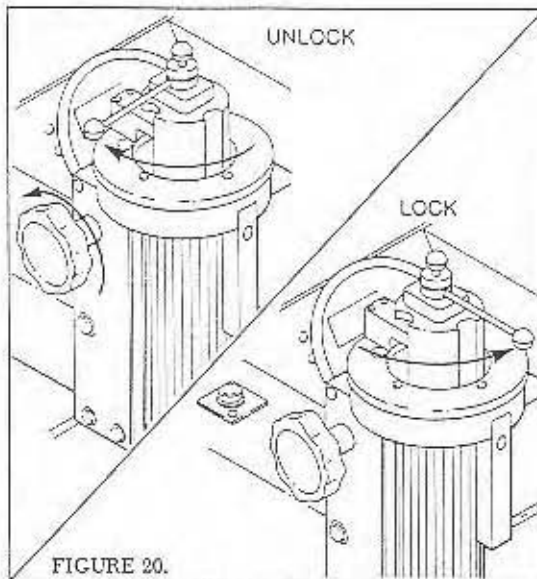


FIGURE 20.

9. Lower the Heater Assembly until the Vacuum Cup contacts the component.

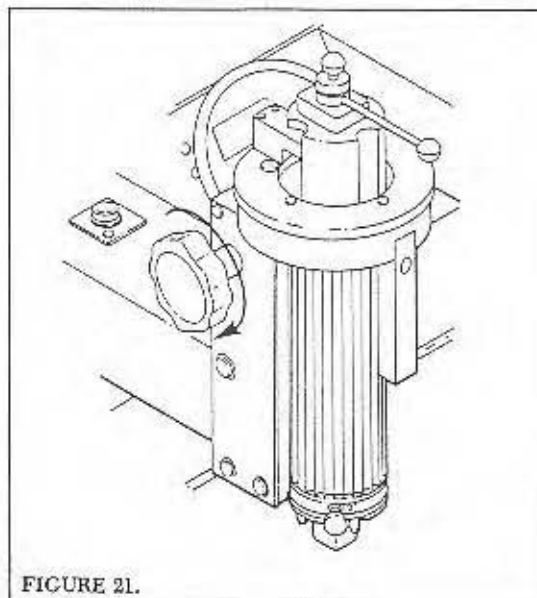


FIGURE 21.

CRAFT 25 OPERATION

COMPONENT REMOVAL (Cont'd)

10. Move the Vacuum Pickup Locking Lever to the unlocked position and lower the Heater Assembly (with Nozzle) over the component.

11. Readjust Work Platform using fine adjustment controls if Nozzle Assembly does not fit over the component. The component should be centered squarely in the Nozzle to insure uniform heating of the PCB land pattern during the reflow process.

12. Adjust Nozzle Clearance Limiter if necessary, to provide repeatable Nozzle-to-PCB clearance. A clearance of .030-.050" is recommended. If vented nozzles are being used, clearance must be set to .000".

13. Activate Main Vacuum Pickup Switch.

14. Push the Cycle Switch to start the heat cycle.

15. Move the Vacuum Pickup Locking Lever to the locked position.

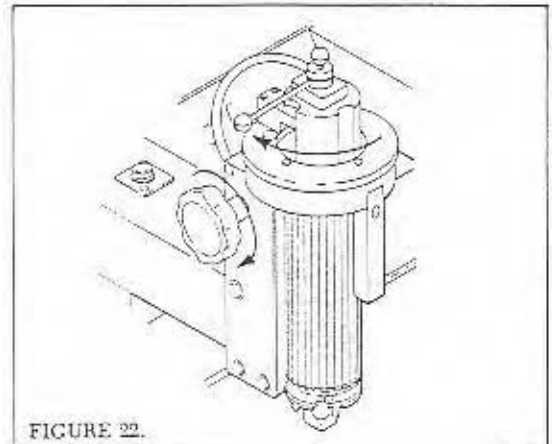


FIGURE 22.

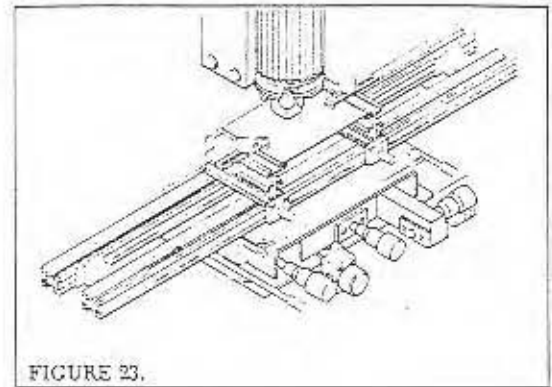


FIGURE 23.

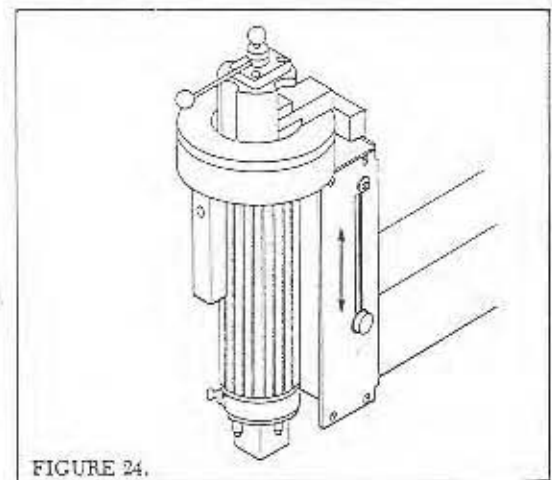


FIGURE 24.

CRAFT 25 OPERATION

COMPONENT REMOVAL (Cont'd)

16. At the conclusion of the heat cycle, lift the Heater Assembly (with component) to the topmost position. NOTE: If the component being removed has been bonded to the substrate, move the Nozzle Retention Lever to the left before lifting the Heater Assembly. This provides a shearing action to break the bond.

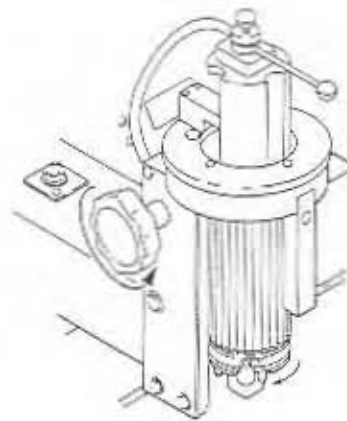


FIGURE 25.

17. Place Nozzle Chip Tool under Nozzle and turn Main Vacuum Pick Switch off to release component.

WARNING

COMPONENT IS HOT! DO NOT retrieve component from Nozzle with hands or fingers, let component drop onto the Nozzle Chip Tool. Allow sufficient time for cooling.

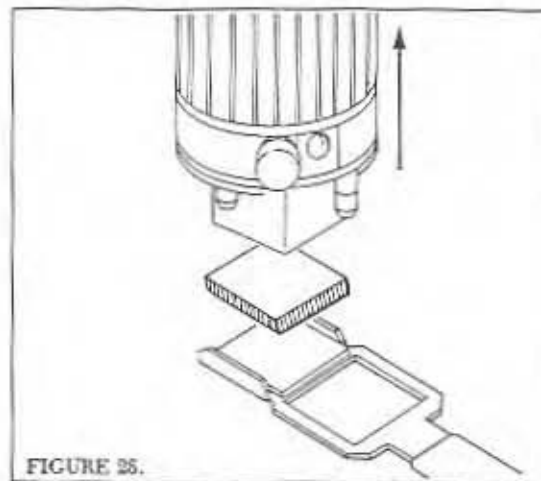


FIGURE 26.

CRAFT 25 OPERATION

BOARD/COMPONENT PREPARATION

Proper preparation is the key to successful soldering. To obtain good solder joints, use the following.

1. All component leads should be freshly tinned to insure solderability.
2. Leadless ceramic chip carriers with gold plating should be pretinned. For quality work, check for correct solder deposition. The tinning process should not fill the castellations with solder.
3. Remove all flux applied during the component removal process.
4. Clean all component leads prior to soldering.
5. Remove all existing "old" solder from the PCB land pattern.
6. Do not touch component leads or PCB lands with bare fingers after cleaning.
7. Prepare the affected land pattern as per your specifications. For recommendations regarding processes which are best for your particular application, contact your local PACE dealer. The most widely used methods are as follows:
 - a) Pretinning—The PCB lands are pretinned using a soldering iron: taking precautions to insure that all lands are tinned with an equal deposition of solder. All lands must also be uniform in appearance.
 - b) Solder Paste—Apply an equal amount of paste to each land using a solder paste dispenser to control deposition. Take care to insure that the proper amount is dispensed. If too much paste is applied, bridging of lands will occur, whereas if a sufficient amount is not applied, solder joint formation will be unacceptable. The PCB assembly should also be preheated (in accordance with user's in-house requirements) after solder paste deposition to remove any solvents present in the paste. The PACE HotSpot (HS-150/150E) unit is highly recommended for this preheating application.
 - c) Solder Preforms—Any preforms must be designed specifically for each component used to insure proper solder deposition.

CRAFT 25 OPERATION

COMPONENT PRE-POSITIONING

The CRAFT 25 system is fully capable of accurately placing even very fine pitched components properly. In some instances however, the user may prefer to pre-position a component and hold it in place for soldering.

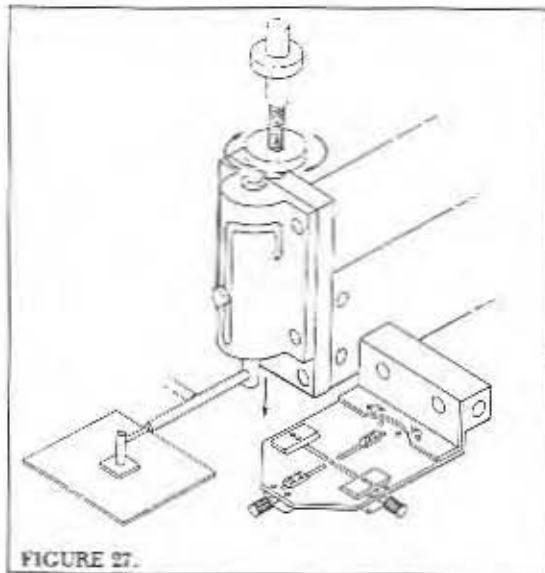
In order to properly position a component accurately, an optical aid (i.e. microscope) and glare free lighting should be used. Such accessories are available from PACE as either stand alone units or as options for the CRAFT 25 unit.

The following information and procedures will help you to obtain acceptable results.

TACK SOLDERING

The following procedure can be useful when mounting leaded components.

1. Pre-position the component leads to align with the land area using one of the following methods. NOTE: A flux paste may be applied to corners of the PCB land pattern to temporarily hold component in place.
 - a) Using the Station 2 Vacuum Pickup Assembly on the CRAFT 25 unit; follow the placement procedure described on pages 36 to 41 to place component on lands properly. Hold in place with the Z Axis Control Wheel, maintaining a slight downward pressure through the Vacuum Pickup Assembly, onto the component body.
 - b) Using a pair of tweezers for handling and holding, pre-position the component leads to align with the land areas.
2. Using a micro-tipped soldering iron, tack two or more lead to land locations at opposite corners of the component. This will provide stability during subsequent handling throughout the soldering process.



STAKING MATERIAL

1. Apply a small amount of adhesive or other suitable staking material to underside of component. DO NOT USE A CYANOACRYLATE BASED ADHESIVE. WHEN SUCH MATERIALS ARE HEATED, CYANIDE GASES MAY BE EMITTED CREATING A HEALTH HAZARD.
2. Pre-position component as in the "TACK SOLDERING" procedure shown above. The staking material will stabilize the component during subsequent handling and soldering. Solvent or water soluble material should be removed after the soldering process.

CRAFT 25 OPERATION

COMPONENT REPLACEMENT (PLCC AND LCC ONLY)

1. Move the Vacuum Pickup Locking Lever to the locked position and raise the Heater Assembly to its' topmost position.
2. Move the Vacuum Pickup Locking Lever to the unlocked position and lower the Heater Assembly to a point at which the Nozzle Assembly extends below the Vacuum Cup.
3. Activate the Main Vacuum Pick Switch.
4. With the right hand and using the Nozzle Chip Tool, insert the replacement component (properly oriented) into the Nozzle. The Vacuum Cup will now hold the component in position. NOTE: You may find it necessary to raise the Heater Assembly slightly using the left hand, in order to place the component onto the Vacuum Cup.

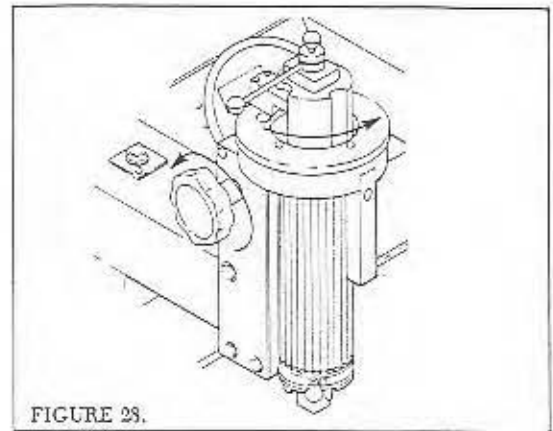


FIGURE 28.

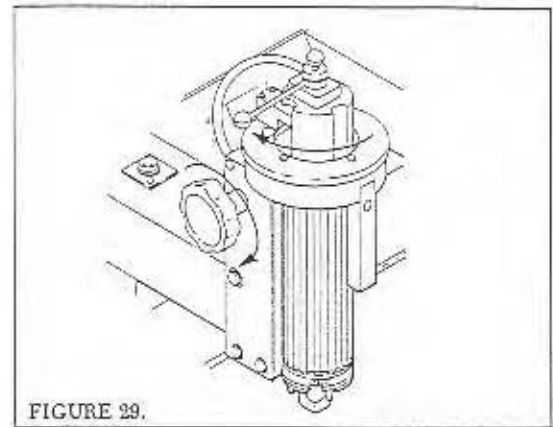


FIGURE 29.

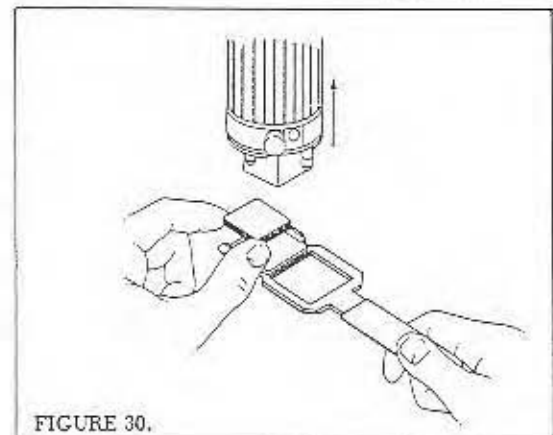


FIGURE 30.

CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (PLCC AND LCC ONLY)

5. Raise the Heater Assembly to expose the component.

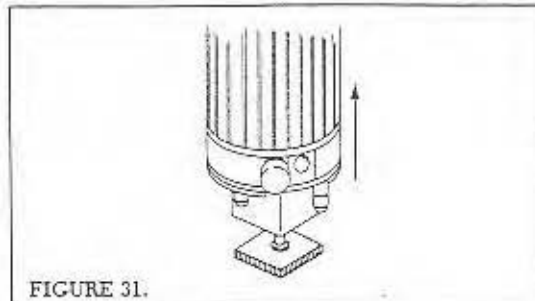


FIGURE 31.

6. Move the Vacuum Pickup Locking Lever to the locked position.

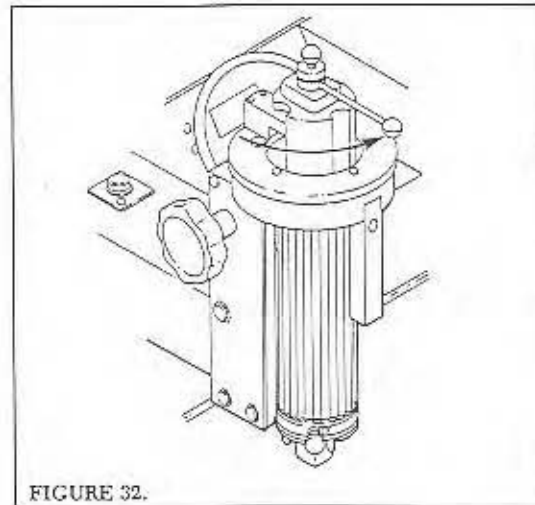


FIGURE 32.

7. Lower Heater Assembly to a point at which the component leads (or pads) rest just off the component land area on the PCB.

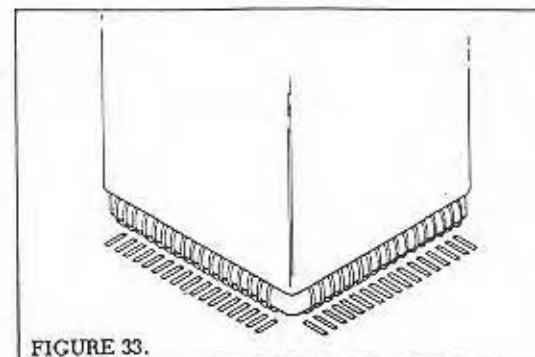


FIGURE 33.

CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (PLCC AND LCC ONLY)

8. Adjust the fine controls on the Work Platform until the component leads (or pads) line up directly over the component land area on the PCB. Use of a video camera and monitor to view this is suggested. A camera mounted at a 45 degree angle to the PCB and swung in an arc of 180 degrees around the front of the component allows the operator to see three sides of the component to PCB alignment.

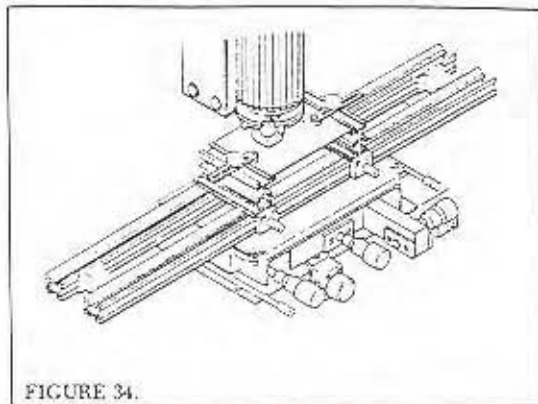


FIGURE 34.

9. Lower the Heat Assembly (with component) until the component leads rest lightly on the PCB land area.

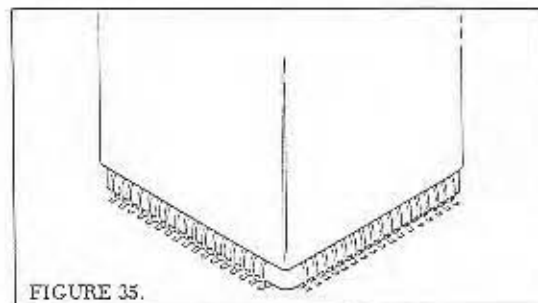


FIGURE 35.

10. Move the Vacuum Pickup Locking Lever to the unlocked position.

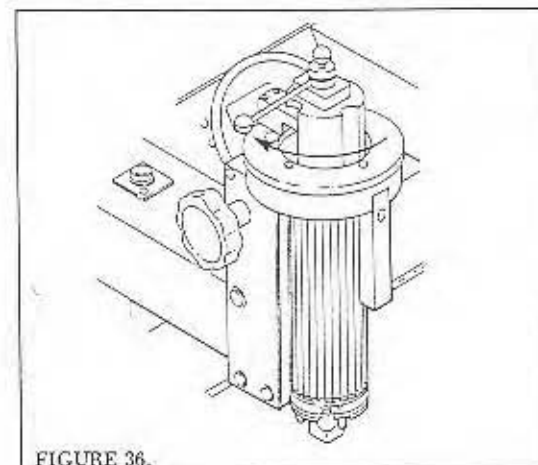


FIGURE 36.

CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (PLCC AND LCC ONLY)

11. Lower the Heater Assembly (with Nozzle) over component. Check to insure that the desired PCB to Nozzle clearance is maintained. Adjust Clearance Limiter if necessary.

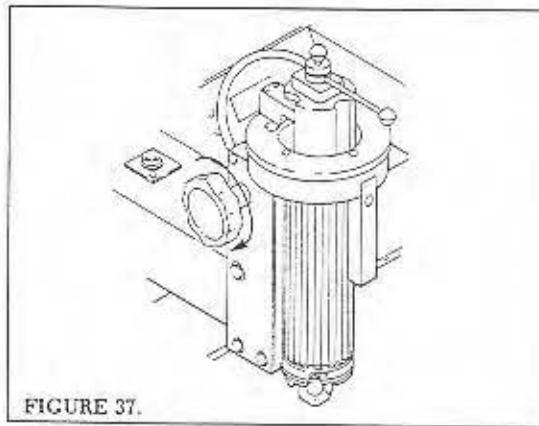


FIGURE 37.

12. Move the Vacuum Pickup Locking Lever to the locked position.

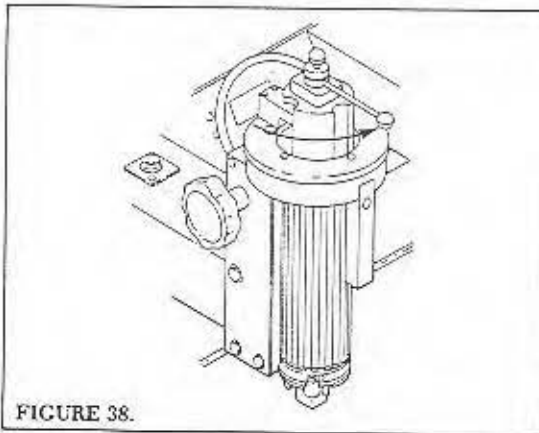


FIGURE 38.

13. Recheck alignment of the component leads-to-land pattern.
14. Push Cycle Switch to activate heat cycle.
15. At conclusion of heat cycle, turn Main Vacuum Pickup Switch off. This will release the component and allow it to settle into the molten solder.
16. Allow sufficient time for the solder to cool down and solidify. A time period of 20 seconds is sufficient in most cases.

CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (PLCC AND LCC ONLY)

17. Raise the Heater Assembly to the topmost position.

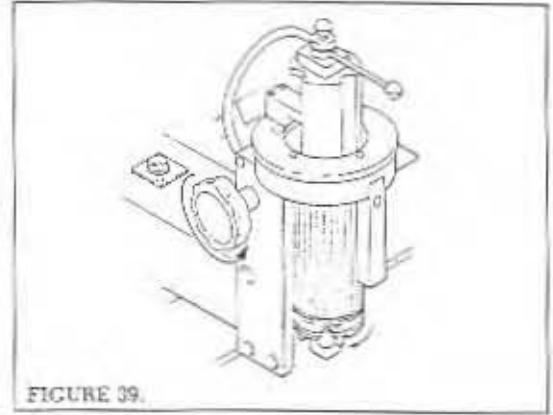


FIGURE 39.

COMPONENT REPLACEMENT (GULL-WING AND FLAT PACK DEVICES)

1. Unlock the Index Assembly and move Work Platform to the right side of the CRAFT 25 unit until it locks in position.

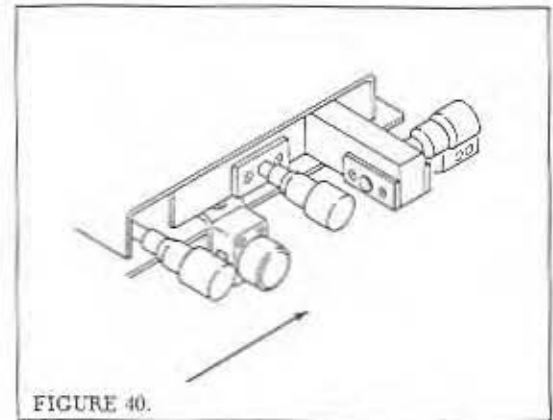


FIGURE 40.

2. Insure that the PCB land pattern has been properly prepared (tinned and/or cleaned) and that RMA flux (or solder paste) has been applied.

CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (GULL-WING AND FLAT PACK DEVICES)

3. Place the new component (properly oriented) into the Component Locating Fixture.

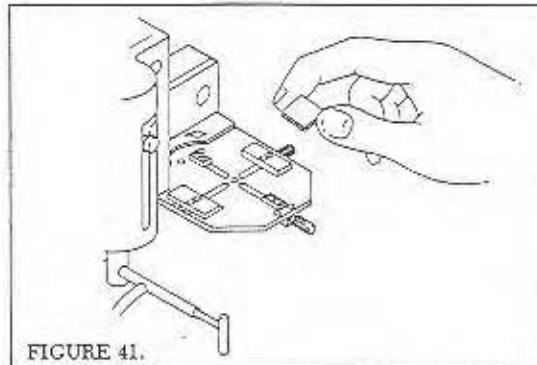


FIGURE 41.

4. Adjust the Component Locating Fixture to fit the component.

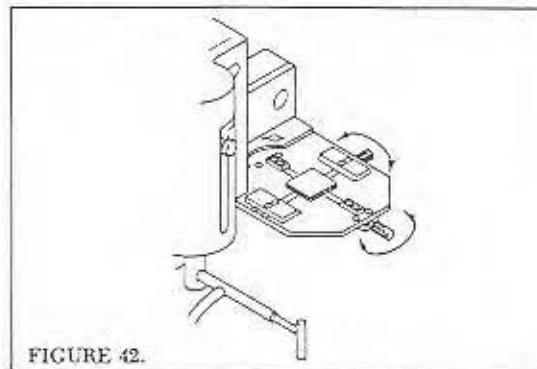


FIGURE 42.

5. Activate the Auxiliary Vacuum Pick Switch and Lower the Station 2 Vacuum Pickup Assembly onto the component.

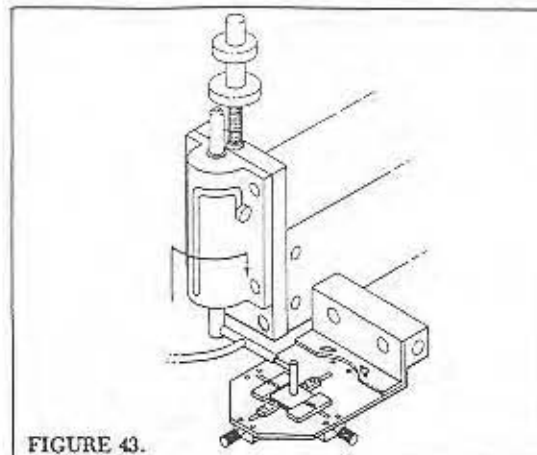
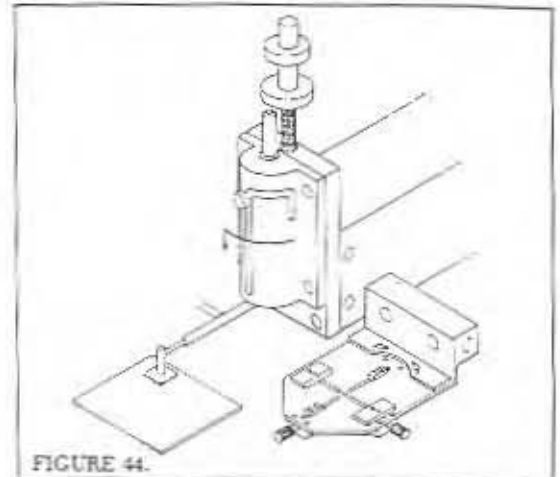


FIGURE 43.

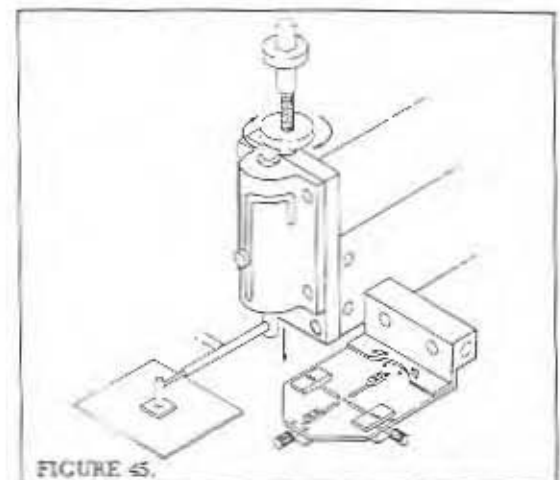
CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (GULL-WING AND FLAT PACK DEVICES)

6. Lift the Vacuum Pickup Assembly (with component) and position over the PCB land area. NOTE: If the component is large in size, it may be necessary to install the supplied metal vacuum cup onto the Vacuum Pick to provide additional holding force.



7. Lower the Vacuum Pick Assembly by turning the Z Axis Control Wheel in a clockwise direction. Lower the assembly to a point where the component leads rest just above the land area.



CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (GULL-WING AND FLAT PACK DEVICES)

8. First adjust the Theta Rotation Knob until the component is square to the PCB land pattern and then the "X" and "Y" Fine Adjust Controls to align the component leads with the PCB land pattern. Viewing of this component-to-pattern alignment is enhanced by the use of a video camera and monitor system. The camera is mounted at an angle of 90 degrees to the PCB. This enables the operator to view all four sides of the component simultaneously.

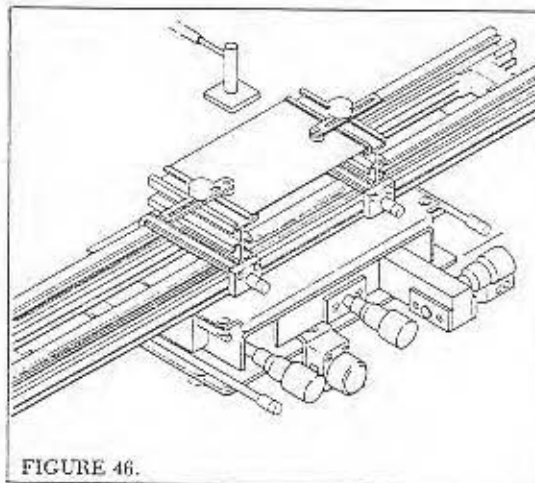


FIGURE 46.

9. Lower the component gently onto the PCB land pattern by turning the Z Axis Control Wheel as described in step 7.
10. Push Auxiliary Vacuum Pick Switch to release component.

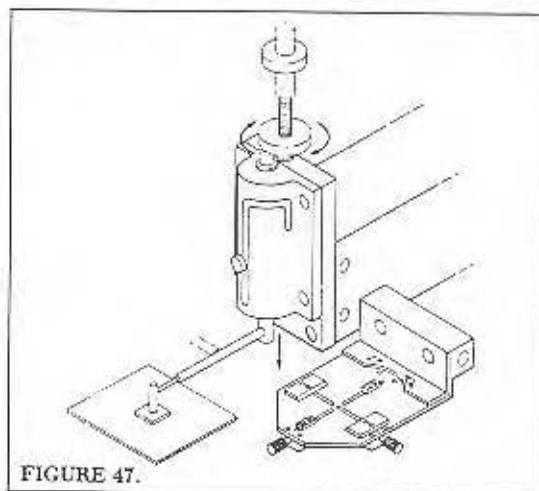


FIGURE 47.

CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (GULL-WING AND FLAT PACK DEVICES)

11. Turn the Z Axis Control Wheel fully counterclockwise. Swing the Vacuum Pickup Assembly into position over the Component Locating Fixture.

12. Recheck component Lead-to-pattern alignment.

13. Unlock the Index Assembly and gently move the Work Platform to the left side of the CRAFT 25 unit until it locks in place.

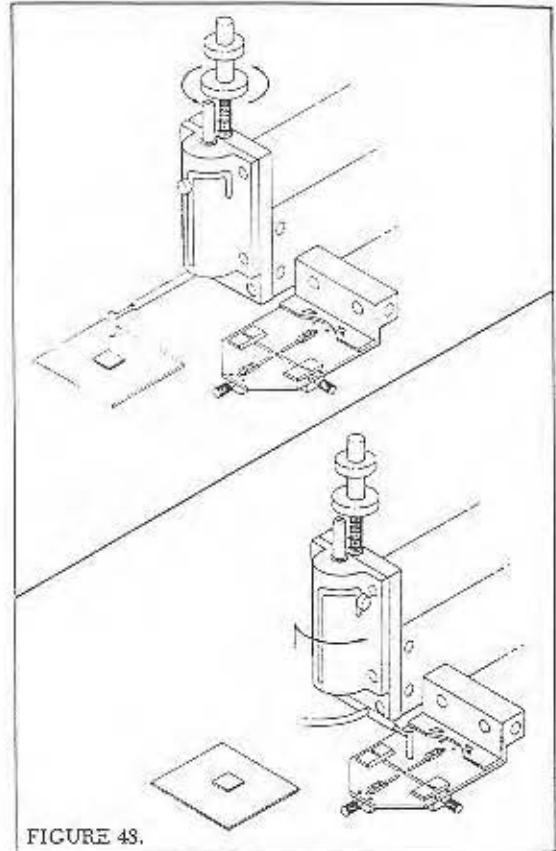


FIGURE 48.

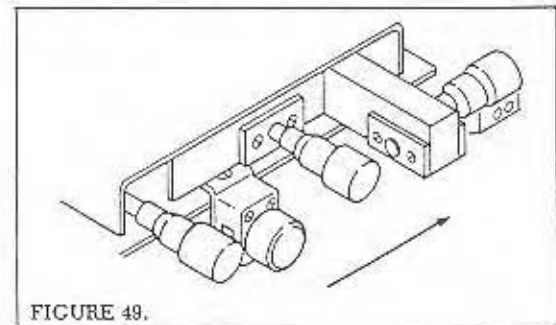


FIGURE 49.

CRAFT 25 OPERATION

COMPONENT REPLACEMENT (Cont'd) (GULL-WING AND FLAT PACK DEVICES)

14. Recheck the component lead-to-land alignment.
15. With the Vacuum Pickup Locking Lever in the unlocked position, lower the Heater Assembly (with Nozzle) over component. Insure that the Nozzle fits properly around the component.
16. Push the Cycle Switch to activate heat cycle.
17. Allow sufficient time at the conclusion of the heat cycle for the solder to cool down and solidify. A time period of twenty seconds is adequate in most cases.
18. Raise Heater Assembly to the topmost position.
19. Inspect solder joints and component lead-to-pad alignment.

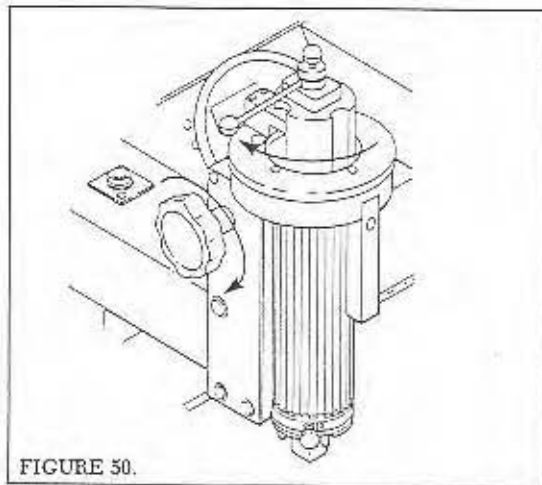


FIGURE 50.

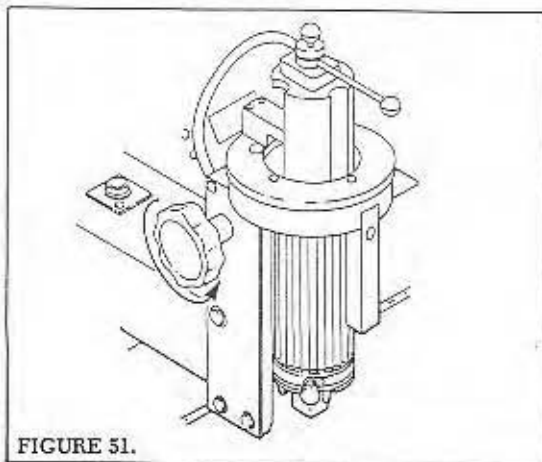


FIGURE 51.

CRAFT 25 OPERATION

CORRECTIVE MAINTENANCE

TABLE 1

When a problem in operation occurs, select the "Symptom" which applies and follow the steps given in the "Solution" column.

SYMPTOM	POSSIBLE CAUSE	SOLUTION
NO POWER—	Circuit breaker tripped.	Reset Main Power Switch.
	Line cord unplugged.	Plug Line Cord into outlet.
	AC supply circuit breaker tripped.	Reduce # of other devices on circuit.
NO TEMPERATURE DISPLAY—	Blown fuse F1	Replace fuse.
NO LIGHTS—	Blown fuse F2	Replace fuse.
NO VACUUM—	Dirty filter(s)	Replace Visi Filter(s).
	Kinked or broken vacuum line.	Repair or replace vacuum line.
UNIT DOES NOT CYCLE— Display reads "888".	Over-temperature cutoff circuit has activated.	Check Blower Supply Cutoff Control and Gas/Blower Switch settings.
	Shorted Airstream Thermocouple.	Contact Pace Customer Service.
READY LED DOES NOT LIGHT— Read temperature is at or near room temperature.	Defective Heater Assembly.	Contact Pace Customer Service.
READ TEMPERATURE DOES NOT REACH SET TEMPERATURE.	Air flow obstructed.	1. Check Blower Supply Cutoff Control and Gas/Blower Switch settings. 2. Check for kinked, or broken air flow tube in unit.
	Defective Airstream Thermocouple.	Contact Pace Customer Service.

CRAFT 25 REPLACEMENT PARTS

When ordering replacement parts for your CRAFT 25 system, find the system area where the part is located on page 46. Refer to the system area illustrations to locate the replacement part and its item number. Using the item number, refer to table 2 for the description and PACE part number.

CRAFT 25 UNIT

TABLE 2

ITEM #	QTY.	PART NO.	DESCRIPTION	SUBASSEMBLY AREA
1	1	7018-0036	CRAFT 25, Domestic (115V)	Unit
	1	7018-0037	CRAFT 25, Export (230V)	Unit
2	1	1157-0063	Power Switch, 115V CRAFT 25	Control Panel
	1	1157-0059	Power Switch, 230V CRAFT 25E	
3	1	1263-0030	Gas/Air Regulator	
4	1	1222-0033	Gas/Air Pressure Knob	
5	1	1108-0005	Gas/Air Pressure Gauge	
6	1	1157-0060	Toggle Switch	
7	2	1222-0049	Control Knob, Temp. & Blower	
8	2	1157-0061	Vacuum Switch, Lighted	
9	2	1171-0007	White Cap, Vacuum Switch	
10	2	1157-0064-01	Cycle Timer Switch	
11	1	1157-0064-02	End Plate, Cycle Timer Switch	
12	1	1157-0062	Cycle Switch	
13	1	1171-0008	Green Cap, Cycle Switch	
14	4	1274-0032	Leveler Pad, Rubber	Chassis
15	1	1336-0026	Motor Pump Assembly	
16	1	6020-0054	Main PCB Assembly	
17	1	6020-0055	Display PCB Assembly	
18	2	1192-0057	Transformer, Lighting	
19	1	1192-0059	Transformer, Power	
20	1	6008-0119	Blower Assembly	
21	3	1194-0016	Solenoid	
22	1	1207-0204	AC Power Receptacle	
23	2	1161-0008	Fuse Holder	
24	1	1159-0246	Fuse, F1, 1 AMP S.B. (Domestic)	
		1159-0213	.5 AMP S.B. (Export)	
25	1	1159-0247	Fuse, F2, 2 AMP S.B. (Domestic)	
		1159-0216	1 AMP S.B. (Export)	

CRAFT 25 REPLACEMENT PARTS

CRAFT 25 UNIT (Cont'd)

TABLE 2

ITEM #	QTY.	PART NO.	DESCRIPTION	SUBASSEMBLY AREA
26	1	4010-0091	Heater Core, CRAFT 25 (115 V)	Reflow Stn.
	1	4010-0092	Heater Core, CRAFT 25E (230 V)	
27	1	4010-0093	Heater Tube Assembly	
28	1	4010-0094	Reflow Sensor	
29	1	4010-0095	Vacuum Pick Assembly	
30	2	1222-0061	Vacuum Pick Control Knob	
31	1	1222-0062	Nozzle Locking Lever Knob	
32	1	1222-0053	Z Axis Control Knob	
33	2	1222-0044	Clamp Locking Knob	Work Platform
34	2	1209-0030	PCB Holder Arm	
35	2	1274-0033	Bumper, PCB Holder Arm	
36	3	1222-0076	Fine Adjust Knob (X,Y, Theta)	
37	4	1222-0074	Rail Locking Knob	
38	1	4018-0043	Vacuum Pickup Assembly	Placement Stn.
39	1	1213-0045-P5	Vacuum Pickup Cup	
40	1	1332-0134	Power Cord, Domestic (115V)	Misc. Access.
41	1	1332-0135	Power Cord, Export (230V)	
42	1	1100-0231	Nozzle/Chip Tool	
43	1	1165-0023	Lamp, 120 V, 20 W	
44	1	1309-0020	VisiFilter	Consummables
45	1	1121-0280-P2	Vacuum Cup, .625 Dia.	
46	1	1121-0281-P2	Vacuum Cup, .400 Dia.	
47	1	1121-0282-P2	Vacuum Cup, .312 Dia.	
48	1	1121-0288-P2	Vacuum Cup, .200 Dia.	
49	1	5050-0219	Operation Manual	
50	1	5050-0261	Service Manual	

CRAFT 25 REPLACEMENT PARTS

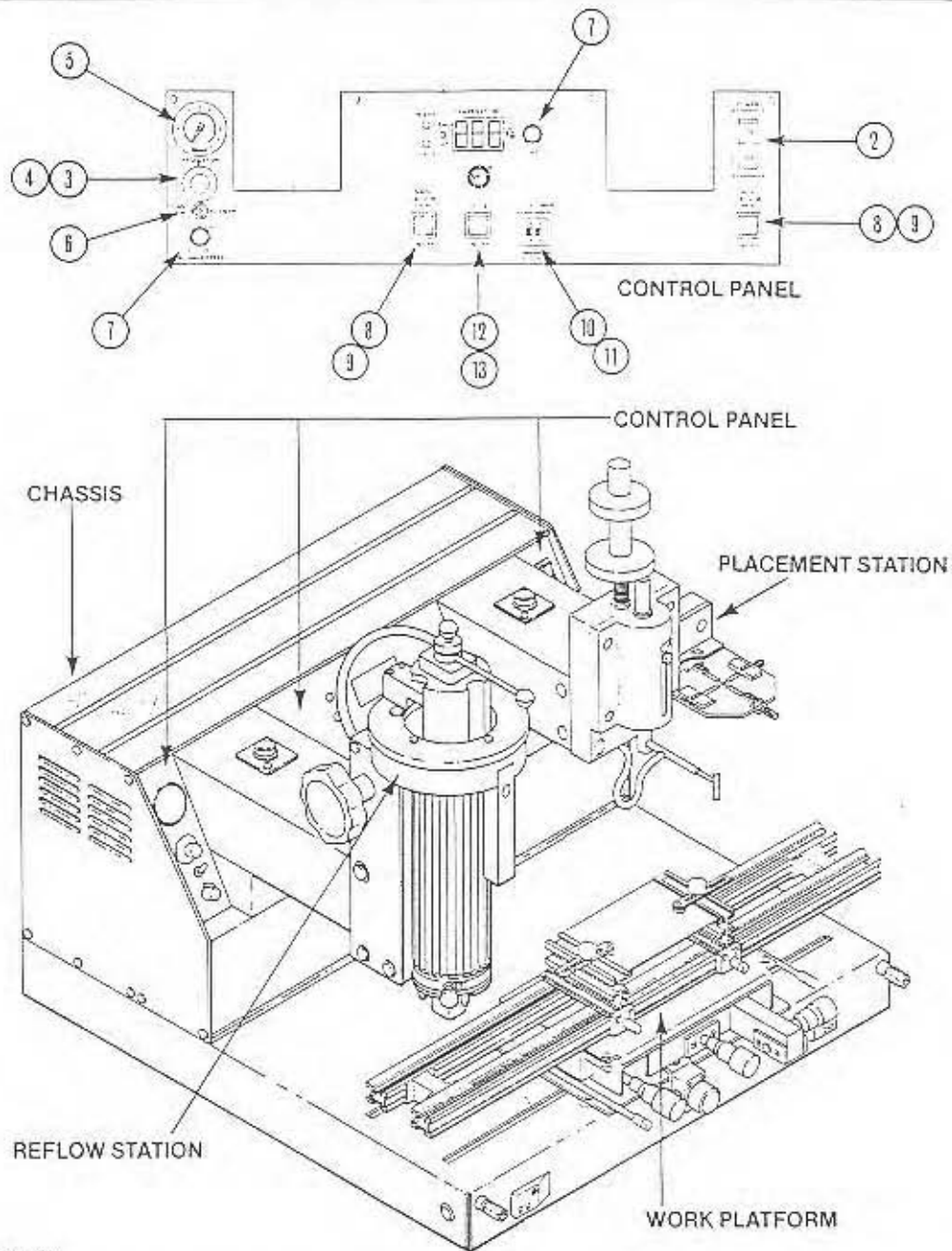


FIGURE 52.

CRAFT 25 REPLACEMENT PARTS

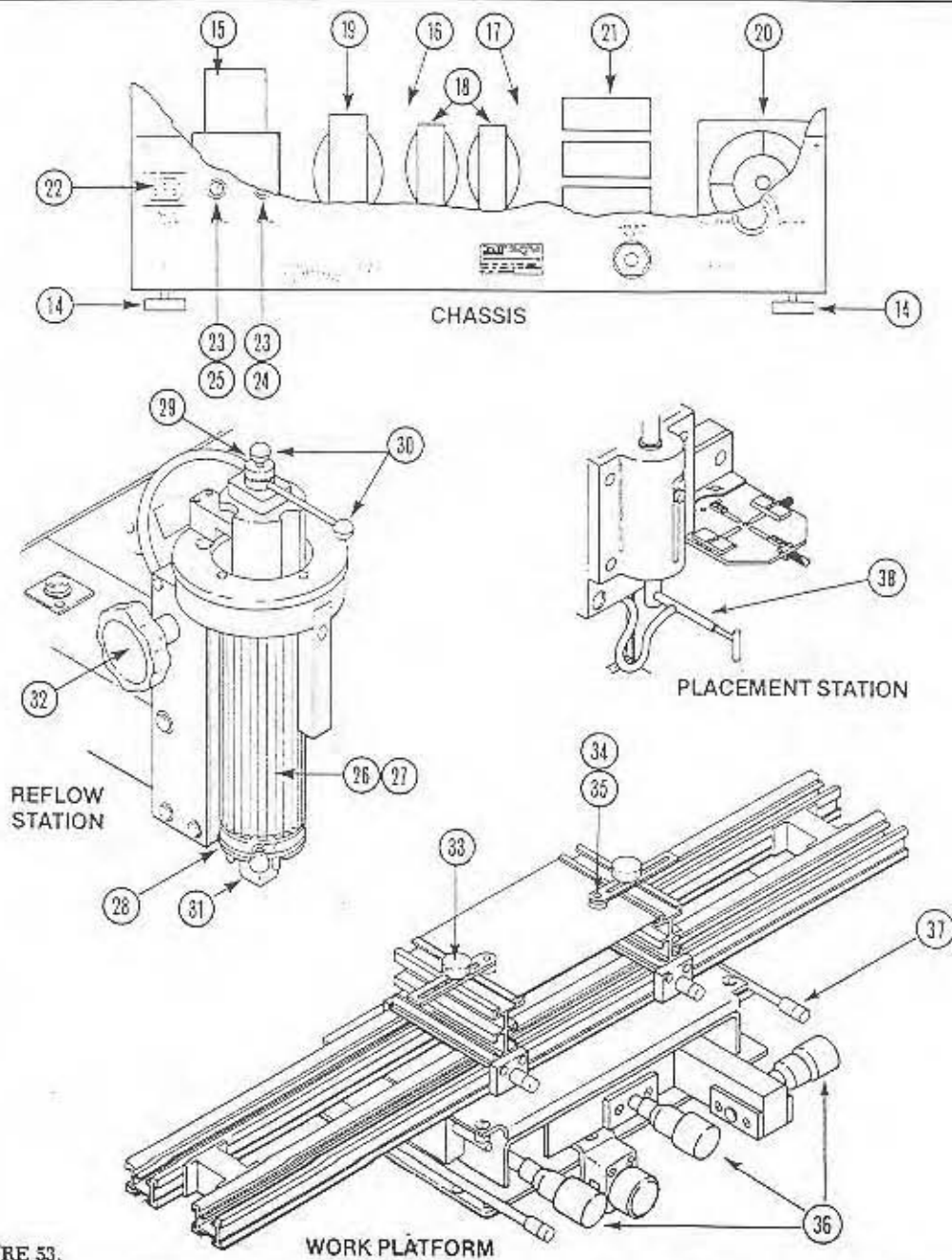


FIGURE 53.

CRAFT 25 REPLACEMENT PARTS

ACCESSORIES

TABLE 3

ITEM NO.	DESCRIPTION	PACE PART NO.
1.	Color Video System	
	Domestic	6018-0054
	Export	6018-0056
	Export Less Monitor	6018-0061
2.	Reflow Station Video Mount	6018-0072
3.	Placement Station Video Mount	6018-0071
4.	Monitor Mount	6018-0044
5.	4X Microscope	6018-0048
6.	20X Eyepieces	1106-0033
7.	Reflow Station Microscope Mount	6018-0049
8.	Placement Scope Assembly, 2.5 Objective	6018-0050
9.	Dual Halogen Lighting System	7007-0011
10.	Alignment Tool Kit	6018-0053
11.	Remote Control	6018-0047
12.	30" Work Holder Rail Kit	6993-0126
13.	PCB Template Kit	6018-0064
14.	Polarizer Kit	6018-0058

CRAFT 25 REPLACEMENT PARTS

NOZZLES

Nozzle configuration plays a critical role in the CRAFT 25 SMD reflow process. A standard range of nozzles are available in Standard (Open-Wall), HV (Fixed Gap) and Vented nozzle design. A brief description of each nozzle type is given below.

1. **STANDARD OPEN-WALL**—Directs heated gas/air flow at the component lead attachment area while minimizing flow over the component body. Especially useful in an R&D environment since the nozzle can be used to reflow different components of similar size and configuration. This nozzle type is also recommended for reflow of all Extended Lead devices (SOIC's, Flat Packs etc.).
2. **HV, FIXED GAP**—Recommended for repeated reflow processes. Precision inserts matching the shape and dimensions of the component body holds the device centered within the nozzle facilitating alignment and placement.
3. **VENTED**—In some applications, high-density packaging of SMD assemblies has raised concerns regarding overheating of adjacent component solder joints leading to solder crystallization and eventual joint failure. The Vented nozzle walls seal off the component and vents the heated air/gas above the component thereby lowering adjacent temperature levels.

When ordering Nozzles for use with the CRAFT 25 system, refer to tables 4 thru 8. PACE can prepare additional special nozzle configurations to address any specific requirements not satisfied through the use of the nozzles listed. Contact PACE inc. directly at (301) 490-9860 (FAX. # 301 498-3252) for assistance.

CRAFT 25 REPLACEMENT PARTS

STANDARD NOZZLES

TABLE 4

COMPONENT APPLICATION	COMPONENT SIZE (MAX.) INCHES	PACE PART NUMBER
PLCC-18	.467 × .327	4018-0033-001
20	.395 × .395	-002
28	.495 × .495	-003
32	.595 × .495	-004
44	.695 × .695	-005
52	.795 × .795	-006
68	.995 × .995	-007
84	1.195 × 1.195	-008
SO- 8	.244 × .197	4018-0034-001
14	.344 × .244	-002
16	.394 × .244	-003
SOL-16	.419 × .413	-004
20	.512 × .419	-005
24	.612 × .419	-006
28	.712 × .419	-007
FLAT PACK- 58 LEAD	.989 × .752	4018-1036-001 (With Locating Plate)

STANDARD HV NOZZLES

TABLE 5

COMPONENT APPLICATION	COMPONENT SIZE (MAX.) INCHES	PACE PART NUMBER
PLCC-18	.467 × .327	4018-0037-001
20	.395 × .395	-002
28	.495 × .495	-003
32	.595 × .495	-004
44	.695 × .695	-005
52	.795 × .795	-006
68	.995 × .995	-007
84	1.195 × 1.195	-008

CRAFT 25 REPLACEMENT PARTS

VENTED NOZZLES

TABLE 8

COMPONENT APPLICATION	COMPONENT SIZE (MAX.) INCHES	PAGE PART NUMBER
PLCC-18	.467 x .327	4018-0053-001
20	.395 x .395	-002
28	.495 x .495	-003
32	.595 x .495	-004
44	.695 x .695	-005
52	.795 x .795	-006
68	.995 x .995	-007
84	1.195 x 1.195	-008
SO- 8	.244 x .197	4018-0054-001
14	.344 x .244	-002
16	.394 x .244	-003
SOL-16	.419 x .413	-004
20	.512 x .419	-005
24	.612 x .419	-006
28	.712 x .419	-007
LCC-16	.308 x .308	4018-0055-001
18	.435 x .300	-002
20	.358 x .358	-003
24	.410 x .410	-004
28	.458 x .458	-005
44	.660 x .660	-006
52	.761 x .761	-007
68	.962 x .962	-008
84	1.165 x 1.165	-009